Volume 18, Issue 1/2018 PRINT ISSN 2284-7995

E-ISSN 2285-3952

SCIENTIFIC PAPERS

SERIES "MANAGEMENT, ECONOMIC ENGINEERING IN AGRICULTURE AND RURAL DEVELOPMENT"

Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development"
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Volume 18, Issue 1/2018

To be cited: Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Volume 18, Issue 1/2018.

Publishers:
University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania. Address: 59 Marasti, District 1, 011464 Bucharest, Romania, Phone: + 40213182564, Fax: +40213182888**,** www.managusamv.ro
S.C. Editura Ceres S.A., Address: 1, Piata Presei Libere, District 1, Bucharest, 013701, Phone/Fax: +40213179023, Email: edituraceres@yahoo.com

The papers belong to the following research fields: economic engineering in agriculture, management, marketing and agri-food trade, rural economy, agricultural policies, accounting, financial analysis, finance, agrarian legislation, durable development, environment protection, tourism, agricultural extension and other connected areas.

CONTENTS

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EFFECT OF LINKAGES AND NETWORKING ON ROLE PERFORMANCE OF STAKEHOLDERS IN CASSAVA RESEARCH OUTPUT UPTAKE IN OYO STATE, NIGERIA

Ibrahim Adebayo ADEKUNLE, and Akinloye Jimoh FARINDE

Obafemi Awolowo University, Department of Agricultural Extension and Rural Development, Ile-Ife, Nigeria. E-mail: bayoadekunle40@yahoo.com, akinloyefarinde@yahoo.com

Corresponding author: bayoadekunle40@yahoo.com

Abstract

Agricultural research outputs are useless until they are picked up by end users, adapted and or utilised for solving social, economic and environmental problems thus bringing about sustainable development. This study assessed the effects of linkages on roles of stakeholders in cassava research output uptake in Oyo State, Nigeria. It specifically described the cassava stakeholders' characteristics, identified the roles performed by stakeholders in relation to the linkages used for networking in the cassava research output uptake process in Oyo State, Nigeria. Multistage sampling procedure was employed to select respondents. Stakeholders were purposively selected along cassava value chain. Only 40 percent of the stakeholders were proportionately selected based on numerical strength in the State. They include research scientists, agricultural extension agents, agricultural input suppliers, cassava farmers, cassava produce processors, cassava produce marketers and three policy makers/legislators.. Data were collected using questionnaire. Data were analyzed with appropriate descriptive and inferential statistics. The results show that the mean age of all the stakeholders along the cassava value chain was 50.04±5.07 years and mean years of experience was 16.76±6.91years. All the cassava stakeholders had at least 50 percent of their expected roles performed above their grand mean score. All the cassava stakeholders make use of agricultural shows/exhibitions and informal contact as major linkages to facilitate uptake of cassava research outputs. In conclusion, there exists a positive and significant effect and relationship between the role performance of stakeholders and the linkages used to transfer the cassava research output (r=0.755).

Key words: *role performance, stakeholders, research output uptake and linkages*

INTRODUCTION

Cassava (*Manihot esculentus Crantz*) is a tropical crop widely grown in Nigeria because of its tropical climate that favours its growth. Nigeria is the highest world producer of cassava, but hardly features in the cassava world trade market [13]. This is because cassava produce mostly takes care of the domestic consumption and high percentage is lost to post harvest handling and lack of industrial processing. It is one of the major staple foods after cereals and second to yam (Dioscorea species) in the root and tuber family. It has many varieties and cassava produce are used for different purposes such as food when processed to different recipes like flour, fufu, gari, tapioca and starch; industrial uses as raw material for production of flour, starch, biofuel, biogas, ethanol, syrups and pesticides; while it also serve as feeds for livestock [13]. Cassava research and development has come a long way to make cassava production, processing and utilisation an easy process for sustainable social, economic and environmental development of people of Nigeria. However, it seems the links between the stakeholders involved in dissemination of cassava technologies which are products of cassava research are weak and sometimes inactive. That is why cassava research output process is still laced with lack of information in relation to stakeholders' roles in enhancing the contribution of cassava to Gross domestic Product (GDP) in Nigeria [7].

Agricultural research output uptake is the process whereby agricultural research findings enter the domains of intended and unintended audience [8]. This raises question of what the focus on agricultural research and development should now be on how to create social and economic value from technologies generated by researchers. This system needed to create better partnerships with other researchers, knowledge brokers, innovation networks, and clients in all stages of Research and Development (R&D) especially along cassava value chain process, from research prioritization and planning to implementation, monitoring and evaluation. This new perspective has implications for capacity building for research; for measuring performance, outputs, and impacts; and for looking at incentive systems to promote interactions and innovativeness among cassava stakeholders [8].

Strengthening the linkages and interaction between Agricultural Research and Development (ARD) actors has been considered as key to improved efficiency and effectiveness of ARD efforts aimed at raising the level of economic performance of rural economy through increased productivity [5]. The technology generation should take into consideration among other things opportunities and constraints associated with input and output markets and the enabling policy environment. This calls for a paradigm shift in the ARD approaches that are supply driven to more demand driven Innovation Systems Approach (ISA) [6].

MATERIALS AND METHODS

Conceptual frameworks

The concept of Systems Approach was used to examine the internal linkages, i.e. interactions between the stakeholders in cassava value chain process as components of the system as well as those between the system and the external environment. It provides an integrated view of the behaviour of the system and is useful in the formulation of policies. A first step in any Systems analysis is the identification of the major stakeholders or actors that interact with each other in value chain process. Another step involves the identification and analysis of the role players or stakeholders and their roles in the development of the Nigerian cassava sector [7]. [6], [14]

Statement of the problem

One of the most deliberating problems of research and policy in agricultural extension in Nigeria is the rate at which available research outputs are lost. There is a lag of discovery of innovations and their effective utilization in the field [14]. Although, provision is made for agricultural input suppliers to participate in Nigeria's research–extension-farmer-input supply linkages system (REFILS), the levels of participation of these stakeholders have been very weak especially in cassava value chain [12]. The identification of annual research needs is done through a joint problem diagnostic survey in each state by staff of national research institutes, universities and State ADPs. Although State ADP officers and national researchers participate in discussing the research problems at regional level, national officers assume power in finalizing decisions on research themes (without farmers' representation). Most decisions on the direction of linkage activities are taken at national level, and research and extension organizations in Nigeria are unequal in status [12].

In spite of the laudable achievement of organization of Research-Extension-Farmer-Input supply Linkages System (REFILS), the implementation activities of REFILS are characterized with various problems and challenges. The problems and challenges are as a result of non-defined expected and actual roles of stakeholders in research output uptake process in relation to cassava research and development in Nigeria. Some empirical studies though examined approaches for setting up multi-stakeholders platform for Agricultural Research and Development [2], successes and challenges of cassava enterprises in West Africa [13], cassava food commodity market and trade network in Nigeria [3], cassava value chain analysis in Nigeria [9] and Research-Extension-Farmers-Input linkages system in Agricultural extension [4], there is no known study focus on effect of linkages and network on role performance of these stakeholders on cassava research output uptake in Nigeria.

The study aim to providing answers to the following questions among many others: what are the characteristics of the stakeholders in cassava research output uptake in Oyo State?

What are the expected and actual roles performed by stakeholders in cassava research output uptake in Oyo State? What are the various linkages employed by stakeholders for networking in the cassava research output uptake process in Oyo State? What is the effect of linkages and networking on role performance of stakeholders in cassava research output uptake process in Oyo State?

Objectives of the study

i) describe the stakeholders' characteristics in the cassava research output uptake process in the study area.

ii) identify the expected and actual roles performed by stakeholders in relation to the cassava research output uptake.

iii) identify and describe the linkages and existing networking among the stakeholders in the cassava research output uptake

iv) determine the effect of linkages and networking on the performance of roles by stakeholders in the cassava research output uptake process in Oyo state.

Hypotheses of the study

Ho_1: There is no significant relationship between the characteristics of stakeholders and corresponding roles performed in the cassava research output uptake process in Oyo State.

Ho_2: There is no significant relationship between the linkages used and role performed by the stakeholders towards cassava research output uptake.

Significance of the study

This study provided relevant information on the established effect of linkages for networking that might directly enhance information dissemination among cassava stakeholders in agricultural research uptake system, so as to boost agricultural productivity in enhancing level and standard of living of cassava farmers in the study area.

Methodology

The design for the study is descriptive correlational design which enabled the researcher to describe the relationships between stakeholders' characteristics, linkages and role performed within the cassava research output uptake process in Oyo State. Respondents for the cross-sectional survey were purposively selected from categories of stakeholders along cassava value chain. This includes cassava farmers, agricultural research scientists on cassava, agricultural extension agents, cassava produce processors, cassava produce marketers and agricultural inputs suppliers and policy makers in Oyo State based on high concentration of these stakeholders in the State.

Multistage sampling technique was employed in proportionate selection of 40 percent of the various stakeholders along the cassava value chains. This amounts to 20 research scientists (RS) from International Institute of Tropical Agriculture (IITA), Ibadan; Institute of Agricultural Research and Training (IAR&T), Ibadan; and University of Ibadan, Ibadan; 44 agricultural extension agents (AEA) and 100 cassava farmers (CF) across the ADP zones in Oyo State. Others are 26 registered agricultural input suppliers (AIS), 40 cassava produce processors (CPP) across the State, 100 cassava produce marketers (CPM) at various locations across the ADP zones in the State, Two staff in the State Ministry of Agriculture and one legislator from Committee on Agriculture in the State House of Assembly totalling 325 respondents.

Research instruments and data collection

Primary data were collected using a combination of quantitative and qualitative methods. Questionnaires were used to obtain quantitative data from the research scientists, agricultural extension agents and agricultural input suppliers. Likewise interview schedule was used for the cassava produce processors, cassava produce marketers and cassava farmers in the selected institutions and farm locations in the State. The secondary data and other information were obtained from the records available at the Federal and State Ministry of Agriculture, Research Institutes centres, Agricultural Institutions of learning, Journal and Past theses related to the study.

Role Performance: The perceived role was measured using the 5-point likert-type scale for 15 opinion statements to generate the scores for the dependent variable. The 5-point likert-type scales are: Strongly Agree (5 points), Agree (4 points), Undecided (3 Points), Disagree (2points) and Strongly

Disagree (1point) for each category of stakeholder considered,

Linkages: Level of the linkage by the respondents was based on the frequency of their linkages with other stakeholders in the last five years. This was measured at ordinal level and scored as Never (0 point), Rarely (1point), Usually (2points), and Always (3points).

Descriptive statistical techniques such as frequency, percentages, mean, weighted mean scores and standard deviation were used to describe the data collected. The relationships between the dependent variable (roles performed by stakeholders and independent variables (major variables: effect of linkages and networking) were determined by the use of inferential statistics such as correlation and regression analyses.

RESULTS AND DISCUSSIONS

Personal and socio-economic characteristics of stakeholders

Age: Result in Table 1 shows that the mean age of the research scientists was 44.9±5.36. Agricultural extension agents' mean age was 46.19±5.55. Cassava farmers' mean age was 54.42±7.37. Agricultural input suppliers' mean age was 54.08±5.59. Cassava produce processors' mean age was 50.10±6.98. While, cassava produce marketers' mean age was 50.5±6.57. The mean age range of stakeholders was 44-54 years. This implies that majority of the respondents were at their productive age, agile and have high tendency for transforming the cassava research output effectively. Age is one of the factors that could be used to measure people's level of maturity, strength and ability to accomplish tasks [1].

Sex: Result in Table 1shows that majority (70%) of the research scientists were male and majority (91.7%) of the agricultural extension agents were male. Also, majority (96.2%) of the agricultural input suppliers were male and majority (93%) of the cassava farmers were male. But majority (57.5%) of the cassava produce processors were female and majority (81%) of the cassava produce marketers also were female. This implies that processing and marketing of cassava were been perceived as female jobs as nearly all activities involved were female dominated. Other stakeholders along the chain process were male dominated with respect to the activities involved in each category of stakeholder. This may foster effective uptake of research output in cassava.

Experience: Result in Table 1 shows that the mean year of experience by research scientists was 10.35±6.22 and the mean year of experience for agricultural extension agents was 13.67±5.29. Moreover, the mean year of experience of agricultural input suppliers was 20.77±6.30 and the mean years of farming experience was 25.54±8.82 while the mean year of processing experience was 16.40±6.76 and the mean year of marketing experience was 13.71±8.07. The mean range of stakeholders based on their years of experience in their field category was 10-26 years. This implies that all the stakeholders had more than 10 years of experience in their field of work which promotes effective performance and enhances uptake of research output on cassava. The wider experience a stakeholder has, the more opportunities of effective link with other stakeholders to address areas of concern on cassava research output and its uptake [1].

Level of Education: All of the research scientists had minimum of first degree in their field of discipline with 90% had postgraduate degree. All of the agricultural extension agents had minimum of first degree in their field of discipline. Over 50 percent of the agricultural input suppliers had minimum of first degree in the related field of discipline.

Over 90 percent of cassava farmers had minimum primary school certificate. Above 90 percent of the cassava produce processors had minimum of secondary school education.

80 percent of the cassava produce marketers had minimum of secondary school education.

The implication of these results is that research scientists, agricultural extension agents considered that their job towards effective transfer of research output highly required advanced education especially in their field of specialization for effective transmission of knowledge on subject matter. Meanwhile cassava processors, farmers and cassava marketers feels that their job and activities along the chain process does not required more advanced education rather than skill acquisition on subject matter for them to perform effectively in the uptake process of the research output and put it into practical utilization. Education gives them opportunity of effective interaction and dissemination of those cassava research output effectively among stakeholders as in support with [1].

Income level: The mean annual income of agricultural input suppliers was ₦1.192,300±368122, the mean annual income realised by cassava processors was ₦307, 500±119,420 and the mean annual income realized by cassava produce marketers was ₦999,500±466,812. The results implies that agricultural input suppliers, cassava processors, farmers and cassava marketers all operating under small and medium scale enterprises.

There is a need for adequate link of these stakeholders with financial bodies either private or government established one to be in partnership towards boosting their productivity through regular loan or bond with moratorium at minimum interest rate.

Group participation: All the respondents in each category of stakeholders along the cassava chain process were involved in active participation in their group or organizations which are basically their professional and vocational associations. This foster linkages and encourages networking among other groups either for advice or other assistance that could promote their productivity.

Table 1. Distribution of stakeholders according to their characteristics

Stakeholders	**R.S**		**AEA**		**AIS**		**CSF**		**CPP**		**CPM**	
Variables	**fre**	**%**	**fre**	**%**	**freq**	**%**	**fre**	**%**	**freq**	**%**	**freq**	**%**
Age												
31-40	5	25	8	22.2	7	26.3	2	2	5	12.5	8	8
41-50	13	85	20	55.6	15	57.7	34	34	17	42.5	44	44
51-60	2	10	8	22.2	4	15.4	47	47	15	37.5	45	45
Above 60							17	17	3	7.5	3	3
Mean	44.9			44.2		54.08	54.4		50.1		50.57	
Sex												
Male	14	70	33	91.7	25	96.2	93	93	17	42.5	19	19
Female	6	30	3	8.3	1	3.6	7	7	23	57.5	81	81
Educational level												
Primary education							28	28	3	7.5	13	13
Ordinary level					3	11.5	41	41	24	60	52	52
NCE/OND					6	23.1	22	22	5	12.5	22	22
HND/Bachelor	2	10	30	83.3	13	50	9	9	8	20.0	13	13
Postgraduate	18	90	6	16.7	4	15.4						
Years of service												
1-10	12	60	11	30.6			3	3	7	17.5	31	31
11-20	7	35	22	61.1	15	57.7	36	36	26	65	61	61
21-30	1	5	3	8.3	9	34.6	45	45	6	15	7	7
31-40					2	7.7	12	12	1	2.5	1	1
Above 40							4	4				
Mean	10.4			13.7		20.77	25.5		16.5		13.71	
Professional membership												
Ordinary	11	55	24	66.7	5	19.2	17	17	24	60	68	68
Committee	2	10	10	27.8	14	53.8	47	47	5	12.5	13	13
Executive	7	35	2	5.5	7	26.9	38	38	11	27.5	9	9
Income generated (₦)												
1,000-500,000					10	38.5	35	35	15	37.5	25	25
500,001-1,000,000					3	11.5	32	32	8	20.0	37	37
1,000,001-1,500,000					8	30.8	23	23	7	17.5	26	26
1,500,001-2,000,000					3	11.5	8	8	6	15.0	10	10
Above 2,000,000					2	7.7	2	2	4	10.0	2	2
Mean					492300		392100			307500		999500

Source: Field survey, 2016

Performed roles of stakeholders towards cassava research output uptake

Research scientists: Result in Table 2 shows that capacity building on monitoring and evaluation, experimentation and empirical study on cassava value chain were mostly rated roles always performed by research scientists towards uptake of cassava research output. The result further shows that about 50 percent of the stated roles that were performed above role grand mean score. Though facilitating cassava innovation platform and interaction survey on cassava value chain were rarely performed by research scientists in relation to uptake of cassava research output uptake.

Agricultural extension agents: Result in Table 2 shows that advisory role on cassava technology, dissemination of practical information and training of new technology on cassava and its products were among the roles rated very high as always performed by agricultural extension agents towards uptake of cassava research output. While facilitating memorandum of understanding within stakeholders and platform facilitating were among the roles rarely performed by agricultural extension agents in relation to uptake of cassava research output. These indicated that above 60 percent of the stated roles were performed above the roles grand mean score.

Agricultural input suppliers: Result in Table 2 shows that delivering and distribution of farm inputs for new technology on cassava and its products were among the roles rated very high as always performed by Agricultural input suppliers towards uptake of cassava research output. Facilitating cassava innovation platform and facilitating memorandum of understanding (MoU) among the stakeholders on cassava value chain were roles rated as poorly and rarely performed by agricultural input suppliers in relation to uptake of cassava research output. There were 60 percent of the stated roles that were performed above the roles grand mean score.

Cassava farmers: Result in Table 2 shows that training of other farmers and providing information on new technology on cassava were among the roles rated very high and always performed by cassava farmers towards uptake of cassava research output. There were about 70 percent of stated roles that were performed above the role grand mean score. Facilitating cassava innovation platform and facilitating memorandum of understanding among stakeholders on cassava value chain were among the roles rated as poorly and rarely performed by cassava farmers in relation to uptake of cassava research output.

Cassava produce processors: Result in Table 2 shows that brainstorming on knowledge of cassava and exploring market linkages were among the roles rated higher and always performed by cassava produce processors towards uptake of cassava research output. Facilitating cassava innovation platform and its operation on cassava value chain were the roles rated as poorly performed by cassava produce processors in relation to uptake of cassava research output. This indicated that above 60 percent of these roles were performed favourably above role grand mean score.

Cassava produce marketers: Result in Table 2 shows that provision of information on strategic market linkages on new products from new cassava technology and proactive networking stakeholders on cassava and its products were among the roles rated very high and always performed by cassava produce marketers towards uptake of cassava research output. Facilitating cassava innovation platform and facilitating memorandum of understanding (MoU) on cassava value chain were the roles rated as poorly and rarely performed by cassava produce marketers in relation to uptake of cassava research output. There were almost 70 percent of the stated roles that were performed above role grand mean score.

The findings reveal that the two most important interactive activities of stakeholders were poorly or rarely done. The implication is that more attention is needed to facilitate innovation platform on cassava and memorandum of understanding among stakeholders on cassava. This can be a private sector led cassava marketing association to improve the marketing and data dissemination. This sectors is essential for developing the domestic market, improve market access, market channels and information on available products [10].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 2. Distribution of stakeholders by their performed roles toward cassava research output uptake

Performed roles	**RS mean**	**AEA Mean**	**AIS Mean**	**CF mean**	**CPP Mean**	**CPM mean**
Information dissemination	1.70	2.54	2.27	2.24.	1.98	2.25
Training of stakeholders	1.70	2.42	2.38	2.22	1.98	1.58
Experimentation on cassava	2.10	1.72	1.42	2.05	1.73	1.64
Identify felt need of stakeholder	1.65	2.47	1.97	2.33	2.08	2.14
Marketing system linkage	1.55	1.94	2.04	2.17	1.77	2.21
Brainstorming on knowledge of cassava and its value chain	1.80	2.47	1.88	2.56	2.23	1.43
Proactive networking of stakeholders	1.55	2.86	1.50	2.21	1.95	2.22
Capacity building on M&E	2.70	2.33	1.65	2.55	2.00	2.11
Facilitating MoU	1.35	1.39	1.31	1.68	1.55	1.43
Building awareness from the local level	1.45	2.39	2.08	2.33	2.13	2.06
Sourcing for input on cassava	1.35	2.36	2.42	2.37	2.10	2.06
Commercializing supply of inputs/outputs	1.50	2.25	2.42	2.13	2.18	2.10
Innovation platform facilitation & operationalization	1.30	1.97	1.19	1.82	1.68	2.17
Advocacy for linkage	1.75	2.61	1.98	1.77	2.25	1.57
Liaison for foreign expert on cassava	1.70	1.44	1.42	2.19	2.00	2.14
Grand mean score	**1.60**	**2.12**	**1.86**	**2.13**	**1.98**	**1.92**

Source: Field survey, 2016

Linkages used by stakeholders to facilitate cassava research output uptake

Result in Table 3 shows that agricultural shows/exhibition and linkage to input/output markets were among highly rated linkages used by farmers, cassava produce processors, agricultural input suppliers and cassava produce marketers. Meanwhile, collaboration with other organization/ project coupled with technical report, meeting with stakeholders and agricultural shows/exhibition were among highly rated as always used linkages by research scientists and agricultural extension agents to facilitate the uptake of cassava research output. This implies that proper and adequate organizing of agricultural shows/ exhibition would facilitate effective uptake of research output among the stakeholders. Result in Table 3 was further revealed that use of internet and joint journal publications were rarely used by all the stakeholders as a means of linkage to facilitate the uptake of cassava research outputs in the study area. This might be as a result of poor facility of the internet and low literacy level of majority of stakeholders in accessing joint journal publication as a regular means of linkage to facilitate cassava research output uptake in the area.

Effect of linkages and networking among the cassava stakeholders

Figure 1 below shows the chart representation of the summary of linkage and networking among the various categories of cassava stakeholders considered in the study. It was revealed from the findings that all the stakeholders interrelated with one another through various linkages available to them. This was corroborated with [1] that stakeholders in cassava value chain process prefers using those linkages that they were conversant with such as organized workshops/agricultural shows, cooperative meeting among themselves, informal meeting, technical report meeting, internet link and journal publications. All the stakeholders considered made use of above 50 percent of the listed linkages above the grand mean score in the study. This implies that stakeholders were ready to use any linkages available to them either to transfer or receive cassava research output in the area which would invariably promotes the uptake of cassava research output in the area.

For achieving the goal of effective uptake of cassava research output among stakeholders, there must be information on how to link farming communities and industrial end users for effective performance of stakeholders' role. From the empirical study, it was observed that there are three main ways to establish this links between farmers, the industrial sector and other stakeholders namely: developing large scale farms, establishing out-growers scheme and private intermediaries [11].

There is implication that if industries, like flour mills should require larger quantities of cassava and do not wish to engage in Out-Grower schemes, private entrepreneurs should then provide the missing link.

Table 3. Distribution of stakeholders by linkages used towards cassava research output uptake

Linkages	**RS**		**AEA**		**AIS**		**CSF**		**CPP**		**CPM**	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
Collaboration with other organization/projects	1.90	1st	2.58	1st	1.58	6th	2.18	7th	1.88	5th	1.91	8th
Joint Journal publication	1.65	2nd	1.06	20th	0.38	20th	0.63	20th	0.25	20th	0.13	20th
Partnering project with other organization	1.60	3rd	1.50	15th	1.35	8th	2.18	7th	1.50	8th	0.55	18th
Alliance collaboration with other stakeholders in programmes	1.45	4th	1.98	10th	1.35	8th	1.46	11th	1.08	11th	1.32	10th
Agricultural shows/exhibition	1.45	4th	2.50	3rd	2.08	1st	2.69	1st	2.28	1st	2.12	6th
Partnership with other stakeholders	1.40	6th	2.08	8th	0.42	19th	1.50	8th	0.70	17th	1.18	11th
Technical report meeting/MTRM/SMS	1.40	6th	2.58	1st	0.96	13th	1.37	13th	0.50	18th	0.15	19th
Internet link/network on cassava	1.40	6th	1.11	19th	0.92	15th	0.75	18th	0.48	19th	1.08	13th
Conferences/seminars for cassava stakeholders	1.40	6th	1.72	14th	0.77	18th	1.36	15th	0.90	14th	0.81	16th
Informal contact/meeting	1.30	10th	2.50	3rd	2.08	1st	2.66	2nd	2.28	1st	2.22	4th
Joint problem solving on cassava	1.15	11th	2.36	5th	1.00	11th	1.84	9th	1.50	8th	1.54	9th
Formal arrangement/meeting with institution	1.15	11th	1.86	12th	0.96	13th	1.41	12th	0.90	14th	0.98	15th
Linkage to farm inputs on cassava	1.15	11th	2.19	7th	1.88	3rd	2.44	3rd	1.95	3rd	2.39	2nd
Partnering knowledge of cassava	1.10	14th	2.08	8th	1.54	7th	0.74	19th	1.70	6th	2.21	5th
Contract knowledge on cassava	1.05	15th	1.25	18th	0.88	16th	0.90	17th	0.88	16th	0.71	17th
Advocacy linkage with relevant stakeholders	1.05	15th	1.92	11th	1.00	11th	1.12	16th	1.03	12th	1.02	14th
Sector association with other organization	0.95	17th	1.36	17th	0.88	16th	1.37	13th	0.93	13th	1.10	12th
Sharing consumers' taste/preferences on cassava	0.90	18th	1.86	12th	1.77	4th	2.38	4th	1.55	7th	2.51	1st
Market linkages for cassava output	0.75	19th	1.58	15th	1.04	10th	1.90	8th	1.25	10th	2.24	3rd
Cooperative meeting among other stakeholders	0.55	20th	2.31	6th	1.73	5th	2.34	5th	1.90	4th	1.97	7th
Grand mean	**1.29**			**1.91**		**1.23**		**1.68**		**1.20**		**1.41**

Source: Field survey, 2016

The implementation of Out-Grower or private intermediaries' schemes will require facilitation by research institutions, NGOs, and extension services.

For example, research and extension services have to play a proactive role by introducing appropriate cassava chipping and drying technologies, with industrial end-users committing to strengthening market linkages by related investments. Lastly, Government should provide an enabling economic environment, which may include an appropriate regulatory and legal framework [10].

It was observed that majority of the means of linkage used such as agricultural show, collaboration with one another, informal meeting with others are the major linkages used by majority of these stakeholders to facilitate networking among each other towards effective uptake of cassava research output uptake.

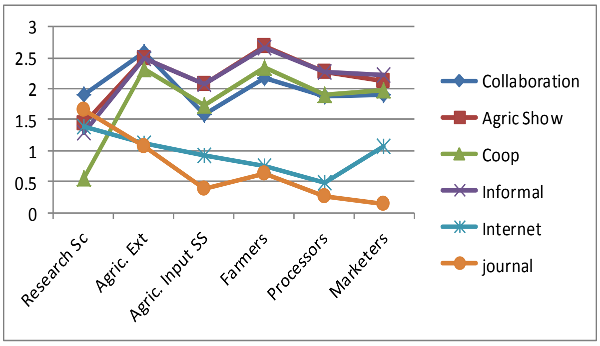


Fig 1. Distribution of stakeholders by linkages
Source: Own design.

Relationship between stakeholders' role performance and their characteristics towards cassava research output uptake

The result in Table 4 shows the second order correlation and regression analysis of stakeholders' characteristics reflects that there exists a positive and significant relationship between the role performance of stakeholders with level of education (r=0.476), group participation (r= 0.332) and years of experience (r=0.210) possess by stakeholders. Meanwhile, age (r= -0.185) has a negative and significant relationship with the role performance of these stakeholders. The lower the age of stakeholders the more effective was their role performance. The coefficients of determination (r^2) indicate that these variables were contributing up to 41.5 percent to the relationship. The regression coefficient further substantiate the strength of the relationship with the significance of age, level of education and years of experience of stakeholders with role performance of the cassava stakeholders with value of R^2=0.67. This indicates 67 percent contribution of the significant variables to role performance of the stakeholders. The finding implies that, high level of education of stakeholders and years of experience amounted to effective role performance of the stakeholders towards uptake of cassava research output.

Relationship between stakeholders' role performance and linkages used towards cassava research output uptake

The result in Table 5 shows the second order correlation and regression analysis of stakeholders' role performance with linkages. This reveals that a positive and significant relationship exists between the role performance of cassava stakeholders with linkages used for transferring cassava research output (r=0.755). The coefficient of determination (r^2) indicates that linkage used contributed up to 57 percent to the relationship. The regression coefficient further substantiate the strength of the relationship with the significance of linkage with role performance of the stakeholders with value of R^2=0.63. This indicates 63 percent of the significant variables to role performance of the stakeholders. This revealed that there was a strong relationship between the stakeholders' role performance and their linkages between other stakeholders. The implication is that the use of common and effective linkage as a means of networking has positive and significant effect on the role performance of stakeholders on cassava. This promotes effective networking among various categories of stakeholders and it facilitates effective uptake of cassava research output among the intended users as reported by [1]. This finding further implies that the use of adequate linkages amounted to strong bond among the stakeholders such that they tend to work together for effective uptake of research outputs in cassava production, processing and marketing. This finding suggests a need for Cluster Development Approach in cassava value chain. This involves the identification, coming together, and operation of different stakeholders at different levels to achieve a common goal. Therefore, it should be led by the private sector [12]. The advantages that would accrue from a Cassava Cluster Development include improvement in efficient uptake of production and processing research output. It will also enhances rural development through provision of infrastructures. The cluster of stakeholders has the potentials to provide a forum for dispute settlements in order to avoid a major commercial or trade conflict; has a defined leadership structure to maintain regular meetings and ensures compliance with codes of conduct as specified in the codified laws [12]. There must be a need for it to cut across all the stakeholders in the cassava value chain process for effective transformation of cassava production in Oyo state and Nigeria as a whole.

Table 4. Results of correlation and regression coefficient showing second order analysis of stakeholders' role performance and socioeconomic characteristics investigated towards cassava research output uptake

Variable	Correlation coefficient (r)	Coefficient of determination (r²)	P-value	Regression coefficient(b)	t-value	p-value
Age	-0.185*	0.034	0.002	0.007*	2.171	0.032
Level of education	0.476*	0.227	0.036	0.301*	2.225	0,035
Years of experience	0.210*	0.044	0.012	0.110	0.573	0.571
Professional membership	0.332*	0.110	0.019	0.223	0.443	0.797

Source: Computed from field survey, 2016 ** Significant at p≤ 0.01 *Significant at p≤ 0.05 **R=0.812; R^2=0.670; F=5.681**

Table 5. Results of correlation and regression coefficient showing second order analysis of stakeholders' role performance and linkages investigated towards cassava research output uptake

Variable	Correlation coefficient (r)	Coefficient of determination (r^2)	p-value	Regression coefficient (b)	t-value	p-value
Linkages	0.755**	0.570	0.000	0.639**	3.381	0.004

Source: Computed from field survey, 2016
** Significant at p≤ 0.01, *Significant at p≤ 0.05 **R=0.794; R^2=0.630; F=4.768**

CONCLUSIONS

Out of the stated expected roles towards uptake of cassava research output, all the stakeholders were able to perform above 50 percent of their roles above the respective grand mean. The most commonly used linkages by all the stakeholders for transferring or receiving research output on cassava and its uptake were organizing workshop, cooperative meeting among stakeholders and informal meeting with other stakeholders.

The study suggested that for effective cassava research output uptake, every stakeholder in cassava agriculture should identify the expected role of active participation in the cassava innovation platform and perform it accordingly, so as to improve effective uptake of cassava research output. Cassava agriculture should be both production-demand driven approach rather than being focusing on production approach alone. Production, processing, storage and marketing processes of cassava should be harnessed together with effective linkages to improve its agribusiness potential.

REFERENCES

[1]Adekunle, I.A., 2017, Assessment of the roles of Stakeholders in Cassava research Output Uptake in Oyo State, Nigeria. Unpublished Ph.D thesis, Obafemi Awolowo
University, Ile-Ife, Nigeria.Pp.48-51.
[2]Adekunle, A. A., Fatunbi, A. O., 2012, Approaches for Setting-up Multi-Stakeholder
Platforms for Agricultural Research and Development. World Applied Sciences Journal 16 (7): 981-988.
[3]Ezedinma, C., 2005, Agribusiness Investments in the cassava sub sector in Nigeria:some critical considerations, Paper presented at a workshop on Guiding Investmentsin the Cassava sub Sector in

Nigeria held at IITA Conference Center, IITA Ibadan, August 2005.

[4]Faborode, H.F.B, Laogun, E.A., 2008, Reseach – Extension – Farmer –Input Linkage System in Agricultural Extension, A comprehensive Treatise. Akinyemiju and Torimiro (eds). ABC, Agricultural System Ltd. Ikeja, Lagos, Nigeria.

[5]Hall, A. J., Bockett, S., Taylor, M. V., Sivamohan, K., Clark. N., 2005, Why research partnerships really matter: Innovation theory, institutional arrangements and implications for developing new technology for the poor. World Development 29(5): 783–797.

[6]Hounkonnou, D., Kossou, D., Kuyper, T.W., Leeuwis, C., Nederlof, E. S., Röling, N., Sakyi-Dawson, O., Traoré, M., van Huis, A., 2012, An innovation systems approach to institutional change: Smallholder development in West Africa. Agricultural Systems 108: 74-83.

[7]Federal Ministry of Agriculture and Rural Development (FMARD) (2011). Agricultural transformation agenda: we will grow Nigeria's agricultural sector. Federal Ministry of Agriculture and Rural Development Abuja, Nigeria. Draft for Discussion, Executive summary, pp.1-89.Value for Africa (C:AVA), Natural Resources Institute, UK.

[8]Kirsten, J. F., Doward, A. R., Poulton, C., Vink, N. (Eds)., 2009, Institutional Economics Perspectives on African Agricultural Development. Copyright ©IFPRI pp. 477.

[9]Kleih, U., Sanni, L., Dipeolu, A., Abass, A., Abdulsalam-Saghir, P., Butterworth, R., Siwoku, B., 2008, Value Chain Analysis for Nigeria. Submitted to Cassava: Adding.

[10]Obiora, C. J., Emodi, A. I., 2013, Restructuring the Agricultural Extension Service for effective Agricultural Transformation Agenda in Nigeria, Greener Journal of Agricultural Science, 3(6):511-517.

[11]Oyewole, L.O., 2002, Contract farming for root production and supply. Paper presented at the International Workshop on Cassava Competitiveness in Nigeria, IITA Conference Centre, Ibadan, November 18-20, 2002.

[12] Research Into Use (RIU), 2009, Putting Research into use: stimulating demand in Sub-Saharan Africa, Rwanda country programme annual report 2008-2009. https://assets.publishing.service.gov.uk/media/57a08bb940f0b652dd000e4a/Brochure_Sub-Saharan_Africa.pdf, Retrieved December 10, 2017.

[13]Sanni, L. O., Onadipe, O. O., Ilona, P., Mussagy, M. D., Abass, A., Dixon, A. G. O., 2009, Successes and Challenges of Cassava Enterprise in West Africa: Case study of Nigeria, Benin and Sierra Leone. IITA, Ibadan, Nigeria. p.35

[14]World Bank, 2006, Enhancing agricultural innovation: How to go beyond the strengthening of research systems. Washington, D.C.: World Bank.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EFFECTS OF FINANCING ON CASSAVA VALUE CHAIN IN OWO LOCAL GOVERNMENT AREA, ONDO STATE, NIGERIA

Similoluwa ADEWOLE, Akinwunmi OMEYE

The Federal University of Technology, Department of Agricultural and Resource Economics, Akure.+2347034926341; Emails: restismine13@gmail.com, rest_mine@yahoo.com

Corresponding author: restismine13@gmail.com

Abstract

The study examined the effects of finance on cassava value chain actors in Owo Local Government Area, Ondo State, Nigeria. Primary data was collected through the aid of structured questionnaire and interview format. Ninety four respondents were interviewed from the study area, consisting of farmers, processors and marketers of cassava and cassava products. Descriptive, financial and regression analysis was carried out on the data collected. Results showed that the majority of the respondents were aged between 36 and 45 years and were married. It also revealed that men are more involved in cassava cultivation and processing while women are more involved in marketing of cassava products. Findings also revealed that cassava value chain actors had some formal education. Fifty Nine (59%) percent of respondents interviewed had no access to formal credit at all while 41% have access to formal credit for cassava farming. Also, 86% of respondents interviewed farmed cassava with their own capital alone while 14% respondents farm using credit from various sources. Inadequate access to credit, high interest rate and fragmentation of farm holdings accounted for this. It also revealed that 45% have access to credit through micro finance banks, 32.5% through farmers union and 22.5% through "aajo" (Daily contribution). The regression result indicated an R^2 value of 0.988 for farmers, 0.959 for marketers and 0.967 for processors. It was revealed that the major factors that influence the level of profitability of the respondents in the study area are age, level of education, years of experience, access to capital while source of capital and technology used by processor increased the level of profitability.

Key words: *actors, segments, Cassava, credit, value chain*

INTRODUCTION

Nigeria is the largest producer of cassava tuber in the world with production of about 45 million mt of the world's production of 242 million mt in 2009. Average annual production in the country was about 35 million metric tonnes (2002-2008) and the total area under cassava cultivation in Nigeria is about 3.60 million hectares [6]. Although the world leader in cassava production, Nigeria is not an active participant in cassava trade in the international markets due to weak segments in the cassava value chain [2].

Efforts, which include commercialising cassava production and processing and increase its range of manufactured products in Ondo State, directed at increasing competitiveness in the chain have not been effective [2]. The activities of value chain actors have not been recognized thus farmers concentrate on the value addition using the common and traditional method of cassava production. They do not recognize that there are other links in the value chain that can help them to regain the losses they encountered during the time of planting and value addition. The broad objective of the study was therefore to identify the effects of value chain financing on the cassava value chain in Owo Local Government Area, Ondo state, Nigeria.

In order to achieve this, it examined the socio-economic characteristics of actors in the cassava value chain in the study area, identified the various sources of finance for actors in the cassava value chain in the study area, determined and compared the profitability of users and non-users of credit in the cassava value chain in the study area, identified the factors that influence the productivity of the actors in the value chain and the various constraints faced by value chin actors in the study area.

A good understanding of value chain finance will improve the overall effectiveness in the cassava value chain. It also gives an opportunity for cassava value chain development, improve efficiency and repayments in financing, and strengthen or solidify linkages among participants in the chain. Value chain finance contributes to meeting the growing need for agricultural finance and investment in response to greater consumer demands for more processed or value added products.

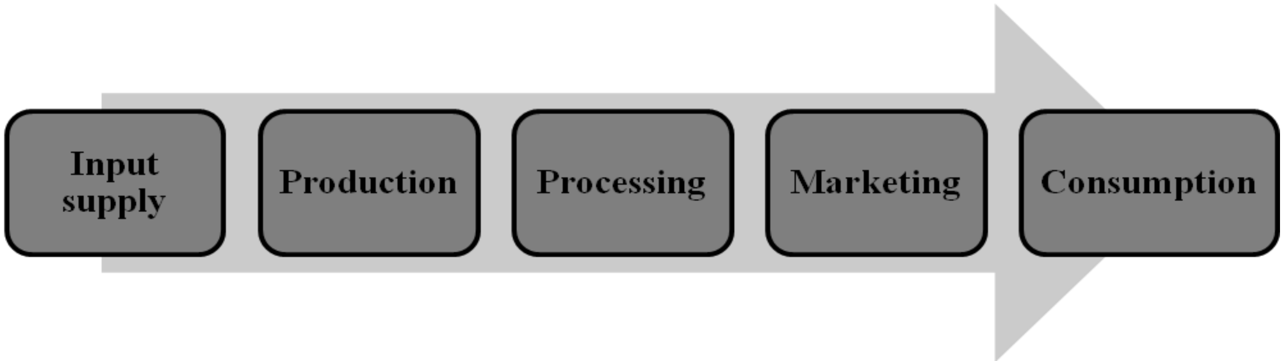


Fig. 1. Five stages of a value chain
Source: [4]

MATERIALS AND METHODS

The study was carried out in Owo Local Government in Ondo State, which is situated in the south western part of Nigeria. Its headquarters is Owo. It has an area of 331 km and a population of 222,262 at the 2006 census. The climate is hot and humid, influenced by rain-bearing southwest monsoon winds from the ocean and dry northwest winds from the Sahara desert. The rainy season lasts from April to October, with rainfall of about 1,524 mm per year. Temperatures vary from 7 11'N 5 35'E to 7.183N 5.583E with mean annual relative humidity of about 80%. Agriculture is their main occupation, providing income and employment for more than 75% of the population.

Primary data was used for this study. The primary data was collected through the use of structured questionnaire and personal interview of the respondents selected using random and purposive sampling techniques. In the first stage, five (5) districts out of the seven (9) districts in the Local Government Area were purposively selected based on their market and predominance in cassava cultivation. In the second stage, two (2) villages were randomly selected from each districts making a total of 10 villages. In the final stage, 4 farmers, 4 processors and 4 marketers respectively were purposively selected from each village making a total of 120 respondents.

Descriptive statistics like frequency distribution, percentages and means, the Ordinary Least Squares Multiple Regression techniques and gross margin was used to analyse data collected.

The multiple regression model is specified as follows;

$Y=f(X^1,X^2,X^3,X^4,X^5,X^6,X^7,X^8,X^9,X^{10},X^{11},X^{12}, e)$

where:

Y = Productivity (Gross Margin)
X^1= Age (in years)
X^2= Educational level (years)
X^3 = Household size (numbers)
X^4= Experience (years)
X^5 = Farm size (hectares)
X^6 = Occupation (farming as primary =1, farming as secondary = 0)
X^7 = Sex (1 for male, 0 for female).
X^8 = Access to capital.
X^9 = Source of capital.
X^{10} = Member of association
X^{11} = Access to loan
X^{12} = Technology used
e = error term.

The gross margin was calculated as follows
Gross Margin = TR – TC
Where:

TR = Total revenue
TC = Total cost
In calculate the Gross margin, the total variable cost was computed by aggregating the cost of roots, processing and marketing. Processing costs include the cost of carrying out the activities in the process flow of producing the products. For instance, garri production involved cost of roots and its transportation/handling (loading and offloading) charges, peeling, washing, grating, pulverizing and toasting (frying). Similarly, marketing costs involved bagging, cost of packaging materials (bags, polyethylene) and transportation to point of sale (markets)

RESULTS AND DISCUSSIONS

Socio-economic characteristics

Age

Table 1 shows that the majority of the respondents was aged between 36 – 45 years. This implies that the respondents are young and this will increase the efficiency and effectiveness in cassava cultivation, processing and marketing.

Table 1. Age distribution of the respondents

Age (year)	Farmers Freq	Farmers %	Processors Freq	Processors %	Marketers Freq	Marketers %
<= 35	3	9.7	1	3.1	5	16.1
36 – 45	20	64.5	16	50.0	17	55.0
46 – 55	6	19.4	13	40.6	6	19.4
56 – 65	1	3.2	1	3.1	2	6.5
66 +	1	3.2	1	3.1	1	3.2
Total	31	100	32	100	31	100

Source: Field Survey, 2017.

Sex

Fig 2 shows that men are more involved in cassava cultivation and processing than women while women are more involved in marketing than men. This was as a result of the stress involved in the production. This finding was against the view that men are more involved in the cassava production and processing and women showed less interest in the production of cassava.[2]

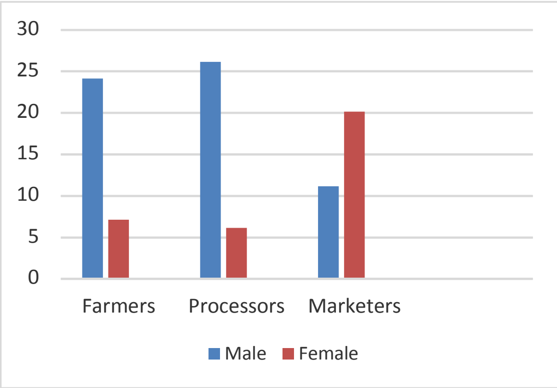


Fig. 2. Gender distribution of respondents
Source: Field Survey, 2017.

Marital status

From Table 2, majority of the respondents were married. This indicates that there were more married individuals who engaged in the cassava value chain in the study area. This may be to reduce the cost of labour by deciding to use members of the household as source of labour for the value chain activities.

Table 2. Marital status of respondents

Status	Farmers Freq	Farmers %	Processors Freq	Processors %	Marketers Freq	Marketers %
Married	20	64.5	28	87.5	20	64.5
Single	1	3.2	3	9.4	1	3.2
Widowed	10	32.3	1	3.1	10	32.3
Total	31	100	32	100	31	100

Source: Field Survey, 2017.

Educational level

In Fig 3, all of the value chain actors had some formal education.

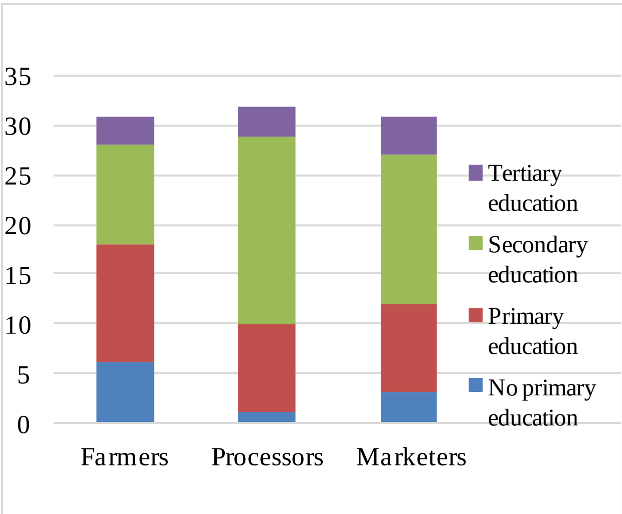


Fig. 3. Respondent's level of education.

This suggests that education attainment influence the way men and women participate in cassava value chain.

Thus, this somewhat agrees economists who posited that education is an important factor to facilitate the adoption of improved technology by increasing the farmer's knowledge and understanding of new farm practices.[3]

Years of experience

Table 3 shows that majority of the respondents had more three (3) years of experience in cassava business. This indicates that the majority of the respondents have acquired some level of experience in production, processing and marketing of cassava which could be very helpful in coping and adapting with the challenges that come with cassava value addition.

Table 3. Years of experience

	Farmers		Processors		Marketers	
Year	Freq	%	Freq	%	Freq	%
<= 3	1	3.2	2	6.5	2	6.5
4 – 6	20	64.5	19	61.3	19	61.3
7 – 9	10	32.2	11	34.5	10	32.3
Total	3	100	32	100	3	100

Source: Field Survey, 2017.

Farm size

Table 4 reveals that the mean farm size in the study area is 1.301 hectares. This confirmed the findings that the average land holdings of small scale farmers were often too small for efficient land utilization [5]. With direct correlation between farm sizes and gross income, it implies that small farm sizes will naturally lead to low cassava output and low productivity.

Table 4. Farm size of the respondents

Farm size	Farmer		Processors		Marketers	
(ha)	Freq	%	Freq	%	Freq	%
0.1 – 0.4	1	3.2	6	18.8	4	12.9
0.5 – 1.4	15	48.4	19	59.4	16	51.6
1.5 – 1.9	3	9.7	1	3.1	2	6.5
2.0 – 2.5	10	32.2	5	15.6	8	25.8
2.5 +	2	6.5	1	3.1	1	3.2
Total	31	100	32	100	31	100

Mean (1.301)
Source: Field Survey, 2017.

Household size

Table 5 shows the mean size of household was 6.17 implying that there will be more hands to assist in the activities of the famers, processors and marketers in cassava value chain thus reducing the cost of hired labour. This result is supported by researchers, who asserted that large household size provides most of the labour force for farming households.[6]

Table 5. Household size

	Farmers		Processors		Marketers	
HH size	Freq	%	Freq	%	Freq	%
< = 3	2	6.5	1	3.1	2	6.5
4 – 6	15	48.4	16	50.0	20	64.5
7 – 9	14	45.2	15	46.9	9	29.0
Total	31	100	32	100	31	100

Source: Field Survey, 2017.

Access to credit

Figure 3 shows that 65.6% of the farmers, 65.6% of the producers and 69.7 of the marketers interviewed had no access to formal credit at all while only 34.4% of the farmers, 34.4% of the processors and 30.3% of the marketers had access to formal credit for cassava business. The reasons attributed to this by the actors was that the financial institutions, which loan money to its members have not been doing much and government efforts to make credit available to the actors does not exist.

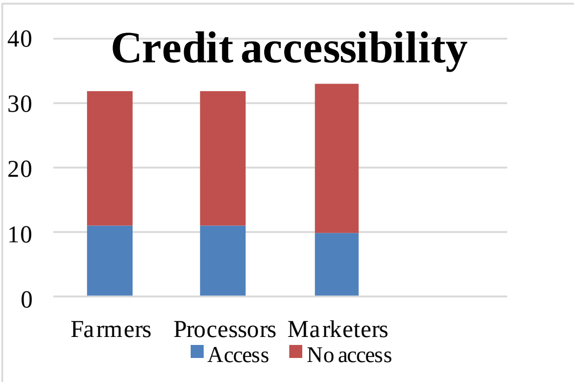


Fig. 4. Credit accessibility of respondents.
Source: Field Survey, 2017

High interest rate charged by informal sources of credit and administrative bottlenecks involved in getting loans from government are other reasons why farmers were not interested in accessing credit from them. Also, because farmers did not have the required collateral security, it was extremely difficult, if not impossible, to get loans from commercial banks.

Source of capital

Source of capital is an important determinant of the size of farm holdings and whether the farm was subsistence or commercial. Figure 4 shows that majority of the respondents interviewed are using their own capital alone while others respondents farm using credit from various sources. Inadequate access to credit, high interest rate and fragmentation of farm holdings accounted for this.

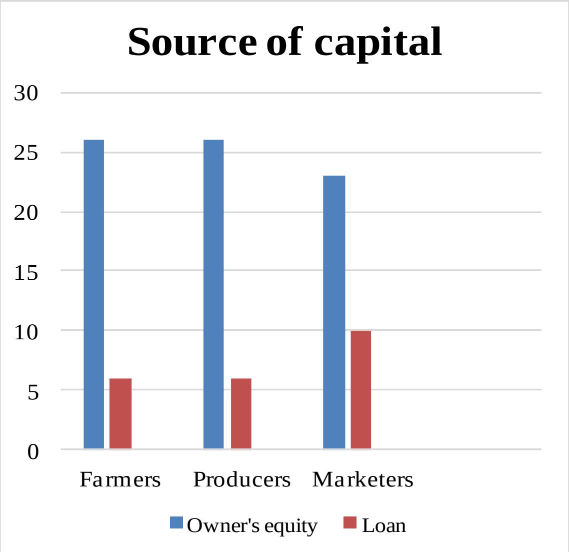


Fig. 5. Source of capital
Source: Field Survey, 2017

Sources of finance for actors in the cassava value chain.

Table 6. Source of finance

Source	Farmers Freq	%	Producers Freq	%	Marketers Freq	%
Micro finance bank	6	19.4	15	46.9	14	42.4
Farmers Union	15	48.4	9	28.1	9	27.3
Aajo	10	32.2	8	25.0	10	30.3
Total	31	100	32	100	31	100

Source: Field Survey, 2017

Table 6 shows that 45% have access to through micro finance banks, 32.5% through farmers union and 22.5% through "aajo" (daily contributions).

Factors influencing profitability of cassava value chain actors.

Farmers

The regression result as shown on table 7, indicated an R^2 value of 0.988 for farmers. Major factors that influence the level of profitability of the respondents in the study area were age, sex, level of education, years of experience, access to capital and source of capital. These factors have a positive significant effect on the level of profitability of cassava value chain actors in the study area. This suggests that increase in age, level of education, years of experience, access to capital and source of capital will increase the level of profitability.

Processors

The regression result indicated an R^2 value of 0.967 for processors. Major factors that influence the level of profitability of the respondents in the study area are age, sex, level of education, years of experience, access to capital, source of capital, source of finance and technology used. These factors have a positive significant effect on the level of profitability of cassava value chain actors in the study area. This suggests that increase in age, level of education, years of experience, access to capital, source of capital and technology used will increase the level of profitability.

Marketers

The regression result indicated an R^2 value of 0.959 for farmers meaning that 95.9 percent of the variability in the model was explained while the remaining 4.1 percent could be attributed to error terms and omitted variables on table 6. It was revealed that the major factors that influence the level of profitability of the respondents in the study area are age, sex, level of education, years of experience, access to capital and source of capital. These factors have a positive significant effect on the level of profitability of cassava value chain actors in the study area. This suggests that increase in age, level of education, years of experience, access to capital and source of capital will increase the level of profitability.

Table 7.Results of multiple regression analysis of the factors influencing profitability of cassava value chain actors

	Farmers		Producers		Marketers	
Variables	Coeff	Sig	Coeff	Sig	Coeff	Sig
Age	.206	.054	- .089	.000*	.033	.866
Sex	.141	.080**	.179	.002**	-.336	.100**
Household size	-.009	.891				
Farm size	.140	.146				
Years of experience	.597	.000*	- .114	.005**	.073	.741
Years of education	.245	.088	.082	.008**	-.064	.733
Access to credit	- .044	.010**	- .358	.000*	.036	.001*
Source of capital	.193	.009**	-.109	.604	-.150	.480
Source of finance			-.049	.841	-.066	.727
Technology used			.546	.020**		
Constraints	.896	.001*	-.243	.008*	.277	.010**
R	-.994		.907		.949	
R^2	.988		.967		.959	

* = sig at 1%, ** = sig at 5%
Source: Field Survey, 2017

Comparative analysis of profitability of credit users and non-credit users

Table 8 and 9 showed the gross margin among farmers, processors and marketers of credit users and non-credits users. The importance of credit was revealed by its users having higher profit compared with non-credit users.

Table 8. Average gross margin of credit users per year

	FARMERS	PROCESSORS	MARKETERS
Quantity of product sold (kg) Price per kg (₦)	540 6,000	620 7,000	585 5,500
Total Revenue (TR) (₦)	**32,400,000**	**4,340,000**	**3,217,500**
Labour Cost(₦) Transportation(₦) Energy(₦) Interest Rate (5%)(₦)	372,000 131,000 135,000	115,200 344,000 357000 371,000	115,200 430,500 234,000
Total Cost (TC) (₦)	**638,000**	**1,187,200**	**779,700**
Gross Margin (TR-TC) (₦)	**2,602,000**	**3,152,800**	**2,437,800**

Source: Field Survey, 2017

Table 9. Average gross margin of non-credit users per year

	FARMERS	PROCESSORS	MARKETERS
Quantity of product sold (kg) Price per kg (₦)	180 6,000	320 7,000	342 5,500
Total Revenue (TR) (₦)	**1,092,000**	**2,240,000**	**1,881,000**
Labour Cost(₦) Transportation(₦) Energy(₦) Interest Rate (5%)(₦)	183,000 101,000 135,000	192,000 144,000 194,000 371,000	24,200 234,000 234,000
Total Cost (TC) (₦)	**284,000**	**530,000**	**258,200**
Gross Margin (TR-TC) (₦)	**808,000**	**1,710,000**	**1,622,800**

Source: Field Survey, 2017

Constraint faced by respondents in the study area

Table 10 reveals that 45.2% farmers, 50% producers and 9.1% marketers were faced with the problem of high cost of transportation due to the distance of their farm to the market. 37.5% processors and 27.2% marketers were with unstable power supply during processing. 16.1% farmers experience problem of infestation of diseases and insects which reduce their output while producers and marketers are not affected by infestation, 9.4% producers and 27.3% are faced with the problem of water scarcity. Poor roads were the major problem faced by the actors which lead to post harvest loss and increase in price of cassava products.

Table 10. Constraints faced by respondents in the study area

Constraints %	Farmers		Producers		Marketers	
	Freq	%	Freq	%	Freq	%
Unstable power supply	0	0	12	37.5	7	21.2
Transport cost	14	45.2	16	50.0	3	9.1
Water scarcity	0	0	3	9.4	9	27.3
Poor roads	12	38.7	1	3.1	8	24.2
Pest infestation	5	16.1	0	0	0	0
Total	31	100	32	100	31	100

Source: Field Survey, 2017

CONCLUSIONS

It was concluded that the activities of cassava value chain actors involved in farming, processing and marketing cassava in the study area are restricted through low financial support hindering the enhancement of mechanised farming, lager scale in processing and marketing.

Based on the findings of this study, the following recommendations were made:

(i)The education of farmers, processors and marketers in the value chain should be a continuous one. Introduction of adult education and skill acquisition programmes will equip the actors to make their activities more profitable,

(ii)Financial institutions and other avenues through which credit can be offered to farmers, small scale processors and marketers should be empowered and enlightened,

(iii)Efforts aimed at increasing farmers' access to more land for farming should be intensified by government and other stakeholders. This will increase output and ensure a steady supply of the raw material and the final product while also increasing profit,

(iv)Special programmes targeted at bringing interaction of ideas between experienced actors and younger ones in the value chain should be encouraged,

(v)Government and non-governmental organizations should embark upon the commercialization of the processing and marketing of the cassava value chain and technological upgrading of the processing.

ACKNOWLEDGMENTS

Data for this research collected by my B.Tech Student, Akinwunmi Omeye.

REFERENCES

[1]Akalumhe, O., 1999, Economics of Marketing and Post-Harvest losses plantain in Southern Nigeria. Unpublished M.Sc Thesis, University of Ibadan, Ibadan, Oyo State, Nigeria.

[2]Henri-Ukoha, A., Anaeto, F.C., Chikezie,C., Ibeagwa, O. B., Ukoha, I.I., Oshaji, I.O., Anyiam, K.H., 2015, Analysis of Cassava Value Chain in Ideato South Local Government Area, Imo State, South-East Nigeria. International Journal of Life Sciences Vol. 4. No. 4. 2015. Pp. 209-215.

[3]Ibekwe, U. C., Orebiyi, J. S., Henri-Ukoha, A., Okorji, E. C., Nwagbo, E. C., Chidiebere-Mark, N. M., 2012, Resource Use Efficiency in Cassava Production in South East Nigeria; Asian Journal of Agricultural Extension, Economics & Sociology, Vol. 1, Issue 1, 16-21.

[4]Iyagba, A.G., Anyanwu, S.O., 2012, Problems and prospects of cassava production in Rivers State, Nigeria: A case study of Oyigbo Local Government Area, Agricultural and biology journal of North America.

[5]The Missing Link in the Value Chain: Financing for Rural Farmers and Micro entrepreneurs: Concept Note, USAID and SEEP Network, October 2005.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CASSAVA VALUE ADDITION: A CASE STUDY OF CASSAVA-BASED BREAD PRODUCERS IN ONDO STATE, NIGERIA

Similoluwa ADEWOLE, Adegboyega OMOWOLE

The Federal University of Technology, Department of Agricultural and Resource Economics, Akure, Nigeria, +2347034926341; Email: restismine13@gmail.com

Corresponding author: restismine13@gmail.com

Abstract

The main objective of this study was to carry out an economic analysis of bread production (using cassava flour) in Akure South Local Government, Ondo State, Nigeria. It ascertained the socio-economic characteristic of the bread producers, estimated costs, returns and profitability in the use of cassava flour for making bread in the study area. Primary data were collected with the aid of a well-structured questionnaire administered to fifty respondents. Data collected were analyzed using descriptive statistics, gross margin analysis and multiple regression analysis. Result showed that production of bread were dominated by male with (73.5%) flour processors and (26.5%) of female processors. Analysis of costs and returns revealed that bread production is profitable in the study area (mean profit of N1,546,657 per month). The estimated functions were in terms of the statistical significance of multiple determinants (R2) 0.998 as indicated by F-value, the significance of the co-efficient of and the magnitude of standard errors. An increase in age will lead to a further increase in the revenue of the producers. The coefficient of educational level is negative and this implies that a decrease in the educational level leads to an increase in the revenue of producers. The coefficient of years of experience was positive and it connotes a corresponding increase in revenue as years of experience rises, the coefficient of purchasing cost was positive and this connotes that the revenue of the producers increased with an increase in purchasing cost as they tend to hike their prices.

Key words*: processors, gross margin, Cassava, bread*

INTRODUCTION

Cassava is the main source of energy for most people living in the lowland tropics and sub-humid tropics of West Africa [1]. Thus, its production and utilization is given prime attention in food policy. Sequel to the pronouncement of presidential initiative on the cassava in 2002, cassava gained prominence in Nigeria. The goal of the policy was to use cassava production as the engine of growth in Nigeria. The Nigerian government encouraged the use cassava to produce a wide range of industrial products such as ethanol, glue, glucose, syrup, biscuits, chin-chin, cake, bread etc. Also, a law was enacted in Nigeria in January 2005, compelling bakers to use composite flour of 10.0% cassava and 90.0% wheat for bread production. Large flour mills that supply flour to bakeries and confectionaries must premix cassava flour with wheat flour. [3]

Cassava farmers have not yet attained the desired technical efficiency in cassava production due to weak access to inputs such as funds, fertilizers, labour and herbicides [2], yet the wide-scale adoption of high yielding varieties and the resulting increase in yield have shifted the problem of the cassava sector from supply (production) to demand issues, The Nigerian government is musing a transition from the present state to the level of industrial raw material and livestock feed for increase in employment. This necessitated various research and policy initiatives in cassava improvement, production and processing.

In the Nigerian industrial environment, approximately 16 percent of cassava root production was utilized as chips in animal feed, 5 percent was processed into a syrup concentrate for soft drinks and less than 1 percent was processed into high quality cassava flour used in biscuits and confectionery, dextrin, adhesives, starch, and hydrolysates for pharmaceuticals and seasonings [5]. Also, different cassava cuisines (such as gari, fufu,starch, lafun, abacha,etc) are produced for human consumption [4]. In view of the renewed emphasis on cassava production (supply), processing and utilization in Nigeria, it becomes necessary to assess the production, demand and utilization patterns of cassava, and its prospects especially in fighting hunger and raising food security.

The increasing use of cassava to produce high quality cassava flour had increased income of farmers. [2]. Thus, additional income is earned from value addition. However, the weak link between cassava farmers and processing groups on one hand and the industries using cassava as raw materials on the other, is depriving farmers and processors from earning the expected income. The effect of socio-economic characteristics and other variables on the amount of value added to cassava products has not been considered over time.

MATERIALS AND METHODS

The study was carried out in Akure south Local Government, Ondo State. Ondo State was created in 1976 out of the former Western State. Akure South is a Local Government Area in Ondo State, Nigeria. Its headquarters are in the town of Akure. It has an area of 331 km² and a population of 353,211 at the 2006 census [6]. Purposive sampling technique was used to select one out of 18 Local Government Areas (LGAs) in Ondo State (Akure South local government). It was chosen because of the predominance of bread producers in the area. Random sampling was carried out to select the respondents from the Local Government Area. A well-structured questionnaire was administered to each respondent. Data was collected from 50 respondents who are bread producers.

Different analytical techniques were used to analyze data that was collected. The socio-economic characteristics of bread processors was analyzed, after collecting data such as age of respondents, marital status of cassava flours processors, educational background, gender of respondents, production experience, and firm size, using descriptive statistics such as frequency distribution, and mean. Data collected on profitability, which range from cost of labour, feeding, quantities and prices of inputs, selling price of the bread, value added activities and cost, were analyzed by the use of Gross Margin (GM).

It is expressed mathematically thus:

$GM = TR – TVC$

The Net Margin Analysis (the difference between the total revenue (TR) and total cost (TC), that is,

Net Margin = TR - TC

Therefore, equations (1) and (2) were being use to estimate the profitability of the processing industries in use of cassava flour for bread production:

$GM_{ps} = TR_{ps} – TVC_{ps}$ ………………. (1)

$NM_{ps} = TR_{ps} – TFC_{ps} – TVC_{ps}$…….. (2)

where:

GM_{ps} = Gross Margin on bread production

NM_{ps} = Net Margin per bag of flour used in production

TR_{ps} = Total Revenue from bread production

TFC_{ps} = Total Fixed Cost incurred in production

TVC_{ps} = Total Variable Cost incurred in production

Analysis of factors influencing the use of cassava flour during production was achieved through the use of regression analysis. The Multiple Regression Model is stated below;

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + e_i$

Y = Total output (proxy by the income generated from sale of bread).

X_1= Cost of Labour (#)

X_2= Cost of transportation (#)

e_i= Random error term

Y is the dependent variable

$X_1….X_2$ are the independent variables

RESULTS AND DISCUSSIONS

Table 1 below shows the socio-economic characteristics of respondents. It could be seen from the findings that majority of the respondents were adults who are still in their active working age. This will have a positive influence on decision making and productivity. Also, male participated more in baking of bread than female counterparts in the study area. This is an indication that flour processing into bread was dominated by male

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

because bread baking is regarded as a man business due to the level of stress that is attached to the business in the study area. Also married people are the majority of flour processors in the study area. It shows that the people who are single are not really looking into agro-enterprise, because most of them are looking for white collar jobs or probably still depending on their parents for their means of livelihood.

Table 1. Socio Economic characteristics of respondents

	FREQUENCY	PERCENTAGE (%)
AGE RANGE		
21-30	9	18.4
31-40	17	34.7
41-50	15	30.6
51-60	77	14.3
61-70	1	2.0
GENDER		
Male	36	73.5
Female	13	26.5
MARITAL STATUS		
Single	7	14.3
Married	37	75.5
Divorced	3	6.1
Widowed	2	4.1
HOUSEHOLD SIZE		
0-5	2	4.1
6-10	27	55.1
11-15	17	34.7
16-20	2	4.1
Above 20	1	2.0
LEVEL OF EDUCATION		
No formal education	1	2.0
Primary education	2	4.1
Secondary education	12	24.5
Tertiary education	32	65.3
Others	2	4.1 100
PRIMARY OCCUPATION		
Farming	5	10.2
Trading	16	32.6
Civil servant	12	24.5
Artisans	10	20.4
Others	6	12.3
YEARS OF EXPERIENCE		
1-5	19	38.8
6-10	17	34.7
11-15	13	26.5
SIZE OF THE FIRM		
Small scale	25	51.0
Medium scale	22	44.9
Large scale	2	4.1

Source: Field Survey, 2017.

The statistics mean of the household size shows that the mean for the household was about 1.45. The result shows that flour processors had fairly large families which will help them to spend less on the labour cost, because they will depend more on family labour for processing. Flour processing into bread in the study area is majorly in the hands of people with tertiary and secondary education. Majority of the respondents are into buying and selling of other commodities where they source for fund to support the production of bread.

Adequate processing experience is pivotal to the success of the agribusiness. Majority of the processors do not have appreciable years of processing experience that can help them to improve their processing operations which could improve their efficiency, especially the most inexperienced ones. It was also discovered that the presence of large scale firms is hugely limited as majority of the processors are small scale enterprises. This is as a result of unavailability of fund to run the business and other factors of production. Majority of the respondents used more than 60 bags of flour in a month while others make use of less than 60 bags of flour in a month which indicates the level of their production capacity. This will in turn determine the level of their income per month. This was as a result of great increase in the consumption of bread and other wheat-based products worldwide because of changing food habits, increasing population, urbanization, and the convenience of these ready-made foods.

Results also indicated that the number of labour required in bread production is very high, it simply means that bread production is one of the business(s) which that provided job opportunity to the people in the study area. Ninety one percent (91.8%) of the respondents population pay for labour monthly, a combined 8.2% use daily and weekly methods of payments. This indicate that majority of the processors pay their workers salary at the end of every month. It shows that majority of the labours are salary earners and are not paid on wages. Markerting patterns revealed that majority of the producers distributes their bread from one retailer's shop to another. This will have a significant effect on the income of the producers as much money will be expended on transportation and maintenance of the vehicle that is been used in distribution or hawking around from one place to the other. Most producers bring the bread down to the door step of both the retailers and the whole sellers in small quantities to sell to the final consumers in unit. The production cycle therefore continues from the producers to the final consumers. This system of marketing will incurred more cost than the factory gate system of marketing.

Table 2, presents the Gross Margin involved in the utilization of cassava flour in production of bread in the study area. The variable cost which include the cost of flour, transportation, labour and other costs. The revenue represented the revenue accrued from the sales of bread. For cassava flour processors, the Total Variable Cost (TVC) incurred in the processing of cassava flour into bread per month was #56,909,600 while the Total Revenue (TR) was #134,242,498 and the Gross Margin (GM) was #77,332,898.

Table 2. Gross Margin Analysis for Assessment of Cassava Flour in Production of Bread

ITEM	AMOUNT	% of costs
Cost of purchasing flour	44,184,300	77.6
Cost of Transportation	6,501,700	11.4
Other Cost	6,223,600	11
Total Variable Cost (TVC) "A"	**56,909,600**	**100**
Total Revenue (TR) "B"	**134,242,498**	
Gross Margin= B-A	**77,332,898**	

Source: Field Survey, 2017.

Table 3, shows the result of the regression analysis techniques (stipulating the technical relationship between inputs and outputs) which was used to determine the relationship between some variables affecting the respondents in the study area. It is the relationship between the revenue of the marketers and factors affecting their level of income. The linear, semi-log and Cobb-Douglas functional forms of the production function were tried using Ordinary least square method. The estimated functions were in terms of the statistical significance of multiple determinants (R^2) as indicated by F-value, the significance of the co-efficient of and the magnitude of standard errors. Based on these statistical and economic criteria, the linear functional form was selected as the lead equation. The result shows that the estimated coefficient of multiple determinations (R^2) indicates that the postulated regressors explained 96.5% in the variation of the regression.

Table 3. Regression Analysis for Assessment of use of Cassava Flour in Production of Bread

VARIABLES	FUNCTIONAL FORMS		
	LINEAR	**COBB-DOUGLAS**	**SEMI-LOG**
Constant	0.543 (0.396)	0.289 (0.200)	0.098 (0.477)
Age of respondents	0.215 (0.146)	0.087 (0.054)	0.105 (0.126)
Educational levels	-0.094 (0.089)	-0.065 (0.077)	-0.165 (0.317)
Years of experience	0.082 (0.202)	0.035 (0.145)	-0.077 (0.756)
Cost of purchase	1.089 (0.058)**	0.954 (0.0465)**	9.898 (0.602)**
Cost of transportation	0.185 (0.950)	0.090 (0.073)	1.918 (0.622)**
R^2	0.998	0.949	0.89
Adjusted R^2	0.965	0.971	0.874
Standard error	0.921	0.096	0.85
F-value	269.738	186.572	145.632

Source: Own results.

The table above shows that the linear equation earlier explained in the research methodology was used.

From the table, it can be deduced that an increase in age will lead to a further increase in the revenue of the producers; this is due to increasing popularity and experience. The coefficient of educational level is negative and this implies that a decrease in the educational level leads to an increase in the revenue of producers; a general decline in the level of education could also lead to an influx of people into the business.

The coefficient of years of experience is positive and it connotes a corresponding increase in venue as years of experience rises, the coefficient of purchasing cost is positive and this connotes that the revenue of the producers will increase with an increase in purchasing cost as they tend to hike their prices. Finally, the coefficient of transportation cost is positive and it also signals an increase in revenue due to hiking when transportation cost is increased.

CONCLUSIONS

This study is centered on creating a balance in comparison between the acceptability of wheat flour and cassava flour**.** The presence of large scale firms is hugely limited as they take up 4.1% of the firms in the market, medium scale organizations are more pronounced as they take up 44.9% of the firms while small scale firms rack up an astonishing 51% of the firms available.

REFERENCES

[1]Abass, A., 2008, Recent Development in Cassava Processing, Utilization and Marketing in East and Southern Africa and Lessons Learned.

[2]Adebayo, K., Abayomi, L., Abass, A., Dziedzoave, N. T., Forsythe, L., Hillocks, R. J., Gensi, R., Gibson, R. W., Graffham, A. J., Ilona, P., Kleih, U. K., Lamboll, R. I., Mahende, G., Martin, A. M., Onumah, G. E., Orr, A. W., Posthumus, H., Sanni, L. O., Sandifolo, V., Westby, A., 2010, Sustainable Inclusion of Smallholders in the Emerging High Quality Cassava Flour Value Chains in Africa: Challenges for Agricultural Extension Services. J. Agric. Extension 14(1):1-10.

[3]Akingbala *et al*., 2009, Chapter 3, Theory of production and cost, The Institute of Chartered Accountants of India.

[4]Hahn, S. K., 2007, An overview of traditional processing and utilization of cassava in Africa. Retrieved Nov. 16th 2007 from http://agri.iiri.cgiar.org/library/docs/x5 45 8E /x5458e05.htm.

[6]Ihedioha, O.C., Akingbala, J.O., and Oguntimein, G.B., 1996, The effect of holding cassava roots for up to four days on quality characteristics of flours milled from the roots. Journal of Food Processing & Preservation 20, 13-23.

[7]Wikipedia,www.wikipedia.com, https://en.m.wikipedia.org/wiki/Akure_south, (Accessed on 13th January, 2018)

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

VINES AND ART

Eugeniu ALEXANDROV, Vasile BOTNARI, Boris GAINA

Institute of Genetics, Physiology and Plant Protection, 20 Padurii Street, 2002, Chisinau, Republic of Moldova, Phone: +37322770447, Fax:+37322556180, Mobile:+37379450998, Emails: e_alexandrov@mail.ru; vasilebotnari@yahoo.com; b.gaina@mail.ru;

Corresponding author: e_alexandrov@mail.ru

Abstract

Each nation constituting its cultural identity is based on several symbols, customs, legends, religious beliefs, etc., which leave its mark on the development of society. One of the commonly used symbols is also the vine. In all times the painters were overwhelmed by the vine, the gift of the gods. On the canvases of the great masters of the past and of the present we see compositions related to the cultivation of the vine, as well as the production of wine. Over the course of his life, man struggled to make his own living space and beautify his living space. Still in the Stone Age, our ancestors were drawing bison, horses, tigers, mammoths and other animals on the walls of the cave. These were the first steps of mankind in the development of art. With the emergence of the first civilizations and the first cities, various techniques of expressing everything that is beautiful and capable of provoking positive emotions have developed.

Key words: *art, collections, landscape, painting, decorative stones, vineyards*

INTRODUCTION

In all times, man struggled to arrange and embellish his living space. Still in the Stone Age, our ancestors were drawing bison, horses, tigers, mammoths and other animals on the walls of the cave. These were the first steps of mankind in the development of art.
In all times the painters were overwhelmed by the vine, the gift of the gods. On the sails of the great masters of the past and of the present we see compositions that are related to the cultivation of the vine, as well as the production of wine [2, 7].

MATERIALS AND METHODS

As a subject of study have served the masters masterpieces in paintings from different periods, which have as theme the vineyard culture, exhibited in various collections and exhibitions [1, 3 - 5].
The comparative evolutionary analysis method was used [6].

RESULTS AND DISCUSSIONS

Francesco del Cossa - was an Italian Renaissance painter. Among the basic works can be mentioned the cycle of six paintings representing museums. One of these paintings is "*Polyhymnia*". 1455-1460, (Fig. 1.).

Fig. 1. „*Polyhymnia*”. Gemäldegalerie, Berlin

Sandro Botticelli (Alessandro di Mariano Filipepi) - Italian painter of the Renaissance period. In his works we can see that the painted figures represent profound human

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

feelings. His characters with slightly melancholic faces generally have a dreamlike expression, Botticelli appears to us as a careful researcher of the human soul.

The picture "*Virgin and Child with an Angel* " expresses the fact that Mary, with her slightly bowed and conceited head, touches the wheat spikes. In his arms he holds a babe with a raised hand in a sign of blessing. The young angel proposes a vase of grapes of wheat and grain of wheat as a sign of the sacrament of the Eucharist, of the Lord's future sufferings (Fig.2.).

Fig. 2. „*Virgin and Child with an Angel* ". Isabella Stewart Gardner Museum, Boston.

Caravaggio (Michelangelo Merisi da Caravaggio) - an Italian painter who was precursor to Baroque style, undoubtedly one of the greatest innovators in the history of painting. In his works of the 1590s, Caravaggio represents exclusively busts. Its paste from that period is dense, golden, and the shaping of objects, though somewhat dry, is so exact that it makes them feel material. The artist likes to render the glass, water-filled vessels, plastic form of fruit, "*Bacchus*" "*Young Sick Bacchus*" etc., (Fig.3., Fig.4.) making objects not only a part of his compositions with figures, but also creating one of the first static natures in the history of painting "*Basket of Fruit*" etc. "*Young Sick Bacchus*" (it.: *Bacchino Malato*) painting is perhaps his self-portrait painted during hospital admission in 1593 (Fig.5., Fig.6.). The work "*Bacchus*" is the portrait of a boy in the style of the Greek god Bacchus. He is dressed in white robes, with a black girdle, the end of which he holds in his right hand. In the left hand he stretches a glass of wine, as he proposes to the one who looks at him to be part of him at this table. On the table, there is a plate of fruit, including grapes, and a wine grape.

Fig. 3. *"Bacchus"* (1595). Uffizi Gallery, Florence.

Fig. 4. *"Young sick Bacchus"* (1594). Galleria Borghese, Rome.

Fig. 5. "*Boy with a Basket of Fruit*" (1593-1594) Galleria Borghese, Roma.

Fig. 6. "*Basket of Fruit*" (1596). Biblioteca Ambrosiana, Milan.

Diego Velázquez (Diego Rodríguez de Silva y Velázquez) - one of the most famous Spanish painters of the 17th century. Representative of the Baroque style.

One of Diego Velasquez's most voluminous and impressive paintings is "*The Triumph of Bacchus*", or a more modest "*The Drunks*" name (Fig.7.).

Velazquez describes the young god of wine, relaxed and drunk, in a company of those who cultivated the vineyards so carefully. Bacchus - surely he is the entourage of the people, with whom he stands and drinks wine. It differs from the others, just by being young, having a strong and well-uncovered body on the crown of the vine. The picture is charming and everything is proportional.

Fig. 7. "*The Triumph of Bacchus*". Museo del Prado, Madrid.

Frans Snyders - painter of deadly compositions and baroque animals. Unlike most of the painters of those times, Snyders chose the way of a narrow specialization, limiting in essence to the execution of dead natures and bruising scenes. However, he was closest to Rubens through the world's understanding, through the very spirit of creation. Snyders' paintings are a true hymn dedicated to the fruitfulness, the abundance, the richness of the earth. The artist has endeavored to embellish in his paintings the whole variety of animal and vegetable worlds. He represents large heaps of fruit, including vineyards and vegetables, fish, hunting animals, and remains faithful to nature, meticulously detailing each detail (Fig. 8 - Fig.10).

Fig. 8. *"The Fruit Basket"*. 1636. Museo del Prado, Madrid.

Fig. 9. ***„****Still Life with Grapes and Game****".*** National Gallery of Art, Washington D.C.

Fig. 10. "*Three monkeys stealing fruit*". Louvre.

Nicolas Poussin - French painter of Baroque classicism period. The works are executed with a historical, mythological and religious motif. A basic element through which the painter is represented is - the landscape.

Nicolas Poussin in the "*The seasons of the year*" works are compositional themes related to the history of mankind, associated by the painter with the seasons of the year, according to the principle: birth, maturation, aging and death (Fig.11).

The work is exposed to an evening mountainous landscape, which, according to the painter's idea, represents the Hanaan lands, recognized by fruitfulness. Late in the evening the workers finish the harvest. In the foreground, Abraham and Lot carry a huge grape vine.

Fig. 11. "*The seasons of the year. The autumn.*". 1660-1640

Francisco José de Goya (Francisco José de Goya y Lucientes), the painting "*Grape harvesting*", (Fig. 12.) is a work in which a lady is painted in the foreground in a yellow dress, in the entourage of a child, another lady and a gentleman in an imposing position,

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

holding a basket full of grapes in his left hand. On the head, the lady holds a basket of black grapes, and a grape of grapes in her hand, to which her hands and her neighbors stretch. In the post plan there is a slope and white clouds. Painted people are dressed in holiday clothes and light-colored shoes. Holiday festivity shows that harvesting grapes is no more than a celebration, not a job, and the heroes are happy, collecting vineyards and living in the mountains, admiring nature.

Fig. 12. "*Grape harvesting*". 1786. Museo del Prado, Madrid.

The Russian painter ***Karl Byiullov***, during the Italian period (1823-1835), painted many scenes from everyday life, which will often feature as a vivid decoration. The famous "*Italian Midday*" Italian painting (Итальянский полдень) represents an oil on canvas, 64 x 55 cm, made in 1827 (Fig.13.). It is one of the most appreciated works of the painter, which is reproduced in hundreds of thousands of copies in various reproductive techniques.

What caused this painting to be so appreciated? Of course, the artist's sincerity and craftsmanship, which has succeeded in bringing back the fascination of beauty, youth and light. Grape vines occupy a central place in the picture. The game of shadows and lights on leaves and bobsles gives the charm of a sunny summer day and the abundance of Italian nature. The young harvester of life is astonished and enchanted by the beautiful fruit of the vineyard. They overwhelm the look and the rays of light irradiating inside the berries. We could say that this bite of grape symbolizes the triumph of nature and that this painting visually embodies Cicero's words: "Grapes are the fruit of the sun. I do not think it's any more pleasant and desirable to see that the fruit of the calf-deviates." (Fig.14.).

Fig. 13. "*Italian Midday*". 1827. The State Russian Museum, Saint Petersburg.

Fig. 14. "*Girl, gathering grapes in the vicinity of Naples"*. 1827. The State Russian Museum, Saint Petersburg.

The work "*Terrace on the Seashore*" ("Веранда, обвитая виноградом") is an oil painting on a 42,5 x 60,8 cm canvas, made by the Russian painter ***Sylvester Shchedrin*** in

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

1828 in Naples. It is exposed to the Tretiakov Gallery in Moscow (Fig.15).

S. Shchedrin created many paintings in Naples, called "interior landscapes", especially terraces with a verandah with a vegetal background, in the Italian pergola, that is, a gazebo or a spring-covered arc with hanging plants. In choosing this type of landscape S. Şcedrin was motivated by the play of lights and shadows and air circulation. He tried to give up the warm colors, adding a blue-gray and silver tones to help sense the Italian air at night, when nature appears in all its splendor. This painting perfectly conveys the perception of that era by the Russian people of Italy - a world full of happiness, harmony and romance.

Fig. 15. „*Terrace on the Seashore*”. 1828. The State Tretyakov Gallery.

It is worth mentioning the work of the painter ***Daniel Ridgway Knight***, «*En Vendanges*», 1870 (Fig.16). This paper presents the process of harvesting grapes. The author very carefully and thoroughly presented the fruit harvested by the grapevine. It also shows how much grapes the grapes are harvesting the workers.

Fig. 16. *”En Vendanges”*, 1870. Leeds Art Gallery, England.

Vincent Willem van Gogh - a post-impressionist painter, and his work through the range of vivid colors and emotional appearance, have greatly influenced XX century art. He painted paintings with the theme of the vine: "*Red vineyard in Arles*", 1884; "*Dead Nature: Grapes, Apples, Lemon and Pears*", 1887; "*Dead Nature: Grapes*", 1887; "*Green vineyards*", 1888 "*Vineyard: Looking Over*", 1890 (Fig.17.).

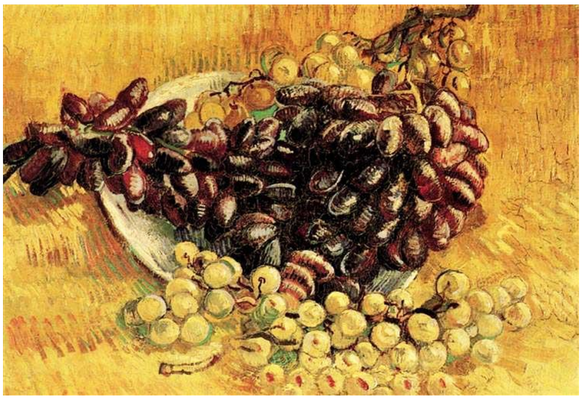


Fig. 17. ” *Dead nature: grapes*”. 1887.

The "*Red vineyard of Arles*" painting was painted by Vincent Willem van Gogh in November 1884 on oil cloth. At that time, living in southern France in Arles, Vincent Willem van Gogh is inspired by urban and rural landscapes, the imposing colors of nature in sunlight (Fig.18.).

One day in Arles, Vincent Willem van Gogh, returning home from the suburbs of the city, noticed an unusual landscape: the sun in the sunset, with its light rays p, the leaves of the huts were colored violet-red and humans and the earth - in shades of gray-lilac. Shortly afterwards, Vincent Willem van Gogh began working on a painting, which involved grape harvesting. The author was not just a simple landscape but a model in which everything has a symbolic meaning. The giant sun of a red-hot in the yellow sky casts a green and orange glow. Everything on the earth, like melting under the sun. The leaves of the vine turn into a bright red, but the underlying soil takes on a lilac hue. The right side of the painting is dedicated to water, which reflects the sky in a flaming yellow flame. People, harvesting grapes, are the symbol of life. People's daily work, Van Gogh understood it as something that allows a person to become an integral part of the universe. The painting is painted in such a way that everything that lies under the sky as if it is a whole. Through this, the idea of an entire human being and the environment was reproduced.

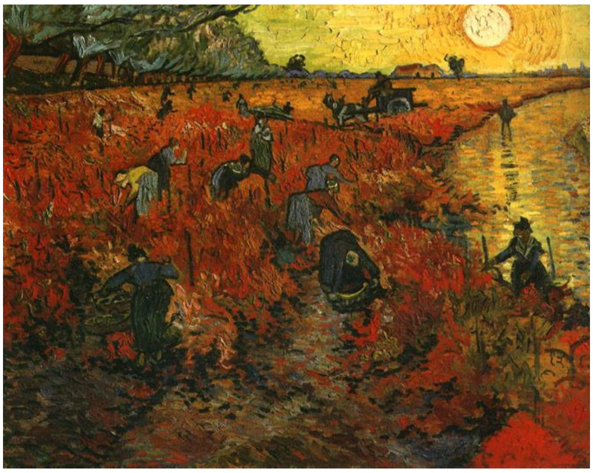


Fig. 18. "*The red vineyard of Arles*". 1884. State Museum of Fine Arts "A.S.Pushkin", Moskova, Russia.

Pablo Picasso (Pablo Ruiz y Picasso), has used various geometrical shapes in his work with decorative elements. This direction of art is called cubism. In "Violin and Grapes", the violin is unfolded in many small details, and the visitor is visually proposed to gather all these elements into an object. Although many details are painted, but all are executed with some detail. Pablo Picasso's goal was not to present the violin but to understand the song that can be played by this violin (Fig.19.).

Fig. 19. *"Violin and Grapes"*, 1912. Contemporary Art Museum, New York, USA.

In Romanian painting, the grapes were rendered in static nature by *Nicolae Grigorescu, Nicolae Tonitza, Theodor Pallady*, etc.

Aurel David (1935-1984), the fascinated painter of color and the author of the Eminescu Tree Engraving, painted oil paintings with live scenes: "*Grape Harvesting*" (1957, collection of the National Museum of Art), "*At the Fruit of the Fame*" 1954, the collection of the Republican College of Fine Arts "A. Plămădeală") (Fig.20).

Fig. 20. "*Grape Harvesting*", 1954

For many generations of art lovers, ***Mihail Petric*** will remain the most representative master of the Basarabian panoramic landscape.

The work "*Vineyards*" by Mihail Petric, 1974, gives the possibility and the desire to cultivate the vine, this being transmitted from an ancient ancestor. It is very fascinated and attractive by its pale colors and vineyard relief (Fig.21.).

Fig. 21. "*Vineyards*". 1974.

The jewelery objects do not make an exception by exposing and recreating the beauty of the vine.

As a raw material for the creation of masterpieces serve mineral stones such as amethyst, jade, onyx, etc.

Amethyst is a variety of quartz. It is also called purple agate, episcopal stone, Bacchus stone, etc. According to the legend, the name "amethyst" comes from the color of the stone. It is considered to resemble the color of the wine, which was strongly diluted. By serving such wine you can not get drunk.

In Ancient Greece the wine was poured in cups with an amethyst, so that the guests at the ceremony would not get drunk.

In Catholic countries the amateur is called the "Episcopal Stone". This choice is not accidental, it is believed that the amateur possesses magical properties to activate the spiritual forces.

Amethyst meets in a wide range of colors ranging from colorless pale-violet, pink-blue-violet, blue-violet to purple, dark purple, and sometimes black. Pink amber-purple and red-purple amethyst stones are used as the raw material for the creation of jewelery.

Using the technique of cutting and stones processing, the gyvagrowi creates decorative compositions by joining cuts of various precious stones on the theme of the grapevine (Fig.22.1. - Fig.23.2.).

Fig. 22.1. "*Grapes from amethyst*" Collection of the Mineralogy Museum on behalf of A.E. Fersman, Academy of Sciences of Russia.

Fig. 22.2. "*Grapes from amethyst*" Collection of the Mineralogy Museum on behalf of A.E. Fersman, Academy of Sciences of Russia

Fig. 23.1. "*Grapes from amethyst*" Collection of the Mineralogy Museum on behalf of A.E. Fersman, Russian Academy of Sciences.

Fig. 23.2. "*Grapes from amethyst*" Collection of the Mineralogy Museum on behalf of A.E. Fersman, Russian Academy of Sciences.

Fig. 24. ”*Grapes from nephrite*”.

Fig. 25. ”*Grapes from onyx*”.

CONCLUSIONS

During the development of civilization, the agricultural activities, including the wine-growing, generated and conditioned the development of specific complementary crafts, such as carpentry - making wooden vessels for collecting and processing grapes, smashing, bleed, tea, tub, fermentation, preservation and transport of wine (barrels), pottery - the production of clay pots for preserving and transporting the wine derivatives, as well as for serving the wines, the blacksmithing - the metal making of the tools necessary for the cultivation of the grapevine and the processing equipment grapes: crushing-pressing, fermentation and storage of wines.

The vine has also greatly influenced the development of painting, architecture, mosaics, etc.

REFERENCES

[1]50 de biografii ale maeştrilor artei plastice vest-europene. Chişinău: Literatura artistică, 1984. 390 p.
[2]Alexandrov, E., Botnari, V., Gaina, B., 2017, Enciclopedie de viticultură ecologică. Chişinău: S.n., (Tipogr. „Lexon-Prim”), 280 p.
[3]Bolişaia sovetskaia ănţiclopedia. V 30-ti tomah. 1969-1978. Izd. Sovetskaia Ănţiclopedia. Moskva.
[4]Dolgopolov, I., 1988, Maeştri şi kapodopere. Arta plastică vest-europeană. Vol. 1. Chişinău: Literatura artistică. 600 p.
[5]Enciclopedie Sovietică Moldovenească. 8 volume. 1970-1981. Chişinău.
[6]Florea, V., 1991, Istoria artei româneşti: în 3 volumes: vol. 1. – Chişinău: Hyperion, 576 pag.
[7]Gaina, B., Alexandrov, E., 2015, Pagini din istoria si actualitatea viticulturii. Chisinău: Lexon-Plus, (Tipografia Reclama), 260 p.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE ANALYSIS OF THE MAIN STATISTICALINDICATORS WHICH CHARACTERIZE THE AGRICULTURE'S EVOLUTION IN THE VEGETAL SECTOR OF THE REPUBLIC OF IRAQ

Hussein Ali Hussein AL-QAESI, Abdulmuttaleb Abbas SALIH

University of Dhi-Qar, District Almustfawiyah, Nasiriyah, 64001, Iraq, Phone: +009647809249646, Emails: hussein_782003@yahoo.com, abd_mtlb@yahoo.com

Corresponding author: hussein_782003@yahoo.com

Abstract

Agriculture in Iraq has gone through many changes in the last decade, its revival has constituted a very important subject for debates. Agriculture is still an important sector since the agricultural sector does provide an opportunity for Iraq to improve the country's economy, and more critically, to increase the resilience of conflict affected rural populations, by increasing their productivity. The focus of this study is on the main crops of Iraq that are very instable in terms of surface and production, affecting also the prices and producers 'confidence. A review of the cultivated crops, total and average productions was made for the period 2000-2014, with the help of the main statistical indicators that analyze the evolution, variation and growth. This study is divided into an introductory section, research methods, results and discussion in which data are interpreted, and end with the conclusions and recommendations.

Key words: *evolution, agriculture, field crops, fruits, vegetables, Iraq*

INTRODUCTION

The present research is situated in the field of agriculture, focusing on evaluating the evolution in the period 2000-2014 of the main agricultural crops that are highly important for the economic development in Iraq. Arable land in Iraq numbers nearly 24 million acres, more than half of which is planted each year, and plant crops (cereal crops in particular) represent two-thirds of agricultural production, while animal production represents one-third [4].

In Iraq, the agriculture is a key factor for the economy, and although a considerable portion of its agricultural lands are irrigated, it still depends highly on rain fed agriculture. The potentially suitable land for agricultural production is not more than 27% of the total area of the country with about 8 million ha which almost 67% of the cultivable area is. Besides this, due to some limitations like shortage of irrigation water in summer, soil salinity, drought and an unstable political situation it is estimated that the average area ranges from 3 to 4 million hectares [10].

The contribution of agriculture to GDP has been declining in the last decade from 9 percent in 2002 to 3.6 percent in 2009, following the problems caused by the war, the social unrest and institutional and economic issues.

Agriculture is mostly practiced on small farming units and it is a low input–low output system. Crop yields are low by any comparative standards as farmers tend to minimize costs concerned with land preparation, planting, weeding and harvesting [11].

After years of war and social unrest, Iraq is facing a number of challenges. The poor performance of the agricultural sector and lack of employment perspectives drive migration to the urban areas, generating pressure on service delivery and increasing urban poverty.

Population growth combined with the need to produce more food from a limited and shrinking resource base of land and water have resulted in farming systems that tend to maximize short-term returns at the expense of long-term sustainability. Water losses in irrigation schemes, all over Iraq, are substantial. The recent intensification of violence in Iraq coincides with wheat planting. If farmers are displaced, or unable to venture to their fields, this will have implications for medium-term food security. Agriculture-based livelihoods also face severe constraints across the value chain [7].

MATERIALS AND METHODS

This study involves the use of theory and statistical data. The theory may or may not be made explicit in the design of the research, although it will usually be made explicit in presentation of the findings and conclusions. In the paper the following indicators have been used: arithmetic mean, coefficient of variation, average annual growth rate, and statistical indicators.

The formulas used for to calculate these indicators, are:

$$For\ the\ arithmetic\ mean = \bar{x} = \frac{\sum xi}{n},$$

where $\bar{x}$ = the arithmetical mean, xi= the average production values for a number of years (i); n= number of years taken into account

The research method followed the following steps, beginning with scientific databases research of the relevant articles concerning organic agriculture in Iraq and marketing of the main agricultural products grown organically in Iraq, followed by an analysis and selection of the relevant data and the last step was extraction and summarization of the results based on interpretation and evaluation of data.

RESULTS AND DISCUSSIONS

In the Arab countries, the share of agriculture in the national GDP is around 6.7% in average for the period 2000 to 2012 [10] and the agricultural sector in Iraq represents the second largest industry of the non-oil economy, contributing 9.7% to GDP in 2013 [5]. Recently, the agricultural sector has been identified by the Government of Iraq and the Kurdistan Regional Government (KRG) as a strategic area of focus to be prioritized.

The selling of agricultural equipment started opening to private sector, while the government still maintained hegemony over importing and selling agricultural machinery and the government remained the main importer and seller of agricultural machinery until 1993 when a new law for the Ministry of Agriculture was issued, which pointed out that the main activities of the government should be addressed to agricultural research, services and extension [2].

In 2003, the new government and administration identified that such issues as mechanization-related problems and agricultural issues were mainly affecting the medium and small producers in Iraq [3]. Three years later, in 2006, three USDA agriculture advisors were assigned to the Iraqi Ministry of Agriculture to build its capacity in agricultural extension, agricultural strategic planning, and food safety and inspection. USDA provided also a public affairs specialist to be part of the U.S. embassy's public affairs team [12]. Iraqi imports had a value of almost $3 billion in food annually, and Iraq was the No. 2 buyer of U.S. hard red winter wheat in marketing year 2005-2006 [World Bank, 2006] [14]. In addition, Iraq was the No. 1 buyer of U.S. long grain milled rice in 2005. In the late 1980s, it was the top market for rice and one of the top 10 wheat export markets. USAID started helping Iraqi farmers improve production technologies for wheat, barley, rice, and maize [12].

The evolution of the surfaces occupied by the main crops in Iraq

The major portion of the agricultural land in Iraq is cultivated with field crops. Wheat and barley are the most important crops. Wheat is the most important staple food crop in Iraq and Barley is mainly used for animal feed. The large increase of wheat grown area after 1991 is likely due to a national policy to increase food production in Iraq, possibly induced by international economic sanctions. Other crops of significance and major importance are pulses that include lentils, chickpeas, broad beans, oil seed crops such as cotton, sesame, sunflower [6].

The analysis begins with the evolution of surfaces that are cultivated with grain cereals, beans and other main crops. Form the first table it can be observed an increase of the surface cultivated with wheat, with high variation between the years, 28.2%, and an annual growth rate of 4.11%. In the year 2014 the wheat registered 2,109.5 thousand ha compared to 1,200 thousand ha in 2000. The barley crop is also cultivated on large areas, and its surface has increased in the last years, having high variations on years. The highest decreases can be observed at the chick peas crop, from 85.4 thousand ha has dropped with 28% per year at just 0.9 thousand ha in year 2014. The beans and sunflower are also two crops that have suffered important decreases in surface [1].

Table 1. The evolution of the surfaces for the main field crops in Iraq, during 2000-2014

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		Th. ha	Th. ha	Th. ha	Th. ha	Th. ha	Th. ha	%	%
Wheat	Th. ha	1,200.0	2,549.8	1,383.3	2,109.5	1,519	429	28.2	4.11
Barley	Th. ha	1,110.0	1,063.3	1,005.8	1,145.8	923	284	30.8	0.23
Beans, dry	Th. ha	9.0	5.0	0.9	1.2	3.7	3.1	84.9	-13.40
Beans, green	Th. ha	2.4	1.3	0.9	1.2	1.5	0.6	40.6	-4.83
Broad beans, horse beans, dry	Th. ha	6.5	4.5	5.1	1.2	3.8	1.6	42.5	-11.32
Chick peas	Th. ha	85.4	11.8	1.0	0.9	50	70	140.3	-28.02
Cow peas, dry	Th. ha	0.6	0.4	0.3	0.2	0.4	0.1	29.5	-6.77
Lentils	Th. ha	2.8	4.5	0.1	0.6	2	3	122.5	-10.83
Maize	Th. ha	72.8	173.8	113.1	84.6	130	38	29.4	1.08
Potatoes	Th. ha	38.8	51.0	13.0	25.7	37	11	30.3	-2.88
Rice, paddy	Th. ha	100.0	107.0	48.0	78.9	85	27	31.7	-1.67
Sugar beet	Th. ha	0.3	0.0	1.2	2.7	1.1	0.9	82.9	71.84
Sugar cane	Th. ha	5.0	0.0	0.6	0.5	1.3	2.3	168.5	19.13
Seed cotton	Th. ha	19.8	27.0	20.6	15.5	22	12	54.7	-1.72
Sunflower seed	Th. ha	6.0	15.8	5.8	0.8	7.2	4.4	61.4	-13.07
Tobacco, unmanufactured	Th. ha	2.4	2.4	2.5	2.6	2.3	0.3	12.5	0.55

Source: FAOSTAT, 2014, Value of Agricultural Production, http://www.fao.org/faostat/en/#data/QV[9]

Important increases in surface are observed at sugar beet, from 0.3 thousand ha in 2000 to 2.7 thousand ha in 2014, the sugar cane decreasing from 5 to 0.5 thousand ha.

Almost all of the crops have high variation between the cultivated surfaces over the period, which represents a high instability on the market and for producers.

The cultivated area of vegetables is estimated at about 9% (450,000 ha) of the total cultivated area and about 6% (300,000 ha) is covered by permanent fruit trees.

Vegetables and fruits provide good supplementary and nutritive food in daily diet and they also fetch attractive price for the producers.

Vegetables are grown all year round in Iraq. Similarly fruit trees are grown throughout Iraq as the climate is considered highly suitable for various fruits.

Analyzing the second table, the surfaces for tomatoes and vegetables have decreased, with high variations on years and high annual rates between 2% and 5.53%.

The tomatoes have a mean of 60 thousand ha, with a high coefficient of variation of 26.5% and standard deviation of 16 thousand ha. In the year 2014 it registered only 34.8 thousand ha cultivated.

Table 2. The evolution of the surfaces for the main vegetable crops in Iraq, during 2000-2014

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		Th. ha	Th. ha	Th. ha	Th. ha	Th. ha	Th. ha	%	%
Tomatoes	Th. ha	77.3	67.0	53.2	34.8	60	16	26.5	-5.53
Vegetables, fresh nes	Th. ha	30.0	27.6	22.8	19.4	25	3	13.2	-3.07
Vegetables, leguminous nes	Th. ha	18.5	33.8	17.9	13.9	21	6	28.1	-2.01

Source: FAOSTAT, 2017, GIEWS - Global Information and Early Warning System,[7]

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The fruits production it's a highly important part in the agriculture of Iraq, and the Table 3 presents the data of the evolution of these crops.

Table 3. The evolution of the surfaces for the main permanent crops in Iraq, during 2000-2014

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		Th. ha	Th. ha	Th. ha	Th. ha	Th. ha	Th. ha	%	%
Apples	Th. ha	9.0	10.8	30.3	66.2	24	21	85.4	15.32
Apricots	Th. ha	4.6	5.1	4.9	5.2	5	0	9.1	0.82
Dates	Th. ha	110.0	50.0	123.0	242.6	118	49	41.6	5.81
Olives	Th. ha	2.0	0.9	4.7	4.5	3	2	54.9	5.93
Oranges	Th. ha	28.0	26.5	37.1	59.6	35	12	33.1	5.54
Tangerines, mandarins, clementines, satsumas	Th. ha	3.0	1.2	0.7	0.8	2	1	56.5	-8.83

Source: FAOSTAT, 2014, Value of Agricultural Production, http://www.fao.org/faostat/en/#data/QV[9]

-The apples have increased in surfaces from 9 thousand ha to 66.2 thousand ha in year 2014, with a very high variation of 85.4% and 15.34% yearly increase.

-Dates are also very significant for the export of Iraq, the year 2014 registering a surface of 242.6 thousand ha, more than double compared to the first year and almost five time more than the surface from year 2005. Iraq is considered to be the largest producer of date palm fruit in the world.

-Increases in surface have also the olives and the oranges with high variations on years and the Tangerines, mandarins, clementines and satsumas have decreased continuously to a surface of 0.8 thousand ha in 2014.

The evolution of the total productions of the main crops in Iraq

The next three tables analyses the evolution of the total production mainly influenced by the changes in the cultivated surface, as it was shown in the previous tables, has had high variations on years.

The wheat, the most cultivated crop in Iraq, has increased from 384 tons in year 2000 to 5,055 tons in year 2014, with a variation of 50%, and a very high standard deviation of 1,182 thousand tons (Table 4).

Table 4. The evolution of the total productions for the main field crops in Iraq

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		Th. to	Th. to	Th. to	Th. to	Th. to	Th. to	%	%
Wheat	Th. to	384	2,228	2,749	5,055	2,358	1,182	50.1	20.21
Barley	Th. to	400	754	1,137	1,278	803	258	32.1	8.66
Beans, dry	Th. to	8.9	8.4	4.1	7.2	6.8	2.5	37.5	-1.48
Beans, green	Th. to	8.0	7.0	5.6	7.2	7.6	2.3	30.9	-0.73
Broad beans, horse beans, dry	Th. to	3.0	4.0	11.3	0.6	8.0	4.3	54.2	-10.96
Chick peas	Th. to	48.9	13.0	0.8	0.8	28.5	38.7	135.9	-25.28
Cow peas, dry	Th. to	0.8	0.6	0.9	1.2	0.8	0.3	33.9	3.26
Lentils	Th. to	2.0	4.0	0.2	0.9	2.5	4.2	166.6	-5.80
Maize	Th. to	55	401	267	289	341	173	50.5	12.59
Potatoes	Th. to	545	808	205	402	582	215	36.9	-2.15
Rice, paddy	Th. to	60	309	156	403	258	121	46.8	14.57
Sugar beet	Th. to	7.5	0.1	10.7	7.9	8.6	6.9	79.4	49.25
Sugar cane	Th. to	65.0	0.0	12.5	8.7	17	26	149.4	12.29
Seed cotton	Th. to	33.0	29.0	45.3	38.0	38	19	49.2	1.01
Sunflower seed	Th. to	7.5	24.0	7.5	1.8	12	8	65.3	-9.61
Tobacco, unmanufactured	Th. to	2.3	2.3	2.3	2.3	2.3	0.1	4.5	0.16

Source:FAOSTAT,2017, GIEWS - Global Information and Early Warning System,[8]

The barley production has increased also, from 400 thousand tons to 1,278 thousand tons in year 2014, also with high variations on years. The beans have decreased in productions and together with the chick peas have the most important downward trend.

Overall, all the productions have important variations on years, with high standard deviations and also high annual growth rate, these fluctuations being main influenced by the variations in surfaces.

The tomatoes increased their production until year 2010, when it was registered a total production of 1,013.2 thousand tons and decreased up to 770.6 thousand tons, with a mean of 934 thousand tons and a very high standard deviation of 253 thousand tons.

The fresh vegetables have a continuous decrease over the years, with a rate of -3.64% per year and the leguminous vegetables increased their production up to 195 thousand tons in year 2005, and 108.2 thousand tons in year 2014 compared to year 2000 when the total production was 75 thousand tons (Table 5).

Table 5. The evolution of the total productions for the main vegetable crops in Iraq

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		Th. to	Th. to	Th. to	Th. to	Th. to	Th. to	%	%
Tomatoes	Th. to	989.0	939.0	1,013.2	770.6	934	253	27.0	-1.77
Vegetables, fresh nes	Th. to	140.0	129.2	103.8	83.3	113	16	14.0	-3.64
Vegetables, leguminous nes	Th. to	75.0	195.0	140.5	108.2	136	45	33.0	2.65

Source:FAOSTAT,2017, GIEWS - Global Information and Early Warning System,[7]

The fruits production has increased at apricots and olives and decreased with high rates at citrus and dates.

The apples production is in year 2014 at 63.4 thousand tons, almost the same with year 2000, but with high variation over the years, and a slight decrease rate of 0.29%.

The dates decrease from 932 thousand tons to 662 thousand tons in year 2014, with a decrease of 2.41% per year and a high standard deviation of 187 thousand tons.

The production of oranges is more than a half smaller in year 2014 compared with year 2000, the coefficient of variation being very high for this category, 63.9%, but also for olives and tangerines and etc (Table 6).

Table 6. The evolution of the total productions for the main permanent crops in Iraq

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		Th. to	Th. to	Th. to	Th. to	Th. to	Th. to	%	%
Apples	Th. to	66.0	25.0	39.6	63.4	47	16	34.8	-0.29
Apricots	Th. to	6.0	11.7	15.7	16.1	12	4	32.8	7.28
Dates	Th. to	932	404	568	662	630	187	29.7	-2.41
Olives	Th. to	6.0	3.0	15.1	24.8	11	8	70.2	10.66
Oranges	Th. to	270.0	79.0	97.9	115.6	144	92	63.9	-5.88
Tangerines, mandarins, clementines, satsumas	Th. to	37.0	27.0	3.7	4.7	18	15	85.5	-13.74

Source: FAOSTAT, 2014, Value of Agricultural Production, http://www.fao.org/faostat/en/#data/QV[9]

The evolution of the average productions/ha of the main crops in Iraq

The other responsible for the increase of the total production is the average production, as it will be demonstrated in the next three tables has very high variations over the years.

The wheat production has increased from 320 kg/ha to 2,396 kg/ha with an average of 1,542 kg/ha and a standard deviation of 620 kg/ha.

The barley production has achieved an average of 1,115 kg/ha in the year 2014, starting also with 360 kg/ha in 2000.

The chick peas have variations between 572 kg/ha and 1,106kg/ha, the production of sugar beet has a very high decrease from 22,727 kg/ha to 2,995 kg/ha in 2014 and the maize also increased in production up to 3,420 kg/ha (Table 7).

An important increase is observed at the tomatoes production, from 12,802 kg/ha to 22,129 kg/ha, i.e. a growth rate of 3.99%.

Also the leguminous vegetables almost doubled their production from 4,054 kg/ha to 7,775 kg/ha, with an average of 6,486 kg/ha and a growth rate of 4.76% per year (Table 8).

Table 7. The evolution of the average productions for the main field crops in Iraq

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	%	%
Wheat	kg/ha	320	873	1,987	2,396	1,542	620	40.2	15.47
Barley	kg/ha	360	709	1,130	1,115	932	323	34.7	8.41
Beans, dry	kg/ha	988	1,698	4,355	6,019	3,083	1,991	64.6	13.78
Beans, green	kg/ha	3,333	5,600	5,977	6,019	5,380	958	17.8	4.31
Broad beans, horse beans, dry	kg/ha	461	888	2223	488	2,306	1,417	61.4	0.41
Chick peas	kg/ha	572	1,106	839	967	747	332	44.4	3.82
Cow peas, dry	kg/ha	1,357	1,425	2,774	5,671	2,567	1,734	67.5	10.75
Lentils	kg/ha	727	888	1,520	1,565	1,163	344	29.5	5.63
Maize	kg/ha	756	2,307	2,358	3,420	2,523	752	29.8	11.38
Potatoes	kg/ha	14,064	15,843	15,717	1,5626	1,5315	2,228	14.5	0.76
Rice, paddy	kg/ha	600	2,887	3,248	5,104	3,098	1,168	37.7	16.52
Sugar beet	kg/ha	22,727	17,500	9,124	2,995	11,799	6,548	55.5	-13.14
Sugar cane	kg/ha	13,000		20,000	15,993	17,198	4,380	25.5	-5.74
Seed cotton	kg/ha	1,670	1,074	2,201	2,451	1,867	476	25.5	2.78
Sunflower seed	kg/ha	1,250	1,523	1,304	2,156	1,744	369	21.2	3.97
Tobacco, unmanufactured	kg/ha	937	937	941	888	1047	199	19.0	-0.38

Source: FAOSTAT, 2014, Value of Agricultural Production, http://www.fao.org/faostat/en/#data/QV[9]

Table 8. The evolution of the average productions for the main vegetable crops in Iraq

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	%	%
Tomatoes	kg/ha	12,802	14,014	19,046	22,129	15,633	2,863	18.3	3.99
Vegetables, fresh nes	kg/ha	4,666	4,682	4,545	4,298	4,506	199	4.4	-0.59
Vegetables, leguminous nes	kg/ha	4,054	5,777	7,853	7,775	6,486	1,532	23.6	4.76

Source: FAOSTAT, 2014, Value of Agricultural Production, http://www.fao.org/faostat/en/#data/QV[9]

It is concerning how the apples production has decreased, a high dropdown from 7,333 kg/ha to 956 kg/ha in year 2014. Also the dates have high decreases in the average production, with a downward trend by -7.77% rate, the olives production has increased up to 5,527 kg/ha and the citrus have important decreases with very high variations over the year (Table 9).

Table 9. The evolution of the average productions for the main permanent crops in Iraq

Indicator	MU	2000	2005	2010	2014	Mean	St. Dev.	Coefficient of variation	The annual growth rate
		kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	%	%
Apples	kg/ha	7,333	2,325	1,307	956	3,083	2,208	71.6	-13.54
Apricots	kg/ha	1,300	2,300	3,240	3,100	2,555	714	27.9	6.40
Dates	kg/ha	8,472	8,080	4,615	2,730	5,922	2,230	37.7	-7.77
Olives	kg/ha	3,000	3,233	3,215	5,527	3,646	790	21.7	4.46
Oranges	kg/ha	9,642	2,981	2,638	1,39	4,669	3,829	82.0	-10.82
Tangerines, mandarins, clementines, satsumas	kg/ha	12,333	22,500	5,175	5,680	9,250	6,117	66.1	-5.39

Source: FAOSTAT, 2014, Value of Agricultural Production, http://www.fao.org/faostat/en/#data/QV[9]

Date palm is the most popular fruit in Iraq, which is grown in the central and southern part of the country.

A New York Times article [13] describes that Iraq produced 75% of the world's supply of dates, growing 629 different varieties.

In recent years, Iraq has lost its position on the world market, and production (281,000 tons) was in 2008 approximately half of production levels in the 1980's. The article states that the number of date palm trees has fallen from 33 million in the mid 50's to 9 million in 2008.

CONCLUSIONS

The agricultural sector confronts enormous challenges to investment and growth. Settlement of unresolved land and water rights issues, renovation of Iraq's irrigation infrastructure, development of a coordinated national program of de-salinization, as well as the rebuilding of infrastructure for handling, storing, and distributing agricultural inputs and outputs will all likely be needed to fully restore producer's confidence in increasing the cultivated surfaces and average productions.

-The agricultural sector in Iraq represents the second largest industry of the non-oil economy, contributing 4.2% to GDP in 2013.

-Overall, all the productions have important variations on years, with high standard deviations and also high annual growth rate, these fluctuations being main influenced by the variations in surfaces.

-The large increase of wheat grown area after 1991 is likely due to a national policy to increase food production in Iraq, possibly induced by international economic sanctions.

-A New York Times article describes that Iraq produced 75% of the world's supply of dates, growing 629 different varieties.

-In recent years, Iraq has lost its position on the world market, and production (281,000 tons) was in 2008 approximately half of production levels in the 1980's.

-Recently, the agricultural sector has been identified by the Government of Iraq and the Kurdistan Regional Government (KRG) as a strategic area of focus to be prioritized.

-In 2006, three USDA agriculture advisors were assigned to the Iraqi Ministry of Agriculture to build its capacity in agricultural extension, agricultural strategic planning, and food safety and inspection.

-USDA provided also a public affairs specialist to be part of the U.S. embassy's public affairs team.

-Through the Agriculture Reconstruction and Development Program for Iraq (ARDI), USAID has helped the development of agriculture.

-As a result and recommendation, a revision of effective policies with a new framework approach, such public-private partnership, will have to be considered to reap expected benefits in terms of agricultural growth.

-The instability of land use and agricultural production is due to politic instability mainly and it is definitely an important issue that must be stabilized and prioritized.

REFERENCES

[1]Al-Hakim Abdul Hussein Nuri, 2011, Studies in Iraqi agriculture, Part 1: Farming for the future. Supreme
Committee for the agricultural initiative to the Prime Minister, Baghdad.

[2]Al-Hakim Abdul Hussein Nuri, Basim Mohammed Abed Ali, 2008, Country Report: Situation of Iraqi Food security for the Year 1997.

[3] Al-Hakim Abdul Hussein Nuri, 2005, Constrains in agricultural policies in the Republic of Iraq. The Ministry of Agriculture, Baghdad, 2005.

[4]Al Hassoun, N. 2015, Iraqi agriculture drops 40% under IS control", in Al Monitor.

[5]Al-Haboby Azhr, Breisinger, C., Debowics, D., El-Hakim, A.H., Ferguson, J., Telleria, R., van Rheenen, T., 2014, Agriculture for Development in Iraq? Estimating the Impacts of Achieving the Agricultural Targets of the National Development Plan 2013–2017 on Economic Growth, Incomes, and Gender Equality, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.431.7749&rep=rep1&type=pdf, Accessed on November 5, 2017.

[6]Bishay, F.K., 2003, Towards sustainable agricultural development in Iraq – The Transition from Relief, Rehabilitation and Reconstruction to Development, FAO.

[7]FAOSTAT,2017, GIEWS - Global Information and Early Warning System, http://www.fao.org/giews/countrybrief/country.jsp?code=IRQ, 2017, Accessed on November 5, 2017

[8]FAO, 2017, Iraq at a glance, http://www.fao.org/iraq/fao-in-iraq, Accessed on November 5, 2017

[9]FAOSTAT, 2014, Value of Agricultural Production, http://www.fao.org/faostat/en/#data/QV, Accessed on November 5, 2017.

[10]Ibrahim, A.R., Necula, R., Capătă, D.R., 2015, The living standard and development analysis through the evolution of Gross Domestic Product for the period 2000- 2012, Scientific Papers Series „Management, Economic Engineering and Rural Development", Vol.15(2):155-160

[11]International Food Policy Research Institute, 2014, Agriculture for Development in Iraq.

[12] U.S. Department of Agriculture, 2006, available at http://www.usda.gov/, Accessed on November 5, 2017

[13]Williams, T.,2009, "Idle Iraqi Date Farms Show Decline of Economy". The New York Times, 15 August, 2009.

[14]World Bank, 2006, Country Water Resource Assistance Strategy.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EVALUATION OF BIOACTIVE COMPOUNDS IN *Pseudarenthemum tunicatum* LEAVES USING GAS CHROMATOGRAPHY- MASS SPECTROMETRY

Nuria Chinonyerem AMEACHI, Chinemerem Linda CHIJIOKE

Abia State University, Department of Food Science and Technology, Uturu, Nigeria.
Emails: chinonyeremwog@yahoo.com, chinemeremlindy@yahoo.com

Corresponding author: chinonyeremwog@yahoo.com

Abstract

Pseudarenthemum tunicatum belongs to the Acanthaceae family and an aqueous infusion of it is taken as a hematinic and for other medicinal purposes. This work was aimed at identifying compounds in dichloromethane/ methanol (1:1v) and methanol extracts of P. tunicatum leaves using Gas Chromatography Mass Spectrometry analysis. Thirty compounds were identified in dichloromethane/methanol extract while thirty five compounds were identified in the methanol extract. The most abundant compounds in the dichloromethane/methanol extract 21-methyl-17-isocholestane-16-[2- [formylthio]ethyl],methyl-5,9,21-octacosatrienoate, 9,19-Cyclolanostan-3-ol, 24-methylene-, (3β.)and n-Hexadecanoic acid which had relative abundance of 13.51%, 12.72%, 10.66% and 10.20% respectively. The most abundant compounds in the methanol extract were 2,5-Furandione- 3-methyl, 5-Hydroxymethylfurfural, 9-Octadecenoic acid, (E) and n-Hexadecanoic acid which had relative abundance of 14.01%, 13.27%, 12.25% and 11.87% respectively. Tetradecanoic acid (i.e myristic acid) and n-Hexadecanoic acid were the only compounds identified in both extracts. Results indicated that polarity of the solvents used in extraction influenced the relative abundance and type of compound extracted. Dichloromethane/ methanol extracted more of the triterpenoids and sterols while methanol extracted more of the flavonoids, fatty acids and fatty acid esters. Various compounds identified are known to have varying bioactivities such as antimicrobial, anticancer, antioxidant and antisickling. As such, P. tunicatum leaves could be useful in the preparation of neutraceuticals.

Key words: *Pseudarenthemum tunicatum leaves, Gas Chromatography-Mass Spectrometry, triterpenoids, fatty acids*

INTRODUCTION

Plants serve as source of medicine and an important component of the health care system [10]. Many plants contain compounds which have curative or protective properties against various diseases [16]. These compounds proffer positive health benefit such as being antioxidants which have the ability of "mopping up" reactive oxygen species (ROS) and reactive nitrogen species (RNS) which are implicated in inducing oxidative stress resulting to various types of cancer in different body parts and other ailments associated with it.

There has been an increasing interest on natural product research especially on medicinal plants which seem to have restorative properties [7]. The World Health Organization estimates that approximately 80% of the world population in developing countries relies on traditional plant medicine for primary health care needs, of which a major proportion corresponds to plant extracts or their active principles [20]. They are a source of novel chemical entities that possess beneficial pharmacological and therapeutic properties [11]. *Pseudarenthenum tunicatun* leaves belongs to the family, Acanthaceae [5] [2] reported that plants belonging to Acanthaceae family have been reported to have anti-fugal, cytotoxic, anti-inflammatory, anti-pyretic, antioxidant, insecticidal, hepatoprotective, immunomodulatory, anti-platelet aggregation and anti-viral activities. Red colored infusion of this plant got after boiling the leaves in water is traditionally taken as 'blood tonic' by some human populations in the southern part of Nigeria and in some African countries who have a knowledge of its medicinal usefulness. Nutrient, phytochemical and amino acid profile of the leaves have been elucidated [3]. *P. tunicatum* is a woody herb or under shrub reaching a height greater than 85cm with red flowers protruding at the tip. This under-shrub grows in evergreen forest and on rocks and near streams. It is found growing from Ghana to West Cameroon and Fernando Po and is wide spread throughout tropical African [5].

The main research interest in plants is aimed at unveiling the presence of some active components in them [17]. Identification and evaluation of these active compounds otherwise known as phytochemicals of uncommonly used plants could help provide information that would be useful in the development of a new drug [1] or in the production of a neutracuetical. It is in view of this that Gas Chromatography- Mass Spectrometry (GCMS) analysis was carried out to identify compounds present in *P. tunicatum* leaves. This will provide information about its usefulness and proposed use as a neutraceutical or as starting material in the synthesis of pharmaceutical drugs.

MATERIALS AND METHODS

Psuederathemum tunicatum leaves were harvested from nearby farms in Abia State University, Umuahia location in Umudike, Ikwuano Local Government Area in the month of January, 2017. It was identified by a taxonomist in the Department of Plant Science and Biotechnology, Abia State University Uturu, Nigeria. Specimen sample of the leaves were deposited in the herbarium. The leaves were de-stalked, washed in clean tap water and drained off the water. Subsequently, the leaves were dried under a shade for 5 days after which they were pulverized in a blender. Bioactive compounds were extracted according to the method described by [21]. Methanol and dichloromethane/methanol (1:1v/v) were used to extract bioactive compounds. 20g of the pulverized leaf sample was put into two labeled conical flasks respectively. 400ml dichloromethane/methanol and 400 ml methanol were added to the conical flasks containing the samples respectively and shaked vigorously. Each flask containing the sample and solvent were covered using aluminum foil and allowed to stand for 24h at room temperature before the sample mixtures were filtered through whatman filter paper No.1 respectively. The respective extracts were concentrated by evaporating excess solvent by boiling in a water bath. Hence, two extracts of *P. tunicatum* leaves were obtained. These extracts were subjected to gas chromatography-mass spectrometry (GCMS) analysis for the separation and identification of compounds respectively. This was done using GCMS (Model QP 2010 series, Shimadzu, Japan) equipped with Optima 5ms fused capillary column of 30mm length, 0.25 mm diameter and 0.25 mm film thickness. Helium (99.99%) was used as carrier gas. The temperature programming was set with initial column oven temperature of 60^0C hold time of 2mins by 120^0Cmin to a final temperature of 300^0C with hold time for 2mins. 2.0 µl of the *P. tunicatum* leaf extracts were injected using a Hamilton syringe into the GC for total ion chromatographic analysis with split injection technique (3:1) respectively. The injector temperature was 250ºC, ion source temperature was 200ºC with an interface temperature of 280ºC and recorded over a scan range of 45 to 650m/z with electron impact ionization energy of 70ev. Total running time of GC-MS for the methanol extract was 29 min, while for the dichloromethane/methanol extract was 23min. The relative percentage of each extract constituents were expressed as a percentage with peak area normalization. Compounds were identified by mass spectroscopy. This was done by comparing retention indices and mass spectra fragmentation patterns of the compounds with those stored on the computer library of the National Institute of Standard Technology (NIST/EPA/NIH Mass Spectral Library, Version 2.0). Quantitative determinations were made by relating respective peak areas to TIC areas from the GC-MS.

RESULTS AND DISCUSSIONS

GC-MS analysis revealed the presence of 30 compounds in dichloromethane/methanol extract and 35 compounds in methanol extract of *Pseuderathemum tunicatum* leaves. Peak

number, retention time, compound name, molecular weight, molecular formula and relative abundance are stated in their various tables. Table 1 shows compounds identified in dichloromethane/methanol extract of *P. tunicatum* leaves which represented the lipophilic fraction. Four compounds were identified as the major bioactive compounds.
They are 21-methyl-17-isocholestane-16-[2-[formylthio]ethyl] and it had a relative abundance of 13.51% and eluted as represented at peak 26.
Methyl-5,9,21-octacosatrienoate had a relative abundance of 12.72% and eluted as represented at peak 19; 9,19-Cyclolanostan-3-ol, 24-methylene- (3β.) had a relative abundance of 10.66% and eluted as represented at peak 29 and n-Hexadecanoic acid (i.e. palmitic acid) had a relative abundance of 10.20% and eluted as represented at peak 17.

Table 1. Bioactive Compounds indentified in Dichloromethane/ methanol extract of *Pseuderathernum tunicatum* leaves

Peak No	RT (mins)	Name of Compound	Molecular formula	Molecular weight	Relative abundance (%)
1	3.709	n-Octanoic acid	$C_8H_{16}O_2$	144	0.12
2	3.900	2-Butanone, 4-hydroxy-3-methyl	$C_5H_{10}O_2$	102	0.26
3	5.857	1,8-Nonadien-3-ol	$C_9H_{16}O$	140	0.16
4	6.120	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	$C_{10}H_{20}O$	156	0.91
5	6.336	Methylene chloride	CH_2Cl_2	84	0.07
6	6.700	Cyclohexanone, 5-methyl-2-(1-methylethyl)-, (2S-trans)-	$C_{10}H_{18}O$	154	0.34
7	6.941	Cyclohexanone, 5-methyl-2-(1-methylethyl)-, trans-	$C_{10}H_{18}O$	154	0.17
8	10.694	2-Decanynoic acid	$C_{10}H_{16}O_2$	168	0.10
9	11.173	Z,Z-4,16-Octadecadiene-1-ol acetate	$C_{20}H_{36}O_2$	308	0.16
10	11.273	5-Aminoimidazole-4-carboxylic acid, methyl ester.	$C_5H_7N_3O_2$	141	0.15
11	11.726	1,2-Benzenedicarboxylic acid, mono(2-ethylhexyl) ester	$C_{16}H_{22}O_4$	278	0.23
12	12.057	Z,Z-4,16-Octadecadien-1-ol acetate	$C_{20}H_{36}O_2$	308	0.34
13	12.286	Z,Z-4,16-Octadecadien-1-ol acetate	$C_{20}H_{36}O_2$	308	0.34
14	12.434	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	0.67
15	12.746	Spiro[androst-5-ene-17,1'-cyclobutan]-2'-one, 3-hydroxy-, (3β, 17β)	$C_{22}H_{32}O_2$	328	0.41
16	13.558	Oxacyclododecan-2-one	$C_{11}H_{20}O_2$	184	0.70
17	13.682	n-Hexadecanoic acid	$C_{16}H_{32}O_2$		10.20
18	14.581	Phytol	$C_{20}H_{40}O$	296	3.70
19	14.798	Methyl 5,9,21-octacosatrienoate	$C_{29}H_{52}O_2$	432	12.72
20	14.904	2,4,6,8-Tetramethyl-1-octacosanol	$C_{32}H_{66}O$	466	7.03
21	15.144	Triamcinolone acetonide	$C_{24}H_{31}FO_6$	434	3.41
22	15.837	Olean-12-en-3-one	$C_{30}H_{48}O$	424	4.70
23	15.933	Olean-12-en-3-one	$C_{30}H_{43}O$	424	4.19
24	16.279	9,19-Cyclo-9β-lanostane-3β,25-diol	$C_{30}H_{52}O_2$	444	7.93
25	16.532	Ergosta-7,22-dien-3-ol acetate (3β, 5α)	$C_{30}H_{48}O_2$	440	4.92
26	16.838	21-Methyl-17-isocholestane 16-[2-[formylthio]ethyl]-	$C_{30}H_{52}OS$	460	13.51
27	17.081	D:B-Friedo-B':A'-neogammacer-5-en-3-ol, (3β) (i.e Simiarenol)	$C_{30}H_{50}O$	426	8.19
28	17.284	Isocitronellol	$C_{10}H_{20}O$	156	1.43
29	17.689	9,19-Cyclolanostan-3-ol, 24-methylene-, (3β)-	$C_{31}H_{52}O$	440	10.66
30	19.967	α-Tocopherol	$C_{29}H_{50}O_2$	430	1.39
31	20.651	Cyclopentane, 1,1'-hexadecylidenebis-	$C_{26}H_{50}$	362	0.90

Source: Own findings.

These represented 47.09% of the compounds present in the lipophilic fraction. These compounds consists of a stanol ester, unsaturated fatty acid, a triterpene and a saturated fatty acid. Stanol esters are a heterogenous group of phytosterol esters with a saturated ring structure which are known to reduce the low density lipoprotein cholesterol when ingested [9]. n-Hexadecanoic acid has been reported to have activities like being antioxidant [12] which is about 68% antioxidant activity [8] as well as having cytotoxic activity [14], anti-inflammatory, anti spasmodic and antiviral [15]. 9,19-Cyclolanostan-3-ol, 24-methylene- (3β.) has been reported to have antimicrobial activity [18]. It has been reported that plant sterols and stanols are of good therapeutic options for the management of hypercholesterolemia [23] while triterpenes have been reported to have cytotoxic activity [24]. The presence of 21-methyl-17-isocholestane-16-[2-[formylthio]ethyl] which is a derivative of stanols, 9,19-Cyclolanostan-3-ol, 24-methylene- (3β.) which is a triterpene and n-Hexadecanoic acid a saturated fatty acid found in appreciable quantities therefore suggests the usefulness of *P. tunicatum* leaves in human nutrition.

Other compounds found in appreciable quantities include 2,4,6,8-Tetramethyl-1-octacosanol (7.03%), Olean -12-en-3-one (8.89%), 9, 19-cyclo-9β-lanostane-3β-20-diol (7.93%), D:B-Friedo-B':A'-neogammacer-5-en-3-ol, (3β)- (i.e Simiarenol) (8.19%). Results therefore indicated the presence of both tetracyclic and pentacyclic triterpenoids of dammarane, oleanane, cyclolartane and friedoursane type which constitutes about 36.08% of the compounds present in dichloromethane/methanol extract of *P. tunicatum* leaves. It has been reported that simiarenol is present in the root of *Rhododen rondayrium* and may have in vitro leishmanicidal activity against leishmania donovani promastigoes [4]. Some other compounds identified in this extract which has been reported to have positive health benefits include phytol (3.7%) and ∝ -tocopherol (ie vitamin E 1.39%). Phytol has been reported to have activities such as antimicrobial, anti-cancer, anti-inflammatory, anti-diuretic, immune-stimulatory and anti-diabetic activities [19]. There are four tocopherol isoforms namely ∝, β, γ,δ-tocopherols among which ∝-tocopherol was found in dichloromethane/methanol extract. It is known to have the highest vitamin E activity amongs the isoforms [6]. ∝ -Tocopherol has some biological activities such as being antioxidant, anti-inflammatory, anti microbial, radical scavenging and anti-spasmodic [19].

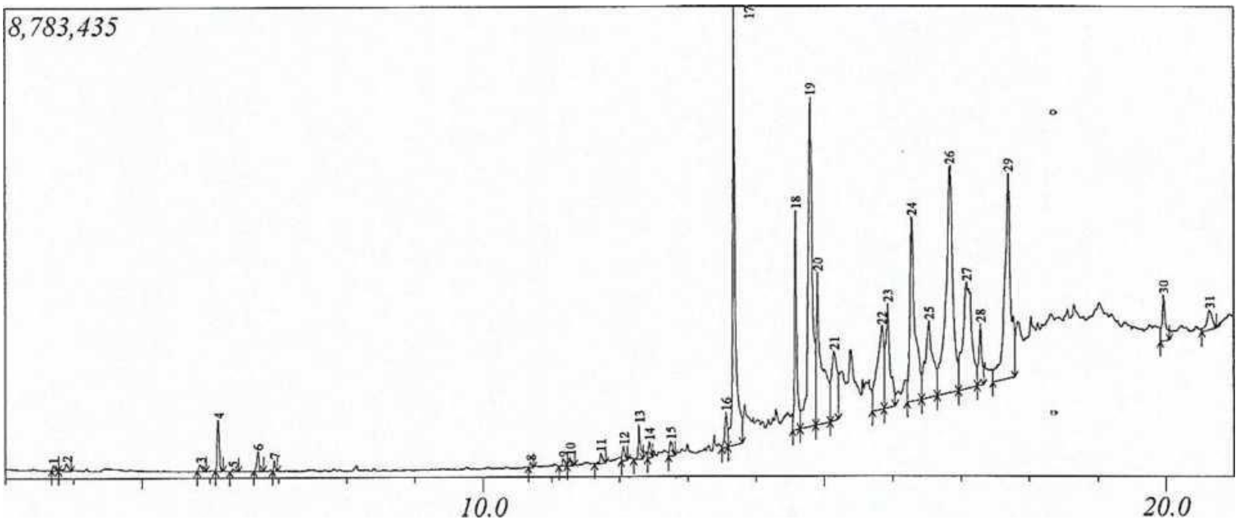


Fig. 1. Gas Chromatography- Mass Spectrometry Chromatogram of Dichloromethane-Methanol Extract of *Pseuderanthemum tunicatum* leaves.
Source: Own findings.

Table 2 shows results on compounds present in the methanol extract of *Pseuderanthemum tunicatum* leaves.The major compounds identified include 2, 5 – furandone, 3- methyl which had relative abundance of 14.01% and eluted as peak 4; 5-hydroxymethly furfural had a relative abundance of 13.27% and eluted as peak 15; n – hexadecanoic acid (i.e. palmitic acid) had a relative abundance of 11. 87% and eluted as peak 30 and 9-octadecenoic € (i.e. oleic acid) had a relative abundance of 12.25% and eluted as peak 34.

These constitute 51.40% of compounds present in the hydrophilic fraction of *P. tunicatum* leaves. 2, 5- furandione, 3 –methyl has been reported to have anti-cancer activity [15]. 5-hydroxy methyl furfural is a sugar derivative and is a heterocydic aldehyde widely present in foods. It is produced though the degradation of hexoses via Maillard reaction during heat treatment of foods containing reducing sugars and amino acids in an acid environment [25]. 5 – hydroxyl methyl furfural has been reported to increase enzyme activities such as superoxide dismutase and glutathione peroxidase as well as potential therapeutic agent for the treatment of Alzheimer's disease [13].

n-Hexadecanoic acid (i.e palmitic acid), 9-Octadecenoic acid (i.e oleic acid) and octadecanoic acid (i.e stearic acid) were the major fatty acids present in the methanol extract of *P. tunicatum* leaves.

Table 2. Bioactive compounds identified in Methanol extract of *Pseuderathernum tunicatum* leaves

Peak No	RT (mins)	Name of Compound	Molecular Formula	Molecular weight	Relative abundance (%)
1	3.382	1,3-Dioxan-5-ol,4,4,5 trimethyl	$C_7H_{14}O_3$	146	0.09
2	3.625	3-methoxy-3-methyl-tetrahydro-pyran-2-one	$C_7H_{12}O_3$	144	0.20
3	4.314	2-Furancarboxaldehyde, 5-methyl	$C_6H_6O_2$	110	0.16
4	4.932	2,5-Furandione, 3-methyl-	$C_5H_4O_3$	112	14.01
5	5.062	1H-Azonine, octahydro-1-nitroso-	$C_8H_{16}N_2O$	156	0.92
6	5.638	Butanedoic acid, monomethyl ester	$C_5H_8O_4$	132	0.45
7	5.806	2-Furancarboxylic acid, methyl ester	$C_6H_6O_3$	126	1.12
8	6.051	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	$C_6H_8O_4$	144	1.62
9	6.139	2(3H)-Furanone,5-ethyenyldihydro-5-methyl.	$C_7H_{10}O_2$	126	1.14
10	6.274	2,5-Furandione, dihydro-3-methylene	$C_5H_4O_3$	112	0.87
11	6.593	Heptanoic acid, 3-hydroxy-methyl ester.	$C_8H_{16}O$	160	0.17
12	6.783	Levoglucosenone	$C_6H_6O_3$	126	0.40
13	7.057	Butanedioic acid, methylene-, 4-methyl ester	$C_6H_8O_4$	144	1.56
14	7.205	1α, 2 α, 4α, 5β-cyclohexanetetrol	$C_6H_{12}O_4$	148	0.64
15	8.096	5-Hydroxymethyl furfural	$C_6H_6O_3$	126	13.27
16	9.900	1,3-Dioxolane, 4,5-diethenyl-2,2-dimethyl	$C_9H_{14}O_2$	154	9.01
17	10.056	2-Furanmethol	$C_5H_6O_2$	98	0.66
18	10.802	Citric acid, trimethyl ester	$C_9H_{14}O_7$	234	5.11
19	10.904	β-D-Glucopyranose-1,6-anhydro	$C_6H_{10}O_5$	162	2.28
20	11.212	Octanedioic	$C_8H_{14}O_4$	174	0.46
21	11.607	2-Hydroxypropane-1,2,3-tricarboxylic acid, dimethyl ester	$C_8H_{12}O_7$	220	4.71
22	11.685	Undecanoic acid	$C_{11}H_{22}O_2$	186	2.43
23	12.005	Nonanedioic acid	$C_9H_{16}O_4$	188	0.90
24	12.307	n-Tetradecanoic acid	$C_{14}H_{28}O_2$	228	1.97
25	12.956	9-undecenol-2,10-dimethyl	$C_{13}H_{26}O$	198	1.27
26	13.035	9-undecenol-2,10-dimethyl	$C_{13}H_{26}O$	198	0.47
27	13.000	Pentadecanoic acid	$C_{15}H_{30}O_2$	242	0.43
28	13.383	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270	0.36
29	13.578	cis-9-Hexadecenoic acid	$C_{16}H_{30}O_2$	254	2.24
30	13.723	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	11.87
31	14.107	Eicosanoic acid	$C_{20}H_{40}O_2$	312	0.37
32	14.304	Eicosanoic acid	$C_{20}H_{40}O_2$	312	0.75
33	14.488	6-Octadecenoic acid, methyl ester (Z)	$C_{19}H_{36}O_2$	296	0.80
34	14.823	9-Octadecenoic, (E)-	$C_{18}H_{34}O_2$	282	12.25
35	14.932	n-Octadecanoic acid	$C_{18}H_{36}O_2$	284	7.22
36	18.469	Hexadecanoic acid, (3-bromoprop-2-ynyl) ester	$C_{19}H_{33}BrO_2$	372	0.46
37	18.658	3α-(Trimethylsiloxy)cholest-5-ene	$C_{30}H_{54}OSi$	458	0.40

Source: Own findings.

They have been reported to have antioxidant activities. However, [8] reported n-hexadecanoic acid to have 68% antioxidant activity while 9-Octadecenoic acid has only moderate activity and n-Octadecanoic acid had poor antioxidant activity. Mostly identified compounds were ketones, dibasic acids, fatty acids, fatty acid esters, sterols, stanols, flavonoids, nitrogen compounds and triterpenoids. The polarity of the respective solvents played a major role to extract more specific compounds. This was confirmed by the isolation of phyto-compounds on polarity based extraction [22]. Dichloromethane methanol extracted more of sterols, stanols and triterpenoids while methanol extracted more of flavonoids, aldehydes, nitrogen compounds , fatty acids and fatty acid esters. It was observed that some compounds were common to both dichloromethane/methanol and methanol extracts of *P. tunicatum* leaves but in varied relative abundance. They are tretradecanoic acid (myristic acid) and n-Hexadecanoic acid (Palmitic acid).

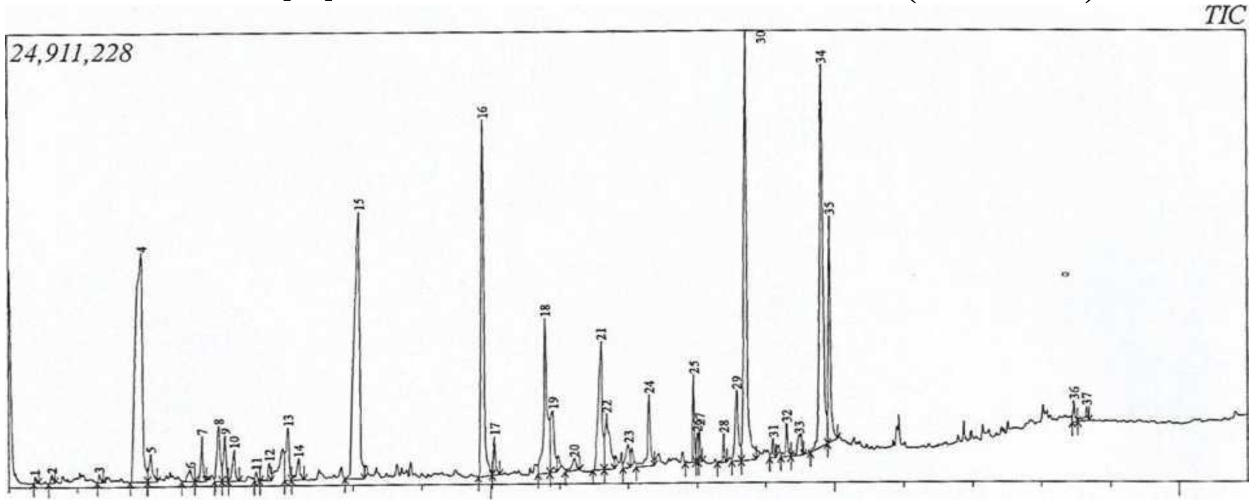


Fig. 2. Gas Chromatography- Mass Spectrometry - Chromatogram of Methanol Extract of *Pseuderanthemum tunicatum* leaves.
Source: Own findings.

CONCLUSIONS

In the present study 30 compounds from dichloromethane/methanol extract and 35 compounds from methanol extract were identified in *Psuederanthenum tunicatum* leaves. The polarity of solvents used for extraction resulted to variations in compounds extracted. The dichloromethane/methanol extract revealed that *P. tunicatum* leaves has good quantities of triterpenoids of the dammarane, oleanane, cyclolartane and friedoursane type. 21-methy 1-17 isocholestane – 16- [2-[formylthio] ethyl] which is a stanol was the most abundant compound in the dichloromethane/methanol extract while 2,5- furandienee – 3- methy (flavonoid) was the most abundant compound in the methanol extract of *P. tunicatum* leaves.

REFERENCES

[1]Achikanu, C.E., Eze-Steven, P.E., Ude, C.M., Ugwuokolie, O.C., 2013, Determination of the vitamin and mineral composition of common leafy vegetables in South-Eastern, Nigeria, Int. J. Curr. Microbiol. App. Sci, 2 (11): 347-353.

[2] Aghaire, P.O., Emoyan, O.O, 2012, Nutritional and antinutritional levels of some local vegetables from Delta State Nigeria, African Journal of Food Science, 6(1):8-11.

[3] Amaechi, N.C., Udeogu, E., Nwokafor, C.U., 2014, Nutrient, phytochemical and amino acid profile of Pseudarenthemum tunicatum leaves. International Journal of Applied Research and Technology, 3 (11):47-84.

[4] Aplin, R.T., Arthur, H.R., Hui, W.H., 1966, The structure of the triterpene simiarenol (a E:B-Friendothop-5-ene) from the Hong Kong species of Rhododendron simiarum. J. Chem. Soc. C.Org, 1:1251-1256.

[5] Burkill, H.M, 1985, Pseudarenthemum tunicatum: The useful plants of West Tropical Africa, Royal Botanic Gardens, Kew.

[6]Carretto, S., Nisi, R., Paradiso, A., Degara, L., 2009, Tocopherol production in plant cell culture, Free Radical Research, 43:527-597.

[7]Eswani, N., Abdkudus, K., Nazre, M., Awang-Noor, A.G., 2010, Medicinal plant diversity and vegetation analysis of logged over bill forest of Tekai Tembeling Forest Reserve, Jerantut, Pahang, Journal of Agricultural Science, 2: 189-210.

[8] Henry, G.E., Momin, R. A., Nair, M.G., Dewitt,

D.L, 2002 Antioxidant and cyclooxygenase activities of fatly acids found in food, Journal of Agric and Food Chemistry, 50: 2231-2234.

[9] Katan, M.B., Grundy, S.M., Jones, P., Law, M., Meittinen, T., Paoletti, R., 2003, Stresa workshop participants. Efficacy and safety of plant stanols and sterols in the management of blood cholesterol level. Mayo Clinic Proceedings, 78 (8): 965-978.

[10] Kathirvel, A., Sujatha, V., 2016, Phytochnemical studies antioxidant activities and identification of active compounds using GCMS of Dryopteris cochleate leaves, Arabian Journal of Chemistry, 9: S1435 – S1442.

[11] Khan, I., Jan, S.A., Shinwani, Z.K., Ali, M., Khan, V., 2017, Ethnobotany and medicinal uses of folklore medicinal plants belonging to family Acanthaceae: An updated review, MOJ Biol. Med., 1 (2): 00009.

[12]Lalitharani, S., Mohan, V.R., Regini, G.S., Kalidass, C., 2009, GCMS analysis of ethanolic extracts of Pothos scandens L. leaf, J. Herb Med. Toxicol., 3: 159-160.

[13] Liu, A., Zhao, X., Li., H., Liu., B., Mao, X., Guo, L., Bi, K., Jia Y., 2014, HMF, an antioxidant agent from Alpini oxyphylla (Mig) improves cognitive impairment in AB 1-42 mouse model of Alzheimer's diseases, Intern. Immunopharmacol, 23: 719-725.

[14]Lokesh, R., Kannabiran, K., 2017, Cytotoxic potential of n-Hexadecanoic acid extracted from Kigela pinnata leaves, Asian Journal of Cell Boilogy, 12(1): 20-27.

[15]Mohammed, G.J., AL- Jassani, M.J., Hameed, I.H., 2016, Antibacterial, antifungal activity and chemical analysis of Punica grantanum (Pomegranate peel) using GCMS and FTIR spectroscopy, International Journal of Pharmacognosy and Phytochemical Research, 8 (3):480-494.

[16]Ong, M.G., Yusuf, S.N.A.M., Lim, V, 2016, Pharmacognostic and antioxidant properties of Dracaena sanderiana leaves. Antioxidants, 5 (28), 9 pages.

[17] Orji, O.U, Ibiam, U. A., Uraku, A.J., Obasi, O.D., Aloke, C.E., Awole, J.N., 2017, Investigations of phytochemical and nutritional composition of Ruspolia hypocrateriformis leaf. IDOSR Journal of Applied Sciences, 2 (2): 7—81.

[18] Penduka, D., Buwa, L., Mayekiso, B., Basson, A.K., Okoh, A.I., 2014, Identification of the antilisterial constitutions of partially purified column chromatography fractions of Garcinia Kola seeds and their interactions with standard antibiotics, Evidence Based Complementary and Alternative Medicine. Article ID 850347, 8 pages.

[19]Raman, B.V., Sameul, L.A., Pardha, S.M., Narashimha, R.B., Naga, V. K. A., Sudhakar, M., Radhakrishnan, T.M., 2012, Antibacterial, antioxidant activity and gas chromatography- mass spectrometry analysis of Eupatorium odoratum, Asian Journal of Pharmaceutical and Clinical Research, 5 (2): 99-106.

[20] Sampson, J.H., Philipson, J.D., Bowery, N.G, O' Neili, M.J, Houston, J.G., Lewis, J.A., 2000, Ethnomedicinally selected plants as sources of potential analgesic compounds indication of in vitro biological activity in receptor binding assays, Phytotherapy Research, 14 (1): 24-29.

[21] Sasidharan, S., Chen T., Saravananm D., Sundram, K.M., Yogalatha, L., 2011, Extraction isolation and characterization of bioactive compounds from plants extracts. African Journal of Traditional complementary and Alternative medicine, 8 (1): 1-10.

[22] Shukla, R., Sharma, D.C., Pathak , N., Bajpai, P., 2016, Estimation of phytochemicals and in vitro antioxidant activity of different solvent extracts of Grewia asiatica fruit, Research and Reviews: Journal of Botanical sciences.

[23] Weingartner, O., Ulrich, C., Luljohann, D., Ismail K., Schirmer, S.H., Vanmierlo, T., Bohm, M., Laufs, U, 2011, Differential effects on inhibition of cholesterol absorption by plant stanol and plant sterol esters in apo E-1-mice, Cardiovascular Research, 90 (3): 484-492.

[24] Zhang, J., Yamada, S., Ogihara, E., Kurita, M., 2016, Biological activities of triterpenoids and phenolic compounds from Myrica cerifera bark, Chem. Biodivers, 13 (11): 1601-1609.

[25] Zhao L., Chen J., Su, J., Li, L., Hu, S., Li, I.B., Zhang, X., Xu, Z., Chen, T., 2013, In-vitro antioxidant and anti-proliferative activities of 5-hydroxymethylfurfural, Journal of Agriculture and Food Chemistry, 61 (44): 10604-10611.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CROPS VARIETIES UNDER CONSERVATION: STUDY CASE CULTIVATED *TRITICUM SSP.*

Maria-Mihaela ANTOFIE, Camelia SAND SAVA

University "Lucian Blaga" of Sibiu, Faculty of Agricultural Sciences, Food Engineering and Environment Protection, 7-9 Dr. Ioan Ratiu, 550012, Sibiu, Sibiu county Romania
E-mail: mihaela.antofie@ulbsibiu.ro, camelia.sand@ulbsibiu.ro

Abstract

The dynamic of crops domestication and use of edible wild plant species is well documented worldwide. The diversity of plant species used for food, changed during humankind history and lot of researchers pointed out the danger of species erosion that may negatively impact food security. The trade of crops is regulated at the international level and as a secondary effect is the promotion of new breed varieties. Today the scientific community is talking about neglected species and old varieties not eligible for trade and consequently removed from the today diet without taking into consideration the fact that their presence in the same agro-ecosystem for more than 50 years, increases their capacity to adapt to climate change effects. Therefore, huge efforts should be done to re-assessing our conservation strategies for breeding crops. At the European level it is already recognized the term "varieties under conservation", that allows members states to maintain old varieties and landraces under specific conditions. The scope of this article is to evaluate the official status of conservation of Triticum ssp. in our country by taking into account the history of cultivation and breeding programmes. At least 6 edible fossilized wheat species were found in human settlements for more than 6,000 years (i.e.: T. aestivum, T. dicoccoides, T. dicoccum, T. durum, T. monococcum and T. spelta). If einkorn and emmer wheat were common between Neolithic and Middle Age, today they are almost absent. Only six varieties of bread wheat are today officially recognized as "varieties under conservation", a series of more than 50 old varieties breed after 1927 being not yet officially recorded.

Key words: *breeding programme, on farm conservation, PGRFA. Romania Triticum ssp, varieties under conservation, wild crops relatives.*

INTRODUCTION

During humankind wild plant species have been domesticated for more than 10,000 years ago and the process continues today [16]. The authors also recorded a historical dynamic of plant species domestication, such as the entering and loses of plant genetic resources for food and agriculture or PGRFA. Different archaeological studies revealed the presence of fossilised crop seeds that have been used in the archaic human settlements, all over the world [11; 13; 23; 26], including the present territory of Romania [9]. Such evidences become more relevant when considering new strategic directives for agriculture development that is today under myriad of pressure factors [18]. Moreover, by taking into account the history of ecosystems regarding crops cultivation and current pressures associated to climate changes (i.e. short heavy rains, long-term drying conditions, diseases and pests breakouts) it is relevant to take into consideration food security for the country [7; 8]. Thus, a specific agro-ecosystem may act today like a living-gene-bank, by preserving all relevant genes of the species for supporting their continuous adaptation to environmental factors [13; 25]. By accessing the diversity of PGRFA in hot-spots of agro-biodiversity may give relevant clues for breeding strategies on one hand and applied agricultural management on the other hand [19]. Romania developed the research infrastructure for crops breeding in between the World Wars for all three historical provinces (Transylvania, Moldova and Walachia) and cereals were among the main research subjects. A continuous development in cereal breeding was achieved in Romania starting with 1927. After the Second World War, cereal breeding recognized another step towards its development [6]. After 1989 breeding cereals suffered some losses, especially in terms of capacity building by weakening the national system for ensuring the long-term development of cereal breeding programmes. Attention today is oriented towards "varieties under conservation" that are officially regulated for European Union countries such as the following: Directive 2008/62/EC (providing for certain derogations for acceptance of agricultural landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion and for marketing of seed and seed potatoes of those landraces and varieties), Directive 2009/145/EC (providing for certain derogations, for acceptance of vegetable landraces and varieties which have been traditionally grown in particular localities and regions and are threatened by genetic erosion and of vegetable varieties with no intrinsic value for commercial crop production but developed for growing under particular conditions and for marketing of seed of those landraces and varieties) and Directive 2010/60/EU (providing for certain derogations for marketing of fodder plant seed mixtures intended for use in the preservation of the natural environment). Under this term, it is regulated *on-farm* conservation of old crop varieties and landraces. This legal framework was developed as a direct result of crops erosion recording. Certain authors underlined the value of traditional crops for species genetic diversity and furthermore for their contribution to increasing biodiversity. Moreover, they recognized some 30 years ago the need to develop farmer's skills and capacity to manage in a dynamic manner the conservation of crops [25]. Such genetic resources will be essential for improving crops in a genomic era by ensuring the rapid access to the genome of a certain species associated to a country [17]. Thus, today in the European Union it is possible to promote both old crops as well as new breeds based on the implementation of Multilateral System under the Plant Treaty (i.e. International Treaty on Plant Genetic Resources for Food and Agriculture) as well as on official catalogues for plant varieties and hybrids. Romania started to publish such varieties after 2011 and by today there are listed six varieties for *Triticum* ssp. The scope of this article is to survey scientific and technical literature in order to evaluate the current relevance of wheat varieties recognized to be "under conservation" towards the future breeding programmes and for ensuring food security of the country.

MATERIALS AND METHODS

This article is based on a SWOT analysis of monographic papers or books and the official catalogues of Romanian plant varieties and hybrids, published between 1956 and 2017, regarding the long history cultivation of six wheat species such as: *Triticum aestivum* L. (bread wheat), *T. dicoccoides* (Körn. ex Asch. & Graebn.) Aarons., *T. dicoccum* Schübl. (emmer wheat), *T. durum* Desf., *T. monococcum* L. (einkorn) and *T. spelta* L. (spelt) [21]. Surveying UPOV database [20] and Gene Bank of Suceava [1] completed the current study.

RESULTS AND DISCUSSIONS

The six species, belonging to *Triticum* genus (i.e. *T aestivum*, *T. dicoccoides*, *T. dicoccum*, *T. durum*, *T. monococcum* and *T. spelta*), have been cultivated for a long time on the current territory of Romania and all of them may become valuable genetic resources for the future wheat breeding programme aside other 45 wild wheat relatives: *T. amyleum* Ser., *T. armeniacum* (Stolet.) Nevski & Nevski, *T. arras* Hochst., *T. arvense* Schreb., *T. biflorum* Brign., *T. campestre* Nyman, *T. caninum* L., *T. cereale* Asch., *T. compactum* Host, *T. cristatum* Schreb., *T. cylindricum* Ces., Pass. & Gibelli, *T. dicoccon* Schrank, *T. elongatum* Host, *T. farrum* Bayle-Bar., *T. fragile* Link, *T. glaucum* Desf., *T. hordeiforme* Host, *T. hybernum* L., *T. imbricatum* M.Bieb., *T. intermedium* Host, *T. junceum* L., *T. laevissimum* Habl.vel Hall. ex Steud., *T. latronum* Godr., *T. maritimum* L., *T. ovatum* Raspail, *T. panarmitanum* Bertol., *T. pectinatum* M.Bieb., *T. pinnatum* Moench, *T. polonicum* L., *T. prostratum* L.f., *T. repens* L., *T. rigidum* Schrad., *T. sativum* Lam., *T. sativum var. compactum* Hack., *T. secale* Link, *T. sepium* Lam., *T. siculum* Roem. & Schult., *T. silvestre* Asch. & Graebn., *T. subulatum* Banks & Sol., *T. trichophorum* Link, *T. turgidum* L., *T. turgidum L. subsp.*

pyramidale (Percival) Valdés & H.Scholz, *T. vaillantianum* Wulfen & Schreb., *T. villosum* (L.) M.Bieb. and *T. vulgare* Vill.) [5].

Neolithic cultivation of wheat species

Archaeological evidences regarding wheat cultivation in the today territory of the country, were proved down the Starčevo-Criș, Vinča and Boian civilizations [11; 22] or about 6,000 years B.C. that changed the wild Neolithic landscape inside the Carpathian Arche [5]. Based on a series of archaeological excavations it was proved the cultivation of four primitive wheat species such as: *T. monococcum* (einkorn), *T. spelta* (spelt), *T. dicoccum* (emmer wheat) and *T. aestivum* (bread wheat) based on fossils analysis in archaic human settlements [8]. As examples in Miercurea Sibiului, Sibiu county, the presence of einkorn and emmer wheat was proved and furthermore in the western part of the country (i.e. Banat region) bread wheat fossils were recorded. The first two species continue to be frequently identified after 3,000 years down the Coțofeni civilization (i.e. 80% by emmer and 20% by einkorn based on statistical estimations conducted by Ciută in 2009 [8]). Based on this author, gradually the bread wheat is covering more the archaic landscapes in the inner Carpathian arch and *T. dicoccoides*, spelt and *T. sativum var. compactum* Hack. were also recorded in human settlements. As a concluding remark it can be considered that at least 5 different species of *Triticum* (i.e. exception is *T. durum*, that was introduced later) have a long and continuous history of cultivation in this territory which makes them relevant for their future conservation and use in national breeding programmes for ensuring food security of the country.

The cultivation of wheat species during middle-age.

During the middle-age continues the cultivation of different species of *Triticum* especially the winter and spring wheat, as primitive cultivars. The politics of 18th century in Transylvania were also interested in recording the wheat leaf rust, relevant for the economy of villages [14]. Fiscal conscription of Transylvania is an economic recording book of all settlements. However, not all localities were described in the same manner, and that may be due to different persons in charge for recoding data from the field. Many localities from Transylvania were officially recorded for the cultivation of bread wheat, excepting those located in mountains. Instead, most localities were cultivating autumn wheat which was some time replaced in certain hilly-mountain areas with spring wheat or other cereals due to harsh conditions (i.e. long winter season). Also, almost half of localities were using both bread wheat varieties, and the production recorded for autumn wheat being almost all the time higher compared to the spring wheat. In certain cases, the officials are mentioning the cultivation of einkorn, especially for hilly-mountain areas (i.e. Presaca and Metiș villages from Sibiu county). However, in the mountain villages, not appropriate for good wheat production, the fiscal office is using the common term of grains (this includes all above mentioned cereals and more). This fiscal conscription is among the first type of official communication method that supported the cultivation of productive species and in this case bread wheat.

The cultivation of wheat species between the World Wars.

Continuing this analysis, the presence of all wheat species, mentioned before were also recorded before the second World War [6; 12].

The cultivation of wheat species after the Second Wold War.

The history of wheat breeding in Romania after 1970 were published by agronomists [8; 14, 24] and the famous silvic engineer Alexandru Beldie [5]. 158 wheat varieties are recorded under UPOV for Romania starting with 1981, proving a high interest for wheat breeding [20]. A summary of officially recorded varieties will be described below based on the type of wheat varieties.

(a)The status of cultivation of *Triticum aestivum* L.

The group of T. aestivum L. var. erythrospermum (Körn.) Velican.

Under this wheat botanical group have been created and placed on the Romanian market at least 32 old varieties such as (in alphabetical order): ‘A15’, ‘Banat’, ‘București 1’ (i.e. as a specific selection of hybrids resulted from ‘Kanred’ x ‘C.906’), ‘Cenad 117’ (i.e. an old wheat variety described in 1921, and possible extinct), ‘Cluj 11’ (i.e. result of continuous selection of a local population), ‘Cluj 650’, ‘Crimeea’, ‘Dacia’ (i.e. placed on the market in 1967 as a variety based on the hybridization between ‘București 1’ and ‘Skorospelska 3’), ‘Excelsior’ (i.e. placed on the market in 1966 as a variety based on the hybridization between ‘București 1’ and ‘Skorospelska 3’), ‘Favorit’ (i.e. placed on the market in 1966 as a variety based on the hybridization between ‘Odvos 241’ and ‘Bezostaia 4’), ‘golden Romanian wheat’, ‘Harrach’ (i.e. imported from Austria in 1958 as a hybridization based on the white wheat of ‘Tisa’ x ‘Carman Red’), ‘Moldova’ (i.e. placed on the market in 1966 as a variety based on the hybridization between ‘București 1’ and ‘Skorospelska 3’), ‘Nr. 301’ (i.e. imported from Bulgaria in 1954 based on a complex hybridization between ‘Nr. 16’, ‘Noe’, ‘Nr. 2010’ and ‘A 741’), ‘Ponca’ (i.e. imported in 1957 based on a complex hybridization between ‘Kawvale’, ‘Marquillo’ and ‘Tenmark’), ‘Skorospelska 3’ (i.e. imported in 1960 from Russia has in its history the hybridisation between ‘Kanred Fulcaster 266286’ and ‘Klein 33’), ‘Tisa’, ‘Triumph’ (i.e. imported in 1957 from USA with a complex hybridisation history based on: ‘Blackhull’, ‘Kanred’ and ‘Flovice’), ‘Turda 195’ (i.e. placed on the market in 1970 as a variety based on the hybridization between ‘ICA 440’ and ‘Skorospelka 3b’). ‘Delia’ was obtained in 1997 from a complex hybridization between ‘Fundulea 29’, ‘Lovrin 32’ and ‘Flamura 80’. Some results have been published by the National Agricultural Research and Development Institute (NARDI) Fundulea in 2010. Relevant wheat varieties such as ‘Dacia’, ‘Excelsior’, ‘Favorit’ and ‘Fundulea 29’ where considered as wheat height standard varieties [24]. Due to dryness of the climate after 1980 the breeding strategy was oriented to semi-dwarf varieties creation (i.e. ‘Flamura 85’, ‘Fundulea 4’ and ‘Dropia’) followed by other six cultivars: ‘Ardeal’, ‘Boema’, ‘Delabrad’, ‘Faur’, ‘Glosa’ and ‘Gruia’ [23].

The group of T. aestivum L. var. ferrugineum (Alef.) Velican

This group was cultivated mainly in Transylvania and Moldova, known under different toponymies. Relevant is ‘Târgu Frumos 16’ a cultivar for Moldova region [23].

The group of T. aestivum L. var. lutescens (Alef.) Velican,

This group was cultivated during 1970 as the following 10 varieties in alphabetical order: ‘Aurora’ (i.e. imported in 1968 from Russia as a variety based on the hybridization between ‘Lutescens 314 h 147’ and ‘Bezostaia 1’), ‘Bezostaia 1’ (i.e. imported from Russia in 1960 and created by the former Krasnodar Agricultural Research Institute, currently the National Grain Center. P. P. Lukyanenko), ‘Caracal 277’ (i.e. placed on the market in 1969 as a variety based on the hybridization between ‘Bezostaia 1’ and ‘Arnăut 048’), ‘Kaukaz’ (i.e. imported in 1968 from Russia as a variety based on the hybridization between ‘Lutescens 314 h 147’ and ‘Bezostaia 1’), ‘Lovrin 10’ (i.e. placed on the market in 1969 as a variety based on complex hybridization between ‘Abondanza’, ‘Triumph’ and ‘Bezostaia 1’), ‘Lovrin 231’ (i.e. placed on the market in 1969 as a variety based on the hybridization between ‘Bezostaia 1’ and ‘Fiorello’), ‘Măgurele 7’ (i.e. placed on the market in 1970 as a variety based on the hybridization between ‘Marquis’ and ‘Bankut 1201’ as a winter wheat), ‘Marquis’ and ‘Selkirk’ [23]. It is added to this a local population ‘Ulca’ [5].

The group of T. aestivum L. var. milturum (Alef.) Velica

Varieties belonging to this group are not very often cultivated in Romania. However, ‘Libelulla’ was imported in 1970 from Italy as a variety based on the complex hybridization between ‘Tevere’, ‘Giuliari’, ‘1482-54-3’ and ‘San Pastore’ [23].

T. aestivum as varieties under conservation for 2017

By analysing the Official catalogue for 2017 six varieties of *Triticum ssp.* have been officially recognized for their importance as conservation varieties. ‘Beti PI’ belongs to *T.*

aestivum L. var. *erythrospermum* and it was obtained after a complex hybridization based on varieties 'PI-2433-89' and 'F-141', being placed on the market in 2004 [15]. Since 2009 it is recorded as a conservation variety. This variety is developed in Iași as a winter wheat [15] and appropriate for bread production [10]. 'Eliana' is another autumn wheat variety that belongs to the same group of varieties, recommended for the southern part of Moldavia [2] (i.e. dry weather conditions) aside 'Gasparom', 'Pădureni', 'Romulus LV' and 'Șimnic 30'.

(b)The status of cultivation of *Triticum diccocoides* (Körn. ex Asch. & Graebn.) Aarons. The presence of this species is recorded from Neolithic up to last century and appears to disappear after 1960 [5]. There is no varieties or local populations officially registered as variety under conservation

(c)The status of cultivation of *Triticum dicoccum* Schübl. Different local populations were recorded to be cultivated in all our country after the 50th but disappeared after 1960 [5]. There is no varieties or local populations officially registered as variety under conservation.

(d)The status of cultivation of *Triticum durum* Desf. This species was not extensively cultivated currently and based on the UPOV data base there are officially registered 8 varieties starting with 'Pandur' in 1996 [20]. Varieties of this species are cultivated mainly in the South and East part of the country. It is not present into the collections of Gene Bank of Suceava [1] and either as varieties under conservation.

(e)The status of cultivation of *Triticum monococcum* L. The distribution of this species before 1950 was mainly recorded in Transylvania being cultivated in small plots in hilly-mountain areas of the following counties: Maramureș, Bistrița-Năsăud, Mureș, Sălaj, Bihor, Cluj, Alba, Hunedoara and Sibiu being highly resistant against wheat leaf rust and powdery mildew. [6]. There is no varieties or local populations registered as variety under conservation.

(f)The status of cultivation of *Triticum spelta* L. Different local populations were cultivated up 1950 and officially disappeared after 1960. Today it is used as a demonstrative field crop in the research stations together with *T. polonicum* and present in the grasslands [5].

Wheat species into national ex situ collections
The Genebank Suceava covers 153 entries for *T aestivum*, 27 of *T monococcum* and 4 of *T turgidum* [1]. However, there are no denominations regarding potential variety similarities.

Ex situ collections exists in several research stations (i.e. Agricultural Research and Development Institute Fundulea, Agricultural Research and Development Station Turda, Agricultural Research and Development Station Suceava, Agricultural Research and Development Station Simnic, Agricultural Research and Development Station Podu Iloaie and Banatului University of Timișoara) but there is not direct connectivity to the portal of Multilateral System for fully ensuring the access to genetic resources.

CONCLUSIONS

Varieties under conservation are meant to maintain their *on-farm* cultivation based on legal requirements. Their *on-farm* maintenance will contribute to traditional knowledge development (i.e. regarding seeds selection, cultivation, storage and use). Romania is a very rich country in terms of agro-biodiversity habitats and therefore the number of varieties under conservation should fit this diversity.

In this article over 50 varieties are described as relevant for our country history in cultivating *Triticum ssp.* Theoretically, all of them may represent a living-genetic-library that incorporates important heredity features for future breeding programmes. Some of the mentioned varieties are extinct or may become extinct (e.g. Cenad varieties) [4]. For others it was proved that they are key varieties for wheat breeding programme for their resistance towards diseases or pests, or productivity or nutritional values. Only six officially recognized varieties under conservation will not support the maintenance *on-farm* of wheat species germplasm. Moreover, by preserving these varieties they should be available for being accessed into the Multilateral System too. The national wheat breeding programme needs for the future to take into consideration *ex situ* and *on-farm* collections as well as crops wild relatives.

ACKNOWLEDGMENTS

This paper was supported by the Research Center for Agricultural Sciences and Environmental Protection of the University Lucian Blaga from Sibiu.

REFERENCES

[1]Banca de Resurse Genetice Vegetale Suceava, http://www.svgenebank.ro/, Accessed on 11 Feb. 2018.
[2] Caracterizarea soiurilor de grâu create la S.C.D.A. Podu Iloaiei, MADR, http://www.madr.ro/docs/cercetare/Rezultate_activitate_de_cercetare/SCDA_Podu_Iloaiei.pdf, Accessed on 11 Feb. 2018.
[3] Bailey, D.W., Andreescu, R., Thissen, L., Howard, A., Macklin, M, Haită, C., Mills, S., 2004, Landscape archaeology of Neolithic southcentral Romania: aims, methods and preliminary results of the Southern Romania Archaeological Project. SCIVA, Bucureşti, 52: 3-40.
[4]Baiski, D., 2015, Cenad - Studii monografice - Ediția a II-a, Editura ArtPress, Timișoara, 380 p
[5]Beldie, A., 1977, Flora Republicii Socialiste România. [București] Editura Academiei Republicii Populare Române, Vol V (1952-1976).
[6]Borza, A., 1945, L'alac (engrain, Triticum monococcum) chez les roumains. Étude botanique et d'histoire culturelle. Sibiu, Roumania, Centru de studii si cercetări privitoare la Transilvania.
[7]Ceccarelli, S., Grando, S., Maatougui, M., Michael, M., Slash, M., Haghparast, R., Labdi, M., 2010, Plant breeding and climate changes. The Journal of Agricultural Science, 148(6): 627-637.
[8]Chakrabortya, S., Newtonb, A.C., 2010, Climate change, plant diseases and food security: an overview. Plant Pathology, 60: 2-14.
[9]Ciută, B., 2009, Cultivarea plantelor în pre-şi protoistoria bazinului intracarpatic din România: analize statistice și spațiale efectuate asupra macroresturilor vegetale, Editura Altip-Alba Iulia, 2009.
[10]Cojocaru, R., Ghiţău, C.S., 2010, The yield of varieties winter wheat grown under environmental conditions of Moldavian plain. Lucrări Științifice, Universitatea de Stiinte Agricole Și Medicină Veterinară" Ion Ionescu de la Brad" Iași, Seria Agronomie, 53(1): 191-194.
[11]Comsa, E., 1985, Le rôle tenu par les Carpates orientales et méridionales à l'époque néolithique. Acta Archaeologica Carpathica Krakow, 24: 5-20.
[12]Damian, M., 2014, Tendinţe agricole interbelice eferitoare la Clisura Dunării în viziunea lui Alexandru Moisi. Banatica, 24(2): 509-518.
[13]Gunda, B., 1983, Cultural ecology of old cultivated plants in the Carpathian area. Ethnologia Europaea, 13 (2): 145–179.
[14]Gyémánt, L., Câmpeanu, R., Dörner, A.E., Mureșan, F.V., 2009, Conscripția fiscală a Transilvaniei din anul 1750: Descrierea localităților conscrise. Editura Enciclopedică Cluj Napoca.
[15]Ioan, I., Ciolpan, G., 2004, Soiul de grâu comun de toamna Beti - Variety Beti of wheat autumn, Lucrări științifice seria Agrocomie, 47: 145-156.
[16]Khoshbakht, K., Hammer, K., 2010, Threatened crop species diversity. Shahid Behesti University Press.
[17]Khush, G.S., 2001, Green revolution: the way forward. Nature Reviews Genetics, 2(10): 815-819.
[18] McDonald, B.A., Linde, C., 2002, The population genetics of plant pathogens and breeding strategies for durable resistance. Euphytica, 124(2): 163-180.
[19]Ortolani, L., Bocci, R., Bàrberi, P., Howlett, S., Chable, V., 2017, Changes in Knowledge Management Strategies Can Support Emerging Innovative Actors in Organic Agriculture: The Case of Participatory Plant Breeding in Europe. Organic Farming, 3(1): 20-33.
[20]PLUTO: Plant Variety Database, https://www3.wipo.int/pluto/user/en/index.jsp#, Accessed on 11 Feb. 2018
[21]The International Plant Names Index (IPNI), http://www.ipni.org/, Accessed on 11 Feb. 2018
[22]Tonkov, S., Marinova, E., Filipova-Marinova, M., Bozilova, E., 2014, Holocene palaeoecology and human–environmental interactions at the coastal Black Sea Lake Durankulak, northeastern Bulgaria. Quaternary International, 328: 277-286.
[23]Torje, D., Popescu, S., Dumitrache, V., Nica, A., Dascălu, A., Pop, E.C., Percialhi, G., 1972, Soiurile de plante agricole cultivate în România, Ed. Ceres, București 395 p.
[24] Verzea, M., 2007, Fifty years of breeding in field crops, at the National Agricultural Research and Development Institute Fundulea, Romania. Romanian Agricultural Research, 24: 1-6.
[25] Wood, D., Lenne, J.M., 1997, The conservation of agrobiodiversity *on-farm*: questioning the emerging paradigm. Biodiversity & Conservation, 6(1): 109-129.
[26]Zohary, D., Hopf, M., Weiss, E., 2012, Domestication of Plants in the Old World: The origin and spread of domesticated plants in Southwest Asia, Europe, and the Mediterranean Basin. Oxford University Press.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CONSTRAINTS TO ADOPTION AND UTILIZATION OF CASSAVA PRODUCTION TECHNOLOGIES AMONG FARMERS IN IMO STAE, NIGERIA

Chidinma Gladys ANYANWU

Michael Okpara University of Agriculture Department of Rural Sociology and Extension Umudike, Abia State, Nigeria, chidexg@yahoo.com

Corresponding author: chidexg@yahoo.com

Abstract

The study analyzed cassava farmers' adoption and utilization of cassava production technologies in Imo State, Nigeria. Purposive and multi-stage random sampling techniques were used to select one hundred and twenty (120) cassava farmers. Data were collected through a structured questionnaire and analyzed with descriptive statistics such as: frequency counts, mean scores and percentages. The result revealed that 60% of the respondents were males, with mean ages of 51.2 years, 35% acquired secondary education, mean farming experience of 26.7 years, mean annual farm income of ₦278, 275.00 and extension contact ($\bar{X}$= 2.2) times in a month. Result reveals that farmers adopted cassava agronomic practices as; improved cassava cuttings ($\bar{X}$=4.7), ridge/mound making technologies practices ($\bar{X}$= 4.6), site selection /land clearing and weeding interval technologies ($\bar{X}$= 4.3), pest and disease control ($\bar{X}$=4.2) and planting dates and time of harvest ($\bar{X}$=3.9) with a grand mean adoption score of 4.3. The farmers also adopted intercrop technologies as; cassava/maize/egusi ($\bar{X}$=4.3) and cassava/maize/telferia and cassava value addition ($\bar{X}$=4.2) with a grand mean adoption of 3.4. The levels of utilization of cassava production technologies on agronomic practices indicate that the respondents utilized site selection/land clearing and ridge/mound making ($\bar{X}$=2.8), improved cassava cuttings, fertilizer application and weeding technologies ($\bar{X}$=2.7) and pest and disease control and planting spacing ($\bar{X}$=2.4) with grand mean utilization score of 2.6. The farmers also utilized intercrop technologies as; cassava/maize/egusi technologies ($\bar{X}$=2.9), cassava value addition technologies ($\bar{X}$=2.5) with grand mean utilization score of 2.1. High wage rate, lack of credit, technology attributes, inadequate land and pest and diseases infestation were serious constraints affecting adoption and utilization of cassava production technologies. Increased extension contact, access on improved varieties and subsidy on farm inputs were advocated for adoption and utilization of cassava production technologies in the study area.

Key words**:** *constraints, adoption, utilization, cassava, technologies*

INTRODUCTION

Cassava, *Manihot esculenta (crantz)*, is a perennial woody shrub with an edible root, which grows in tropical and subtropical areas of the world. It can tolerate drought and can grow in low-nutrients soils. In Africa, cassava provides a basic daily source of dietary energy, it roots are processed into a wide variety of granules, pastes, flours and among others; or consumed when freshly boiled [14]. Cassava often referred to as "poor man crop" produces acceptable yields on poor depleted soils where other crops will yield virtually nothing; therefore it can be used to take advantage of marginal soils [3]. The Federal Government of Nigeria, recognizing the need to develop agricultural innovations that are appropriate to the Nigerian environment, has set up a number of agricultural related research institutes to develop innovations appropriate to crops and animal husbandry in different ecological zones in Nigeria [9].The agricultural scientists in research institutes as well as the universities have been concerned about demonstrating that their innovations actually work and that their improved crop varieties out-yields local varieties and their new methods of farming is far better than the traditional methods of farming. Little or no efforts have been made by the researchers to investigate how their innovations are compatible with the farmer's social and economic environment. [10] recommends the incorporation of social and economic assessment into evaluations of agricultural innovations and the results of the assessment should be taken into consideration before agricultural innovations are recommended to farmers for acceptance. According to [5], the factors related to determinants of adoption and utilization (financial, times and resources) and the complexity, visibility, profitability, divisibility, and the extent the innovation can be adopted in components, compatibility, agreeability to the existing culture, utility and group action. Adaptability and appropriateness of a technology determine its adoption.

The level of adoption of new technologies may be influenced by factors such as effectiveness of the extension agencies, net value of technology, economic strength and educational status of farmers, integrated package of farm support measure, age of farmers and size of holdings [11]. This calls for improved cassava farming technologies and other information needed for improved production level. According to [2], the following recommended cassava production technologies have been developed and disseminated over the years in Nigeria are; Improved cassava varieties that are low in HCN levels and resistant to various diseases, Plastic mulch for nursery, Plant population density of 10,000 plants/ha, fertilizer application NPK 15:15:15, intercrop cassava with component arable crops, maize or cowpea, and spacing: 0.9 m x 0.9 or 1 m x 1 m. Others include; planting date: cassava can be planted alone from April to October but July gives best yield in rain forest zones. When planted with maize, it should be dome in early march or April. If intercrop with cowpea, planting should be done in July or August, weed control (early weeding at least twice 30 days after planting), herbicides application (Flumetoron or Diuron at 2.0 mg/ha (pre-emergence) and use of pesticides (Aldrin, Carbuforan or Nuvacron).

The International Institute for Tropical Agriculture (IITA) and National Root Crop Research Institute Umudike has also played a leading role in the development of improved cassava varieties which are disease and pest resistant, low in cyanide content, drought resistant, early maturing, and high yielding. The improved varieties have been introduced throughout Africa's cassava belt. Varieties with resistance to the major diseases give sustained yield of about 50% more than the local ones. Today, 60% of the area cropped with cassava in Nigeria is planted with improved varieties and Nigeria is the current world leader in cassava production [16]. Despite the effort by these organizations in the development of these cassava recommended production technologies in the state, it is not certain whether the farmers efficiently adopted and utilized these technologies let alone its adoption and use.

The objectives of the study were to:

(i)describe selected socio-economic characteristics of farmers in the study area.

(ii)ascertain the respondents levels of adoption of cassava production technologies in the study area.

(iii)ascertain the respondents level of utilization of cassava production technologies in the study area.

(iv)identify constraints to adoption and utilization of production technologies by farmers in the study area.

MATERIALS AND METHODS

The study was carried out in Imo State. The state lies within latitudes 40 45'N and 70 15'N, and longitude 60 50'E and 70 25'E. It occupies the area between the lower River Niger and the upper and middle Imo River. The state is bounded on the North by Anambra State, while Rivers state lies to the South. It is also bounded to the West by River Niger and Delta state and to East by Abia state. The state is located within the rainforest belt of Nigeria, and the temperature ranges between 20^{o} C and 30^{o} C. Agriculture is the major occupation of the people. The major food produced includes cassava, yam, cocoyam, maize, and melon. Imo state is made up of 27 Local Government Areas (LGAs) and three Agricultural zones of Okigwe, Owerri and Orlu [7]. The population for this study comprised all the cassava farmers in the three agricultural zones of the state. Purposive and multistage random sampling techniques were adopted in the study. Purposive sampling was used to select Agricultural Development Programme contact farmers who were involved in cassava cultivation were chosen for the study. First, the three agricultural zones that make up Imo state namely; Owerri, Orlu and Okigwe were selected for the study. Two blocks each were randomly selected from the three agricultural zones to give a total of 6 blocks (Owerri – Owerri North and Owerri South blocks: Orlu – Orlu and Nkwerre blocks and Okigwe – Obowo and Isiukwuato blocks). Also, 2 circles each were randomly selected from the selected blocks which gave a total of 12 circles. Finally, ten cassava farmers each were randomly selected from each of the selected circles to give a sample size of 120 cassava farmers. Descriptive statistics such as frequency counts, percentages and means were used to analyze objective i, ii and iii, while the hypothesis was tested with Z - test analysis.

Measurement of variables

(i) The levels of adoption cassava production technology among famers in the study area were achieved using adoption scale analysis. A 5-point type Likert scale of; Aware = 1; Interest = 2; Evaluation = 3; Trial = 4; Accept= 5 was used. Farmers with adoption score of 3.0 and above were regarded as having reached mean adoption score of technology and below at any level of adoption.

Decision Rule

1.0 – 1.49 = Awareness stage of the technology.

1.50 – 1.99 = Interest stage of the technology.

2.0 – 2.49 = Evaluation stage of the technology.

2.50 – 2.99 = Trial stage of the technology.

3.0 and above = Adoption of the technology.

(ii) The levels of utilization of cassava intercrop technologies was captured using a 3-point Likert type rating scale namely; always=3, occasionally = 2 and never = 1. The bench mark was obtained thus; 3+2+1 = 6 divided by 3 to give 2.0

The following decision rule was obtained

1.00- 1.50 (low)

1.51- 1.99 (moderate)

2.0 and above (high)

(iii) Constraints to adoption and use of production technologies by farmers in the study area were rated on a 4-point Likert type scale "High constraints" = 4: "Medium constraint" =3: "Low constraint" =2: and "No constraint" =1: The mean score is derived by adding 4+3+2+1=10 and dividing by 4 to give 2.5The mean of the response values which is 2.5 was used as the cutoff point. Thus constraints with mean score of 2.5 and above were considered serious while those with mean score below 2.5 are not serious constraints.

RESULTS AND DISCUSSIONS

Selected Socio-economic Characteristics of Farmers

The socio-economic characteristics of respondents are shown in Table 1. The result showed that most (60%) of the respondents were females. This infers that cassava farming dominated by females in the study area and is in tandem with the findings [1]. The result indicates that 30.17% of the farmers fell within the age bracket of 50 – 60 years with mean ages of 51.2 years. The implication of this result is that older farmers dominate cassava production in Imo state and this makes them not to be receptive to new innovations especially in cassava production technologies. This result is in agreement with Asadu [4] that cassava farming is dominated by older farmers in Enugu state, Nigeria. The mean farming experience for the farmers was 26.7 years. Farming experience has shown to enhance participation and adoption of improved farming practices by farmers thereby assuring farmers decision on technology utilization [13]. The result shows that 35% of the respondents acquired secondary education. [15] noted that education will enhance the adoption of modern farm technologies thereby increase in production. The result reveals that farmers had 2.2 contacts with extension in a month. The mean annual farm income of the respondents was ₦278,275.00. The income levels of the farmers depend largely on the enterprise combination and farm size. Extension contact enhances farmers' production through adoption and utilization of agricultural innovations.

Table 1. Distribution of Respondents according to Socio-economic Characteristics

Variables	Frequency	Percentage
Gender		
Male	49	40
Female	71	60
Age (years)		
20 – 30	6	5.00
31 – 40	15	12.50
41 – 50	32	26.67
51 – 60	47	30.17
61 – 70	20	16.66
Mean		**51.2**
Education (years)		
No formal Education	10	8.33
Primary Education	42	34.17
Secondary Education	41	35.00
Tertiary Education	27	22.50
Farming Experience (years)		
1 - 10	18	15.00
11 - 20	25	20.83
21 - 30	53	41.67
31 - 40	27	22.50
Mean		**26.67**
Farm Size (hectares)		
0.1 – 1.0	44	36.67
1.1 – 2.0	62	51.67
2.1 – 3.0	8	6.66
Mean		**2.6**
Annual Farm Income (₦)		
50,000 – 150, 000	11	9.19
151,000 – 250, 000	13	19.83
351, 000 – 450, 000	78	65.00
251,000 – 350,000	11	9.97
451, 000 – 550, 000	7	5.83
Mean		**278, 275.83**
Extension Contact (numbers)		
1 – 2	55	45.83
3 – 4	29	25.84
No Contact	34	28.33
Mean		**2.2**

Source: Field Survey, 2015
IUSD = 175 Nigeria Naira (NGN) @ time of the Research

Levels of Adoption of Cassava Production Technologies

Result in Table 2 shows levels of adoption of agronomic practices and technology components/intercrop of cassava production technologies in the study area. The result indicates that the respondents adopted improved cassava cuttings and ridge/mound making technologies practices with mean scores of 4.7 and 4.6 respectively. Also, site selection and fertilizer application ($\bar{X}$=4.4), site selection/land clearing and weeding interval technologies ($\bar{X}$= 4.3) and pest and disease control ($\bar{X}$=4.2) were adopted by the farmers as against planting dates and time of harvest (3.9) with a mean adoption score of 3.4 indicating high adoption of the technology. For cassava intercrop combination technologies, the farmers adopted Cassava/maize/*egusi* ($\bar{X}$=4.3) and cassava/maize/*telferia* and cassava value addition ($\bar{X}$=4.2) respectively. Furthermore, the respondents assert that cassava/maize single alternate row ($\bar{X}$=2.9) and cassava/maize/sweet potatoes ($\bar{X}$=2.8) were at the trial stages of adoption while, cassava/maize double alternate row ($\bar{X}$=2.1) were at the evaluation stages of adoption. The mean adoption scores for technology components/intercrop was 3.4 indicating high adoption. Adoption of improved production practices by farmers leads to improved yields of crops. Studies have shown positive correlation between adoption of extension recommendations by farmers and crop yields which translate into increased income and improved quality of life of farmers [3].

Table 2. Distribution of Respondents according to their Levels of Adoption of Cassava Production Technologies

Cassava Production Technologies	Mean Adoption Score
Agronomic Practices	
Site selection/ land clearing	4.4
Ridge/mound making	4.6
Use of improved cassava cutting	4.7
Planting date and spacing (1m x 1m at angle 45^0)	3.9
Fertilizer application	4.4
Pest and disease control	4.2
Weeding interval	4.3
Grand Mean	4.3
Intercrop combination	
Cassava/maize/*egusi*	4.3
Cassava/maize/*telferia*	4.2
Cassava/maize/sweet potato	2.8
Cassava/maize single alternate row	2.9
Cassava/maize double altérante row	2.1
Cassava value addition technologies	4.2
Grand Mean	3.4

Source: Field Survey, 2015

Levels of Utilization of Cassava Production Technologies

The distribution of respondents according to levels of utilization of cassava production technologies is shown in Table 3. The utilization of cassava production technologies is grouped into agronomic practices and technology components/intercrop. The result indicate that farmers utilized site selection/land clearing and ridge/mound making with mean scores of 2.8 respectively. Again, the respondents utilized improved cassava cuttings, fertilizer application and weeding technologies respectively with mean score 2.7. Furthermore, the farmers utilized pest and disease control and planting spacing with mean ratings of 2.4. The grand mean utilization score for agronomic practices was 2.6, indicating that the technologies were highly utilized.

Table 3. Distribution of Respondents according to levels of Utilization of Cassava Production Technologies

Cassava Production Technologies	Mean Utilization Score
Agronomic practices	
Site selection/ land clearing	2.8
Ridge/mound making	2.8
Use of improved cassava cutting	2.7
Planting date and spacing (1m x 1m at angle 45^0)	2.4
Fertilizer application	2.7
Pest and disease control	2.4
Weeding interval	2.7
Time of harvest	2.5
Grand Mean	**2.6**
Technology Components/Intercrop	
Cassava/maize/*egusi*	2.6
Cassava/maize/*telferia*	2.9
Cassava/maize/sweet potato	1.7
Cassava/maize single alternate row	1.8
Cassava/maize double alternate row	1.3
Cassava value addition technologies	2.5
Grand mean	**2.1**

Source: Field survey, 2015

On technology components/intercrop, farmers utilized cassava/maize/*egusi* technologies with mean score of 2.9, and cassava value addition technologies ($\bar{X}$=2.5). The grand mean ($\bar{X}$= 2.1) shows that the technologies were utilized. The high utilization of these technology may be due to the extensively cultivation of cassava as an annual crop in tropical and sub-tropical regions for its edible starchy tuber roots. According to [6], cassava is the third largest source of carbohydrates for meal in the world. Its high resilience and adaptability to a wide range of ecological conditions has sustained its production through many generations in sub-Saharan African. The adoption of these packages may be due to the marketing potentials the products possess when processed.

Constraints to Adoption and Use of Cassava Production Technologies

Result in Table 4 shows the mean scores of constraints to adoption and utilization of cassava production technologies in the study area. Result reveals that high wage rate ($\bar{X}$=3.8) and $\bar{X}$= 3.7 for adoption and utilization of cassava production technologies were serious constraints. However, lack of credit (($\bar{X}$= 3.8 and $\bar{X}$= 3.5) constrained utilization and adoption of cassava production technologies respectively, inadequate land ($\bar{X}$=3.7 and $\bar{X}$=3.3), technology attributes ($\bar{X}$= 3.6 and $\bar{X}$= 3.5) and poor extension contact ($\bar{X}$=3.3 and $\bar{X}$=2.7), inadequate land (($\bar{X}$= 3.3), pest and diseases ($\bar{X}$= 3.2) were also serious constraints to adoption and utilization of cassava production technologies in the study area. [8] in his study of community-based farmers involved in Abia and Cross River States identified these serious constraints as affecting arable crop production.

Table 4. Distribution of Respondents according to Constraints to Adoption and Utilization of Cassava Production Technologies among Farmers in the Study Area

Constraints	Mean Adoption	Mean Utilization
Inadequate land	3.7*	3.3*
Lack of farm credit	3.5*	3.8*
Disease and pest infestation	3.2*	3.2*
Marketing problems	3.0*	2.6*
Poor extension contact	3.3*	2.7*
Attributes of technology	3.6*	3.5*
High wages of labour	3.8*	3.7*
Poor income from cassava farming	2.9	2.4
Illiteracy	2.8	2.4
Gender sensitiveness of the technology	2.9	2.4

Source: Field Survey 2015
*Constraint

Improper packaging of research results thus leading to misinterpretations, release of vague technologically not feasible, economically unviable and culturally incompatible technologies in existing farming systems as factors impeding cassava production in the study area [12].

CONCLUSIONS

Results show that there was high adoption and utilization of cassava production technologies among farmers in the study area. High wage rate, lack of credit, technology attributes, inadequate land and pest and diseases infestation were serious constraints affecting adoption and utilization of cassava production technologies in the study area. The study therefore recommends; intensive extension campaign on adoption and utilization of cassava production technologies, provision and access and subsidy of improved varieties and inputs, while technologies that are at the trial stages need to be properly demonstrated by extension agents to facilitate adoption and utilization.

REFERENCES

[1]Adegbite, D. A., Oloruntoba, O. A., Adubi, K. O., Sobanke, S. B., 2008, Impact of National Fadama Development Project II on Small Scale Farmers Income in Ogun State. Implications for Agricultural Financing in Nigeria. Journal of Sustainable Development in Africa, 10(3) 20 - 28.

[2] Ajeih, P. C., 2014, Adoption of Improved Cassava production and processing technologies in Oshimili North Local Government Area of Delta State. African Journal of Agricultural Extension, 3(2):15-22.

[3]Alabi, O. O., Alabi, O. A., 2002, Economics of Cassava Production in Kogi State. A Case Study of Yagba West LGA of Kogi State, Nigeria. Savannah Journal of Science and Agriculture, 1(1): 105 – 109.

[4]Asadu, A.N., Agwu, A.E., Chah, J.M., Enwelu, I. A., 2014, Factors Influencing Adoption of Improved Cassava Processing Technologies by Rural Women in Enugu State, Nigeria. International Journal of Agricultural Science, Research and Technology in Extension and Education Systems, 4(4):205-210.

[5]Asiabaka, C. C., 2002, Agricultural Extension: A Handbook for Development Practitioners. Omoku: Molsystem United Services Port Harcourt, Rivers State, Nigeria.

[6]Audu, S., Haruna, S. K., Idehen, O. E., Jamilu, A. A., 2014, Adoption of recommended cassava production practices among farmers in Edo state, Nigeria. Proceedings of the 19th Annual National Conference of Agricultural Extension Society of Nigeria held at Federal University of Technology Owerri, Imo State, Nigeria, 27th – 30th April : 23 – 29.

[7]Imo State Planning Commission (ISPC) (2006). Imo State Economic Empowerment Development Strategy Report.

[8]Nwaobiala, C. U., 2013, Socio-economic Determinants of Upland and Swamp Rice Farmers in Ebonyi State, Nigeria. Journal of Applied Food Research (JAFR) 5(1):32- 40.

[9]Nwaobiala, C. U., 2015, Determinants of Rice Output among ADP Contact Farmers in Mining and Non Mining Locations of Ivo Local Government Area of Ebonyi State, Nigeria. The Nigerian Agricultural Journal, 46(1&2): 292 – 313.

[10]Nwaobiala, C. U., 2017, Effect of Agricultural Extension Delivery Methods on Arable Crop Farmers' Cropping Systems in Kaduna State, Nigeria. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development 17 (3): 225 – 230.

[11]Nwaobiala, C. U., Uchechi, T. N., 2016, Utilization of Cocoyam Production Technologies among Women Farmers in Abia State, Nigeria. Journal of Agricultural Extension, 20(1):13 - 26.

[12]Nwaobiala, C. U., Nzeakor, F. C., 2015, Constraints to Adoption of Recommended Fish Technologies among Homestead Catfish Farmers in Ebonyi State, Nigeria. Nigerian Journal of Rural Extension and Development, 9(1): 67 – 71.

[13]Nwaobiala, C.U., 2014, Farmers' Participation in IFAD/FGN/NDDC/
Community - Based Natural Resource Management Programme Technologies in Cross River State, Nigeria. Journal of the Science of Agriculture, Food Technology and the Environment. 13(1):119-124.

[14]Nweke, F. I., Spencer, O. S. C., Lynam, J. K., 2002, The Cassava Transformation: Africa Best Kept Secret.

[15]Ogunbameru, B. O., 2001, Practical Agricultural Communication, Daily Graphic Publications. Ibadan Oyo State, Nigeria.

[16]Okanade, E.O., Olaniyi, O. A., Ogunleye, K. Y., 2005, Adoption of Improved cassava Techniques among Farmers in Surulere Local Government Area of Oyo State. Proceedings of 39th Annual Conference of Agricultural Society of Nigeria, (ASN), Benin 2005. Pp15.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

UTILIZATION OF WHEY IN DAIRY AND FOOD INDUSTRY PRODUCTION PROFITABILITY

Slavica ARSIC, Predrag VUKOVIC, Nataša KLJAJIC

Institute of Agricultural Economics 15, Volgina Street, 11060 Belgrade, Serbia, Tel: +381 (0) 11 69 72 852, Fax: +381 (0) 11 69 72 858, Emails: slavica_a@iep.bg.ac.rs, predrag_v@iep.bg.ac.rs, natasha_k@iep.bg.ac.rs

Corresponding author: slavica_a@iep.bg.ac.rs

Abstract

Considering the fact that milk is one of the strategic products for the economy of each country, there is a tendency to provide the population with sufficient quantities through the development of primary milk production. According to the conducted analysis, out of 1.5 billion liters of milk per year, approximately half, about 50%, is purchased by the dairy processing industry. Milk production and processing in Serbia is mainly focused on products that do not require a lot of time nor complex or lengthy technological processes of production. Such products have a short shelf life, but are most often consumed on the market. Fermented dairy products are the most important group of products in the market structure of domestic supply and demand. These products are the most popular commercial industrial products because they contain probiotic microorganisms that have a beneficial effect on the human digestive system. Since whey is a by-product of cheese and casein production, it is one of the underutilized by-products of the dairy industry in Serbia. Therefore, the first part of this paper analyses the production of cow's milk and dairy products intended for the market in the period 2013-2015 with special emphasis on fermented milk products. The second part focuses on the utilization of whey, as one of the more effective solutions in the production of functional fermented whey-based beverages in the food industry, which mainly uses whey concentrate or whey powder.

Key words: *milk products, whey, cost-effective production*

INTRODUCTION

According to the Ministry of Agriculture, milk processing takes place in about 200 dairy plants in Serbia. Milk is directly submitted to the dairies by milk producers through their raw material network or is purchased from raw material companies that have their own collection facilities. Average capacity utilization of registered dairy plants is at the level of about 60%. There are 25 industrial facilities in Serbia with over 10 tons of daily milk purchase, accounting for 85% of purchased milk. Then, there are 175 small milk facilities, with daily purchase of 3-10 tones, accounting for 15-20% of purchased milk. There are numerous mini-dairies that purchase less than 5 tons per day [5]. From the standpoint of the range of finished products according to the installed capacities, there are several different kinds of basic facilities for raw milk processing. There are capacities:

-For the production of pasteurized and sterilized milk (i.e. drinking milk)

-For the production of fermented products (yogurt, sour cream, sour milk, etc.) and

-For the production of solid dairy products (cheese, butter and milk powder).

Production capacities of the majority of dairy plants are predominantly oriented toward the production of fermented milk products and the production of solid milk products; whereas the production of liquid milk products (drinking milk) is significantly lower [11]. Milk producers are the largest producers of whey, which is formed during the production processes in an amount that is approximately equal to the amount of processed milk. Whey processing would lead to an increase in its price and would solve the problem of its utilization which would consequently have a direct economic benefit for the producers.

Whey contains high amount of lactose, proteins of highest biological value, essential minerals and immunoactive substances as well as the B-group vitamins. Such

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

composition makes it convenient for the preparation of fermented and probiotic beverages where within a single process all the potential of whey as a raw material is exploited. Thus, material which is a hazardous biological pollutant is removed from the environment, and on the other hand an inexpensive, completely healthy and natural product is obtained [13].
Production of fermented whey beverage makes whey become a healthy and tasty product with extended shelf life, which, according to numerous studies, has a positive effect on a number of different functions in the human body. On the other hand, the loss due to underutilization of whey is transformed into a 100% gain. Expanding range of fermented milk and whey products in competitive conditions in the market has a strong commercial character and brings higher profits to processors [8].

MATERIALS AND METHODS

The first part of the paper presents the state and the tendency of movement of total cow milk production in Serbia from 2010-2015. By calculating the base index, where 2010 represent the basic year, according to which statistical data processing leads to results that indicate a decline in the total production of cow's milk compared to the basic year untill the 2013, but in 2014 and 2015 there is a slight increase. In the second part of the paper work statistical data obtained from the Statistical Office of the Republic of Serbia (SORS - SZS) for 2015, which are related to milk products from cow's milk obtained in dairies and intended for the market in the period from 2013 to 2015 with special emphasis on fermented dairy products. Also, the production of cheese in which process comes to the production of large quantities of whey, which represents one of the underused auxiliary products of the dairy industry in the Republic of Serbia. Therefore, the paper presents the possibility of full utilization and use of whey in the production of fermented functional drinks, whose production is economically justified for the dairy industry.

RESULTS AND DISCUSSIONS

Production of milk and dairy products

From the nutritional point of view it can be concluded that milk is the most complete and most balanced foodstuff. In Serbia, the most common is cow's milk and is mainly used in the production of dairy products, while sheep's and goat's milk are produced in smaller quantities and they together account for only about 2% of total production. In recent years there has been an increasing emphasis on their advantages, which has resulted in larger production of sheep's and goat's milk both at home and abroad.
Total milk production in Serbia amounts to over 1.5 million tonnes, but in the period 2010 - 2015 a decrease in total milk production was observed, comparing 2010 as the base year to 2014 when there was a slight increase of 1.98%. In 2015 there was an increase in production of up to 2.7%, as can be seen in Table 1, which is very little compared to the previous year. With regard to the displayed total milk production index, milk yield per cow has a reverse trend. There was an increase beginning with 2010 (reaching its highest level in 2015 with 3,477 litres), which makes an average of 3.1 thousand litres per cow in the observed period (Table 1.) (Statistical Yearbook of the Republic of Serbia 2013-2016) [15].

Table 1. The amount of produced cow's milk in Serbia in the period 2011-2015 and base

Year	Total cow's milk production in ml	Index – total production 2010=100	Liters of milk per cow
2010	1462	100	2.795
2011	1434	98,08	2.865
2012	1442	98,63	2.920
2013	1451	99.25	3.246
2014	1491	101,98	3.269
2015	1501	102.67	3.477
Average	1.464	600.61	3,1

Source: Author's calculations based on the data provided by Statistical Yearbook of the Republic of Serbia 2013-2016 (without data for Kosovo and Metohija) [15].

If we look at different regions throughout Serbia there are differences in terms of milk yield per cow. Thus, Vojvodina has much higher milk yield of 3,890 litres per cow, since great breeders of dairy cows are situated there, compared to central Serbia where milk yield is 2,730 litres per cow. One important reason for these differences in milk yield is the breed composition, because Friesian-Holstein breed prevails in Vojvodina with 52%, while Simmental cattle and cattle of Simmental type are dominant in central Serbia. Another important factor, in addition to breed difference, is the quality of animal feed, especially in mountainous regions (central Serbia), which do not meet the needs of dairy cattle, thus resulting in lower production than in lowland areas such as Vojvodina [16].

Cow’s milk and milk products are of excellent nutritional value, water and dry matter are the basic components of milk. Water is a dominant component in milk and ranges from 80 to 90%, 87.3% on average. Dry matter in milk contains proteins, fat, lactose and minerals. Its composition is not constant, but varies depending on the species, breed, lactation period, diet and other factors [19].

Besides being a foodstuff milk is also a raw material with great potential as it is a basis for a large number of products such as sour milk, yogurt, a variety of cheeses, sour cream, butter, fermented milk products and other products that are obtained from milk [10]. Lately, new, enriched dairy products could be found on the market, by which dairy manufactured products, well known from ancient times, have been developing into a new generation of dairy products with different characteristics and better nutritional and health values [1].

Some milk products can be prepared under very simple technical conditions, whereas many other products require appropriate technical equipment, usually of high capacity, which only industrial dairies own. In order to be sold to the final consumers, it is necessary that milk be prepared following specific procedures of control, processing and packaging [20].

In Serbia, dairy industry is highly developed and there is a large number of dairies. However, their big problem is a small amount of milk on the market, seasonal variations in milk production and the existing milk quality. With regard to milk quality, the existing regulations are complied with the EU regulations, but they are still not sufficiently implemented in practice. Milk quality directly affects the structure of dairy production as well as the product quality and shelf life, but also the production efficiency [1, 2].

The paper work presents results According to the Report of SORS - SZS Belgrade for 2015 and data processing for dairy products from cow milk (1,000 t) obtained in dairies for market realization in the period from 2013 to 2015, where one can notice the movement of certain products on the annual production level [7].

Given that there are a number of dairy products, this paper will take into account only those market products that are relevant to the subject of this paper, such as drinking milk, fermented products and cheese production.

Table 2. Total produced amount of drinking milk (1,000 t) for placement on the market in the period 2013-2015.

Year	Drinking milk	% in total production over 3 years
2013	251.04	34.53
2014	237.27	32.64
2015	238.73	32.83
Total	726.97	100 %

Source: Author’s calculation according to the data of the Statistical Office of the Republic of Serbia, Belgrade [7].

Taking in account total volume of production of drinking milk intended for the market, for the observed years it amounts to 726.97 thousand tons. Observed by years, the largest production is in 2013, which in the total production for the three years (2013-2015) is 34.53%. The next two years there is recording a slight decline in the production of drinking milk marketed for the market, as can be seen from Table 2.

According to the data of the Statistical Office for the given period (2013-2015), as in the above table, there was a slight decrease in the production of fermented milk products intended for the market as of 2013 as shown in Table 4, but with a slight increase in 2015

compared to the previous year.
According to the data of the Statistical Office for the given period (2013-2015), as in the above table, there was a slight decrease in the production of fermented milk products intended for the market as of 2013 as shown in Table 3, but with a slight increase in 2015 compared to the previous year.

Table 3. Total produced amount of fermented milk products (1000 t) for placement on the market in the period 2013-2015.

Year	Fermented milk products	% in total production over 3 years
2013	214.22	34.24
2014	200.73	32.1
2015	210.59	33.66
Total	625,54	100 %

Source: Author's calculation according to the data of the Statistical Office of the Republic of Serbia, Belgrade [15].

Table 4, shows that production of cheese intended for the market increased from 2013 to 2015, which means that during cheese production the amount of whey as a by-product, that could be used in the production of various fermented and other products, increased too.

Table 4. Total production of cheese from cow's milk for placement on the market in the period 2013-2015.

Year	Total production of cheese	% in total production over 3 years
2013	28.22	27.54
2014	33,71	32.89
2015	40.55	39.57
Total	102.48	100%

Source: Author's calculation according to the data of the Statistical Office of the Republic of Serbia, Belgrade [15].

The biggest problem of the dairy industry is that only 10-20% of milk is used for the preparation of a product, while whey comprises 80-90% of milk entering the process [13].
The amount of whey obtained during the process of cheese making is nearly equal to the amount of milk required for its production. That means that during the production of 1 kg of cheese an average of 9 kg or 8-12 l of whey is obtained, depending on the variety of cheese produced [14]. Scientists believe, on the basis of data on cheese production projected by 2019, that the world whey production will record a permanent annual growth of about 2% by the end of 2019 [9, 12].
Therefore, the dairy industry is increasingly developing new, fortified milk products which have proved very successful, with different characteristics and better nutritional and health properties. Whey-based beverages certainly belong to this group of new products, although whey as a by-product has long been disposed of as waste or used as animal feed.

The possibility of full utilization and use of whey

Due to the rapid population growth and insufficient food production, and despite increased production, the issue of rational utilization of food, which has already been produced for human consumption (ex. cheese), is raised. With regard to the production and processing of milk, whey is certainly one of the most common by-products, which retains the largest quantity of milk nutrients. Whey contains 93% water on average, and over 50% dry matter of milk, depending on the basic composition of milk and the technological processes of cheese or casein manufacture. The dry matter of whey is composed essentially of lactose (about 70%), which is a very important energy source, whey proteins make up approximately 1% and water-soluble minerals and vitamins are present in smaller quantities.
In our country and the world, dairy industry treated whey as a waste product obtained during the cheese making process up until a few years ago. Today, however, bearing in mind that whey is rich in lactose, proteins, (especially lactalbumin and globulin), minerals and vitamins; there is a tendency to use this product in as cost-effective way as possible, either completely or as individual whey components. Today, the best-known whey preparations are acid and sweet whey powder, condensed whey, and modified whey powder [19]. One of the most economical and efficient procedures in improving the structure and viscosity of many life groceries is the use of whey preparations.

Whey preparations are widely used as additives in the food industry, where they contribute to valuable food products characterized by improved organoleptic properties, increased shelf life and higher levels of nutrients. Baking industry is the largest consumer of dry whey for human consumption. Considering the fact that the vast quantity of skimmed milk powder is used in baking and dairy industry, it can be substituted with dry whey. Whey has similar properties as milk powder, which is preferred for use in the baking industry, and there are also strong economic reasons to replace the more expensive skim milk by cheaper whey, either by whey powder or condensed whey [18].

Whey is also widely used in the dairy industry, especially in the production of ice cream and similar frozen dairy products. It is used in the production of processed cheese as well, and whey is especially desirable ingredient in the production of soft and spreadable processed cheese and similar products.

It is also suitable for producing various toppings, gives good texture and enhances the taste of cheese. Whey is also used in other food products in smaller quantities, such as mixtures for cakes, sauces, spices and the like. The use of whey is constantly increasing in the confectionery industry and it has also been applied in the meat industry.

Due to the high amount of lactose and biologically valuable proteins wide ranges of baby food as well as various types of dietary supplements are made on the basis of whey. Whey is very important for the pharmaceutical industry as well, due to lactose which is used in the manufacture of tablets and pills, most often as an inert carrier for the drug substance.

Among numerous possibilities of whey processing, a very important role belongs to alcoholic and non-alcoholic beverages. The use of whey in beverage production began back in the 1970s, and a large group of whey beverages has developed so far.

Analysis of production of non-alcoholic whey beverages, compared to alcoholic beverages, has so far given many favorable results throughout the world.

Baković, D. and Tratnik, Lj. (1979, 1980) provide numerous possibilities of using whey and its products in many branches of the food industry, by means of pasteurization, thickening and fermentation. Today, the food industry in particular shows the tendency towards the production of lactic acid fermented products such as soft drinks based on fruit and vegetables, milk and whey-based beverages, which represent a very healthy, so-called “functional food products” [3, 4].

Fermented whey-based beverages proved to be the best option in preparation of products with favorable sensory characteristics. Fermented whey-based beverages hold a special place among whey beverages, and can be divided into two groups: functional and probiotic. Both groups have beneficial effects on the host organism but in two different ways [6].

Probiotic drinks are characterized by direct effects of live microorganisms (probiotics), while functional drinks are characterized by indirect effects through metabolites synthesized during fermentation, which are also called biogenic.

During the fermentation of whey its components are broken down into various functional substances, such as lactic acid, butyric acid, bioactive peptides, β-galactosidase and exopolysaccharides which show a significant effect on the human organism [17].

Therefore, nowadays, the issue of whey mostly amounts to finding the types and forms of whey products that will be as useful and affordable as possible. Further research in this field and close cooperation with the dairy industry would offer the possibility of greater utilization of whey through products that would be of interest from the standpoint both of nutrition and placement.

In most industrialized countries in Europe and the United States whey has already found an important place in the food industry.

There is a wide range of whey products on the markets of these countries.

Efforts have been made in our country as well, to utilize this important by-product of dairy industry as much as possible in order to reduce the loss of whey nutrients.

CONCLUSIONS

The importance of the dairy sector in Serbia is reflected in the fact that milk production: among the all agricultural sectors with the highest value of primary production of over 500 million Euros a year, which additionally increases in processing, the sector that covers over 280 thousand producers and significantly contributes to the rural development of Serbia, the sector which, due to the quantity and nutritionally significant consumption, is important for the food safety of the country, the sector that is most demanding by the standards that need to be met when joining the EU, and the sector in which Serbia has significant potential only for further development.

Structure of milk production in Serbia is such that fermented products and liquid milk account for almost 90% of products manufactured each year.

With regard to fermented products, the amount of fermented whey products is minor, which leads to the conclusion that by whey fermentation we could obtain products with significant place among the range of dairy products intended for mass consumption. Regarding the current lack of facilities for whey processing, a huge amount of money would be saved if whey processing was stimulated in Serbia instead of being imported. In terms of prospects of utilization of whey as a raw material and in accordance with the existing equipment situation in Serbia, the main goal should be incentives for utilization of whey in the food industry.

One of the ways to include whey in daily diet, i.e. to activate its regular processing in the food industry, is to produce functional fermented whey-based beverages.

This is another effort to preserve as much of the whey for human consumption, by creating products using simple and economically viable technology for our industry.

AKNOWLEDGEMENTS

Paper work is part of the research Project III - 46006 – “Sustainable agriculture and rural development in function of Republic of Serbia strategic goals achievement within the Danube region”, Ministry of education, science and technological development of the Republic of Serbia.

REFERENCES

[1]Arsić, S., Kljajić, N., Vuković, P., 2010, Analyses of the current situation in cattle production in Serbia (With Special Review of Milk and Meat Production (Edita II,). Competitivitatea economiei agroalimentare si rurale in conditiile crizei mondiale II. (340-347), Bucharest, Academia de Studii Economice.

[2]Arsić, S., Vuković, P., Kljajić, N., 2011, Stanje i perspektive proizvodnje mleka u Srbiji. XXV Conference of agronomists, veterinarians and Technology engineering, Institute PKB ćAgroekonomik, Belgrade, Vol.17 (3-4), 57-69.

[3]Baković, D., Tratnik, LJ., 1979, Mogućnost korištenja sirutke u prehrani, Mljekarstvo, 29 (2), 36-40.

[4]Baković, D., Tratnik, LJ., 1980, Mogućnost korištenja sirutke u ishrani, Hrana i ishrana, 21 (9-12), 271-273.

[5]Bošković, T., 2014, Tržište mleka i mlečnih proizvoda, Privredni pregled, 29-30 september 2014.

[6]Bulatović, M., Rakin, M., Mojović, Lj., Nikolić, S., Vukašinović Sekulić, M., Đukić Vuković, A., 2012, Surutka kao sirovina za proizvodnju funkcionalnih napitaka, Hemijska industrija, 66(4), 567-579. 2012. Web. Link: http://www.fao.org/fileadmin/user_upload/newsroom/docs/ENGLISH_outlook.pdf (Retrieved on April, 21th, 2017).

[7]Mlečni proizvodi od kravljeg mleka (1000 t) dobijeni u mlekarama za realizaciju na tržištu po mesecima u periodu 2013 – 2015, Izveštaj, Republički Zavod za Statistiku, Beograd 2015.

[8]Jelen, P., 2003, Whey Processing, in: H. Rginski, J. F. Fuquau, P. F. Fox (Eds.), Encyclopedia of Dairy Sciences, London, Academic Press – An Imprint of Elsevier, Boston, London, 2740, Vol. 4, 369-370.

[9]Jelinić, J., Đurović, S., 2009, Poljoprivredna politika - sektor mlekarske proizvodnje, Fond za otvoreno društvo, centar za primenjene evropske studije, Beograd, 54–56.

[10]Kljajić, N., Savić, M., Arsić, S., 2009, Proizvodnja mleka i mlečnih proizvoda u Republici Srbiji, Ekonomika, Vol. 55 (6), 166-177.

[11]Komisija za zaštitu konkurencije, 2012, Sektorska analiza tržišta otkupa sirovog mleka, proizvodnje i prerade mleka i mlečnih proizvoda, Beograd, Srbia, Avgust 2012.

[12]OECD - FAO, 2010, Agricultural outlook 2010 – 2019, highlights, pp. 83.

[13]Popović Vranješ, A., I., Vujičić, I., 1997, Tehnologija surutke, Poljoprivredni fakultet Novi Sad.

[14]Savant, V. D., Torres, J. A., 2000, Chitosan-based

coagulating agents for treatment of cheddar cheese whey, Biotechnology Progress, Vol. 16 (6), 1091–1097.

[15]Statistical Yearbook of the Republic of Serbia 2013 – 2016, Belgrade.

[16]Strategy for Agriculture and Rural Development of the Republic of Slovenia for the period 2014-2024, Belgrade, Official Gazette No. 85/14.

[17]Tamime, A. Y., Božanić, R., Rogelj, I., 2003, Probiotički fermentirani mliječni proizvodi, Mljekarstvo 53 (2), 111-134.

[18]Tratnik, Lj., 2003, Uloga surutke u proizvodnji funkcionalne mliječne hrane, Mljekarstvo 53(4), 325 - 352.

[19]Tratnik, LJ., 1998, Mlijeko-tehnologija, biokemija i mikrobiologija, Hrvatska mljekarska udruga, Zagreb, Hrvatska.

[20] Pravilnik o kvalitetu i drugim zahtevima za mleko, mlečne proizvode, kompozitne mlečne proizvode i starter kulture, Tehnologia Hrane, http://www.tehnologijahrane.com/pravilnik/o-kvalitetu-i-drugim-zahtevima-za-mleko-i, Retrieved on April 30, 2017.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CHALLENGES OF POPULATION DEVELOPMENT AND VALUE CHAINS IN ROMANIAN MOUNTAIN AREAS

Silviu BECIU[1], Stefan MANN[2], Georgiana Armenița ARGHIROIU[1]

[1]University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti, District 1, 11464, Bucharest, Romania, Phone: +40213182564, Fax:+40213182888, Mobile:+40723 16590, Emails: beciu.silviu@gmail.com, arghiroiu.armenita@gmail.com
[2]Agroscope, INH Institut, Tänikon, CH-8356 Ettenhausen, Switzerland, email: stefan.mann@agroscope.admin.ch

Corresponding author: arghiroiu.armenita@gmail.com

Abstract

The paper aims to make an assessment related to the Romanian mountain areas, insisting on the aspects in connection with the population from the rural areas and the evolution of the value chains in these areas. The research method is rather empiric, based on the recent evolutions related with the population and the food chain supply from the mountain areas. Most of the data are provided by the recently established Romanian Agency for the Mountain Area and the Ministry of Agriculture and Rural Development from Romania. The discussions are focused on how this mountain area evolved in the last years, in relation to the needs of its inhabitants. The paper is developing the idea of the mountain as a marketing argument. The results indicates that many aspects related with the mountain areas are not supported by the field studies and the researches in this field are a necessity.

Key words*: *Romania, mountain, rural areas, value chains

INTRODUCTION

The sustainable and growth-orientated development of the Romanian mountain areas is depending on the understanding of the need to extend the current level of knowledge by carrying out more faithful studies in these beautiful but disadvantaged areas. This study aimed to report to what is known about the mountain areas from Romania in order to give new directions of research which can contribute to the sustainable development of these areas. The Carpathians were evaluated from the point of view of social sustainability of agriculture in the neighbour country Serbia [5], based on a set criteria related with: density of agricultural population, density of active agricultural population or density of employees in agriculture. As in the other European countries with significant mountain areas, the rural depopulation affected most of the isolated and poor Romanian mountain areas [1]. A third of the Romanian territory in which live 15 % of the national population [2] is situated in the mountain areas. Almost 1 milion households faces harsh living conditions, threatened by the lack of jobs and a variable income which already generated internal and abroad exodus of the young generation. Romania is the fourth largest mountainous agricultural area in the European Union, with 2.9 million ha [3], after Spain (7.4 million ha), Italy (4.4 million ha) and France. (Source 1), but even if at the national level where identified 658 territorial administrative units situated in the mountain area, we couldn’t find any specific study dedicated to them. These territorial administrative units belongs to 27 of 42 total counties existing at national level. The lack of detailed studies related with the mountain areas from Romania is confirmed within the Memorandum Regarding the National Strategic Orientations (2014-2020) for sustainable development in the less-favoured mountain areas from 2014, which include many references about mountain agriculture in Romania from EU studies made by JRC and many outdate aspects related with the Romanian agricultural census from 2010. The Romanian Agency for the Mountain Area, which was established in 2014 provides some data related only the repartition of the mountain territorial administrative units within the counties and the related mountain area, also calculated per county. Studies made within this agency [6] indicate in the Romanian mountain areas is situated 18.71 % from the total of Romanian agriculture land and 5.84 % from the total arable surfaces, 21.94 % from the total fruit trees, 1.7 % from the all vineyards, 37.43% from the total existing pastures at the national level and 59.51 % from meadows. Is also estimated that the ratio of land covered by forest vegetation in the mountain areas is about 56% while the share of the forest in the mountain areas is 59% from the total national forest area.

MATERIAL AND METHODS

The study is based on data provided by the Romanian Agency for the Mountain Area and the Ministry of Agriculture and Rural Development from Romania. The research method is rather empiric, the study being focused on the evolution of two components related with the mountain areas: the population and the value chains. One of the challenges for the mountain areas approached in this paper is the use of the term of mountain product as an optional quality argument, which can lead to more attractive promotion and increased sales of products made in the mountain areas.

RESULTS AND DISCUSSIONS

Population living in the mountain areas. The population that is living in the mountain area is decreasing, and the problems that the mountain people faces cannot be easily solved in order to change this trend. Approximately 3.3 million inhabitants, representing 15% of the national population, live in the mountain area. The mountain areas faced a double exodus: to the urban area and to the EU countries, especially Italy, Spain, Germany and UK. The exodus is noticed especially among young people who are looking for better live conditions and higher income jobs. The rate of natural increase of the population in the mountain area is negative, and it is higher than the national average. Besides the economic aspects related, the population from the mountain areas face problems related with the poor infrastructure and reducing number of schools and hospitals, mostly in the rural areas. The rural population of the mountain area accounts more than half from the total population living in this area, but the future is uncertain. Only from 2005 to 2011, the number of pupils enrolled in primary and secondary schools decreased by 13%, while the number of primary and secondary units was reduced by 37%. [4]

Challenges related with value chains. The Romanian Carpathian, one of the high mountains of Europe, have the food supply chain affected by a significant inequality of bargaining power. Farm producers are generally small and economically drawback by limited access to the market, where the rules are made by processing industry and the retail actors. The livestock in the mountain area decreased in two phases: one related with the change of economic system from 1989 and one with the integration in the EU, when the farmers faced new challenges generated by the increase of food and safety standards and the rules related with animal welfare. The transhumance is still practiced in Romania, and large herds travel up to 1,500 km starting from middle of September when the pastors move their livestock from the mountain areas to the low valleys where they own or rent some winter stables. Until May the sheep and goats are returning to the mountain. The distances traveled are higher due to the areas they are not allowed to cross. The evolution of the livestock is related with the recent evolutions on the food supply chain. As a good example we can underline here the case of milk supply chain. In the communist era, in the milk sector, were organized state enterprises for the collection and industrialization of the milk. Some of these enterprises changed into joint stock companies since 1990 and have undergone several sales of the majority stake while other collapsed and disappeared from the market. From over 1,800 enterprises specialized in production of milk and milk products, around 32 are part now of the employers' association in the milk industry (APRIL), which include the main brands on the market, but few of them have a network in the mountain areas. As regarding the production of milk, the impact of collectivization was not as accentuated in the mountain areas as in the plain parts of the country and the mountain farmers kept their traditional animal husbandry system despite the economic and political changes. The milk which is not used for self-consumption is brought nowadays by farmers in collection points where can be found milk cooling tanks distributed in the villages, by SMEs specialized in industrialization of the milk, who designates a person in charge with each collection point. Several hundreds of liters are collected each day from each collection point, using auto tankers that belongs to the SMEs. Usual a SMEs industrialized thousands litres of row milk per day and have several processing hale, resulting in different varieties of dairy products. The price of the milk in the supermarkets is 4-5 times larger than the farm gate, which has discouraged production and led to a significant reduction of the number of milk cows in Romania in the last decade.While some SMEs specialized in the milk industrialization have their own network stores and also promote their product through websites and also developed online selling, other producers have contracts with retailers or wholesalers. The deliveries made for the online command are made either faster by deliver companies, and the consumer support the transport cost, which is related with the weight (e.g. 4 euro/ 1 to10 kg for goat dairy products, or 6.5 euro/10 to 19 kg for the same products), or through the SMEs own transport system which is made in specific days of the months through all country regions and is usual free of charge. The reduction of the livestock led to raw milk shortage and the SMEs with large industrial capacity are obliged to import milk from abroad in order to maintain the level of production and their commitments. At national level, in Romania there is monopoly in the commercialization of pharma-veterinary products. Only one enterprise has a national network for selling biological products, medicaments, medicated and vitamin-mineral premixes, feed additives, culture medium, disinfectants, hygienic-sanitary materials, protective equipment, either manufactured in Romania or imported.

Is mountain a marketing argument? Since 2016, when in the national legislation were implemented the provisions of EU Regulation no 665/2014 related with the conditions of use of the optional quality term 'mountain product', several producers applied and have been accepted with their products in The National Mountain Products Register.

Table 1. Samples with the products entitled to use the optional quality term: ``Mountain product`` - Category: Milk and milk products, included in The National Mountain Products Register

Year	County	Products	Company
2017	Mureș	 Cascaval Ibănești	S.C. Mirdatod Prod S.R.L.
2017	Mureș	 Smantana Ibănești	S.C. Mirdatod Prod S.R.L.
2017	Mureș	 Urda Ibănești	S.C. Mirdatod Prod S.R.L.
2017	Prahova	Cascaval taranesc Valdostana Brânză de burduf Valdostana Cașcavea Valdostana	S.C. Ferma IP Valea Doftanei S.R.L.

Source: Ministry of Agriculture and Rural Development from Romania
Source of images: http://mirdatod.ro

Now this register includes 30 produces in the categories: milk and milk products (21), meat and meat products (2), fruits and vegetables (6) and honey (1). Some of these products are well identified on the market, but most of them are products without any brand image promoted on the internet.

CONCLUSIONS

Few studies are approaching the mountain rural areas and their current issues. The studies related with the value chain are not recently and none of them was focused on the mountain rural areas. Few things are known about who is dealing with farmers, both on the factor and food side. Also few data are known about local food chains. The population from these areas have for certain low levels of income but no average income was calculated for a region or for the all mountain areas. The national statistic is not divided between the plane and mountain areas and data related with farm structure or land use are few or inaccurate. Mountain yet is rarely a marketing argument, but several efforts made by entrepreneurs or enterprises are on their way to be rewarded on the market.

REFERENCES

[1] MacDonald, D., Crabtree J.R., Wiesinger G., Dax, T., Stamouc, N., Fleury P., Gutierrez Lazpitae, J., Gibon, A., 2000, Agricultural abandonment in mountain areas of Europe: Environmental consequences and policy response, Journal of Environmental Management, Vol. 59 (1): 47-69
[2]Mountain Agency from Romania, 2018, Activity report for 2017, available at: http://azm.gov.ro/wp-content/uploads/2018/01/Raport-de-activitate-AZM-2017.pdf, accessed at 15 February, 2018.
[3]National Strategic Guidelines for Sustainable Development of Disadvantaged Mountain Area (2014-2020, Available at: http://www.madr.ro/docs/dezvoltare-rurala/memorandum/Anexa-Memorandum-zona-montana-defavorizata-2014-2020.pdf, accessed at 14 February, 2018
[4]Santini, F., Guri, F., Gomez y Paloma, S., 2013, Labelling of agricultural and food products of mountain farming, European Commission, JRC, Institute of Prospective Technological Studies, available at: https://ec.europa.eu/agriculture/sites/agriculture/files/external-studies/2013/mountain-farming/fulltext_en.pdf, accessed at 14 February, 2018.
[5] Subić, J., Jeločnik, M., Jovanović, M., 2013, Evaluation of social sustainability of agriculture within the Carpathians in the Republic of Serbia, Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural development", Vol. 13 (2): 411-416.
[6]Ungureanu, D., 2017, Mountain Agency from Romania, 2017, Sustainable development of the Romanian mountain areas, Realities and prospects, http://www.turismulresponsabil.ro/wp-content/uploads/2017/01/2.-Danut-Ungureanu-Zona-montana.pdf, accessed at 15 February, 2018

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

A PROMISING MECHANISM FOR THE MATERIAL SUPPORT OF THE FARMING INDUSTRY (A CASE STUDY OF THE NOVOSIBIRSK REGION)

Dmitry S. BELAITS, Maxim S. VYSHEGUROV, Anatoly P. BALASHOV, Natalia N. KONOVA, Anastasiia A. SAMOKHVALOVA, Alexey I. GOLIKOV

Novosibirsk State Agrarian University, 630039, Russia, Novosibirsk, Dobrolyubova St., 160, Phone: 8 (495) 607-80-00; emails: belaits@list.ru, vyshegurovm@bk.ru, anatoly.p.balashov@mail.ru, natalia.konova@list.ru, anastasiia.samokhvalova@inbox.ru, golikov.alexey@list.ru

***Corresponding author**:* belaits@list.ru

Abstract

The ramp-up of the agricultural industry output requires the use of new, high-performance machines, whilst the complicated world economic situation has made it difficult to purchase foreign agricultural equipment. All these factors contributed to an increase in the demand for both domestic and Belarusian equipment. Tractors and various attachments are the most popular type of farm machinery with agricultural producers, which is used in almost all farm works. In this regard, there is a significant load being placed on them which leads to frequent breakdowns. At the same time, the age of tractors in farms of the Novosibirsk Region is mostly more than 10 years, which is also one of the reasons for failing. Most farms are simply unable to regularly update their machine and tractor fleet; therefore, during the spring field works or crop harvesting, it often happens that machines break down and wait for repairs for a long time. This results in crop losses and low yields. It is necessary to develop such a mechanism of the material support for agricultural producers which will help to avoid equipment downtime and lead to an increase in the gross collection.

Key words: *agriculture, tractors, trade-in, after-sales service, MTZ, purchase and sale*

INTRODUCTION

The farming industry of the Novosibirsk Region is a dynamically developing branch of the national economy and one of the drivers of the regional economic development. Because of the growing demand for food commodities, which has been observed in our country in recent decades, agricultural producers are expected to increase production volumes and efficiency, which is impossible without the use of modern high-performance agricultural equipment. The high level of mechanization determines the growth in the volume and quality of farm products. The issue of technical modernization of the farming industry is of big importance for commodity producers, for the state, and for producers and sellers of the agricultural equipment [12].
The machine and tractor fleet of agricultural producers in the Novosibirsk Region is in a rather worn condition, and needs modernization. MTZ tractors are the most popular technique equipment for agricultural producers, which is confirmed by statistical data: about 40% of all tractors in the Novosibirsk Region are the MTZ tractors [2].
The efficiency of farm production depends more on the level of energy supply of farm organizations. The Novosibirsk Region is one of the country's leaders in terms of the pace of technical and technological reequipment of the industry, but at the same time, it is still not enough and the fleet is in a rather worn condition [15].

MATERIALS AND METHODS

The research aimed to develop theoretical foundations and recommended practices for the implementation of the material support mechanism for the farming industry.
The target of research is the organizational and economic relations that arise between agricultural producers and service centers in

the region.

The subject of research is the economic processes and patterns of development of the material and technical resources of the farming industry.

The objects under observation are agricultural organizations and service centers of the Novosibirsk Region.

The information basis of the research is the official materials of the Federal State Statistics Service of the Russian Federation; the Novosibirsk Region territorial body of the Federal State Statistics Service; the latest information of the Ministry of Agriculture of the Novosibirsk Region; the data of statistical and accounting reports of agricultural and processing organizations; normative and legal acts of the Russian Federation, executive and legislative authorities of the regions; scientific publications on the problem under study and other sources.

The theoretical and methodological background of the research is provided by scientific works of domestic agricultural economists on the development of material and technical resources, development and recommendations of research institutes and universities, normative and methodological materials, authorial calculations and generalizations. Various methods of economic research are applied in the work: abstract-logical, statistical-economic, balance, computational-constructive, dialectical, monographic and others.

To determine the profit loss in crop production or animal husbandry, the following formulas were used:

-loss of profit from 1 ha of crops = average crop yield x area of crops x price of crop;

-loss of profit from 1 liter of milk = Average milk yield per 1 cow x volume of milk loss x milk price.

RESULTS AND DISCUSSIONS

With a view to increase the efficiency of the material support of agricultural organizations, we propose the sale of agricultural machinery through the trade-in technology, the essence of which is the acquisition by dealers of used equipment from customers as payment for new equipment [18].

The trade-in agreement allows upgrading the fleet of used equipment without problems associated with its sale in the aftermarket and getting new high-performance equipment with guaranteed quality. Trade-in is designed to make the sale of old equipment safe and to simplify as much as possible the acquisition of new generation equipment, protecting buyers from all sorts of risks that may arise in case of self-sale. This scheme opens up new opportunities for agricultural producers which expand their production, implement new technologies or replace equipment even if they do not have temporary free funds by that time [7].

This mechanism is an effective tool for increasing the material and technical security of agricultural producers in the Novosibirsk Region as well as for increasing the dealer's sales and improving the quality of services provided [4].

Calculation showed that in case of a tractor failure, the replacement tractor delivery mechanism did not work and the farms lost significant money, both in the crop and livestock industries. At the same time, the more the acreage or the number of dairy cows, the greater the loss of production.

Using tractors from a fleet of replacement vehicles will result in the growth in revenue and production efficiency: production profitability up to 35.1%, profitability of sales up to 26%, main production cost recovery up to 101.5%.

Analysis of the use of agricultural producers' machine and tractor fleet in the Novosibirsk Region

Tractors are the kind of machinery that is present in every farm and performs a significant amount of agricultural work [20]. The efficiency of the entire production in an agricultural organization depends on their normal functioning. Figure 1 shows the quantity of tractors in each municipal district of the Novosibirsk Region, as well as the number of repaired machines [9].

According to the number of tractors in 2017, the region's leaders are the Toguchinsky District with 740 units, among which 634 units or 86% are the repaired ones, and the

Krasnozersky District with 750 units, 692 repaired units (92%). Areas with a very little number of tractors are the Severniy District with 55 units, the Ubinsky District with 129 units, and the Moshkovsky District with 130 units. On the average in the region, 93% of all tractors are in good order. Their total number is 10,809 units.

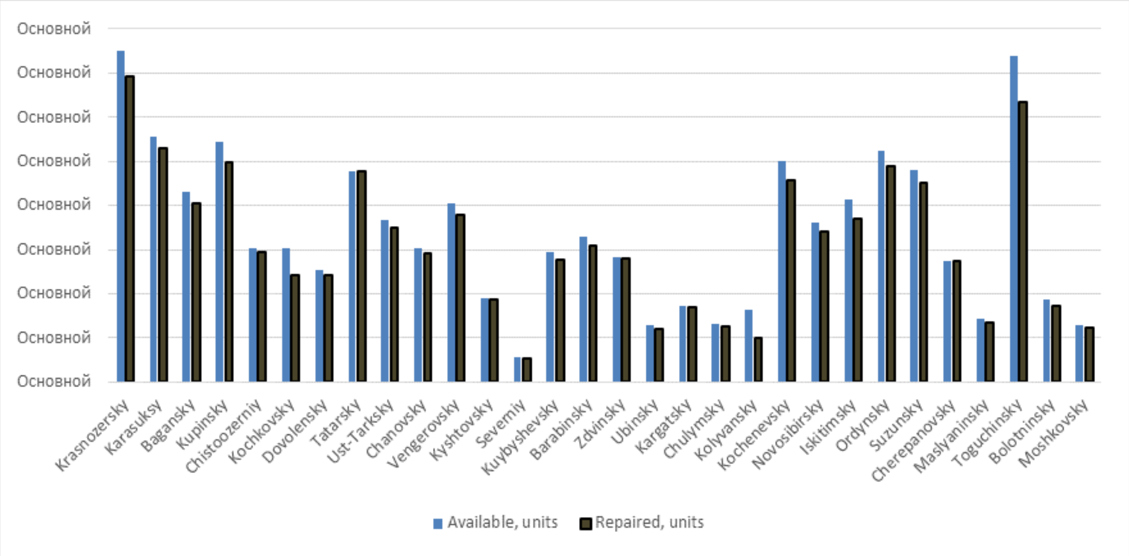


Fig. 1. Distribution of the total number of tractors, including those reconditioned, in the Novosibirsk Region as of July 1, 2017.
Source: http://mcx.nso.ru/

Let us consider the acquisition of tractors by farms in the municipal districts of the Novosibirsk Region in 2016 (Figure 2).

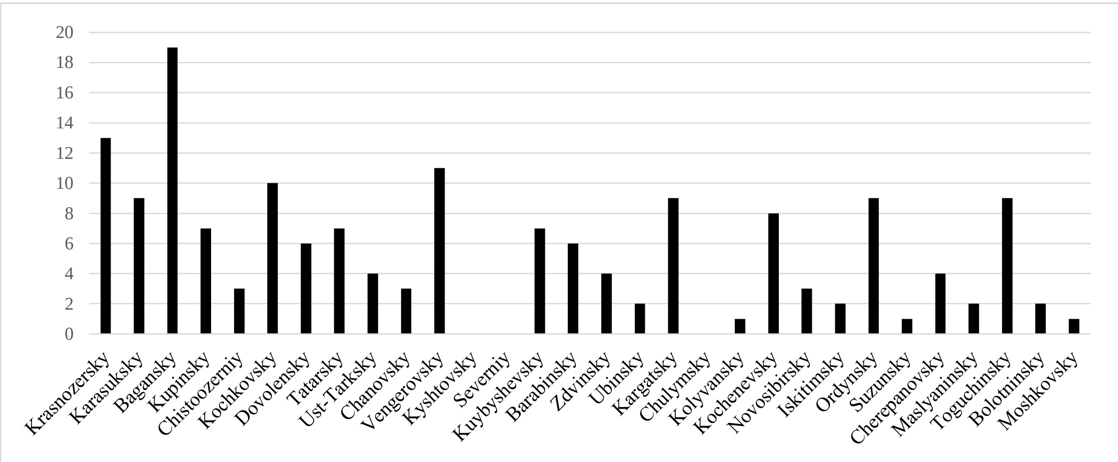


Fig. 2. Number of purchased tractors in the Novosibirsk Region in 2016.
Source: http://mcx.nso.ru/

In 2016, the greatest number of tractors was purchased in the Bagansky District (19 units), and the Krasnozersksky District (13 units). In Kyshtovsky, Severniy and Chulymsky Districts, no machines were bought.

As already mentioned above, the most common type of machinery at farms are tractors aged mostly more than 10 years (Table 1). The most common model of the tractor in the agricultural organizations of the Novosibirsk Region (about 40% of the total tractor fleet) is the MTZ-80 and MTZ-82. K-700A, K-701 are also quite popular tractors models.

More than half of all available tractors are older than 10 years; at the same time, as for tractors MTZ, only 33% of them can be attributed to this category [3].

Table 1. Availability of tractors with agricultural producers in the Novosibirsk Region in 2016

No.	Brand of machine	Available, in total	Older than 10 years	
			Total	%
1.	K-700A, K-701, K-744	68	68	100.0
2.	T-150K, T-150, KhTZ	56	56	100.0
3.	T-130, T-170, T-100	39	39	100.0
4.	T-4A	1	1	100.0
5.	DT-75, DT-75M	22	21	95.5
6.	MTZ-80, MTZ-82	204	68	33.3
7.	UMZ-6, ZTM-60	8	8	100.0
8.	T-40, T-40AM, LTZ-60	13	12	92.3
9.	T-16, T-25, VTZ-30	8	8	100.0
10.	Other, incl. self-made tractors	91	34	37.4
11.	TOTAL of tractors	517	281	54.4

Source: http://mcx.nso.ru/

According to the Ministry of Agriculture of Russia, deviations in the basic performance criteria are characteristic for more than 30% of the units produced; many tractors provide an average mean time to failure 2 to 3 times lower than the performance standards, since more than half of them have a leak of fuel, oils, have various gaskets damaged, etc. The main types of defects detected during testing are, first of all, poor-quality assembly of machines (10-20% of all failures) and poor quality of welding (9-13%). Up to a third of spare parts and components of agricultural machinery are scrapped. They are bought up at lower prices at the plants by for-profit businesses, and then sold to agricultural producers as high-quality ones. Along with this, they do not bear any pecuniary responsibility for this [11].

In 2016, 4,252 tractors out of 10,809 units underwent a technical check-up, only 273 of them not meeting the safety requirements (Table 2).

Table 2. Results of technical check-up of the Novosibirsk Region agricultural producers' machine and tractor fleet in 2016

	Trailers	**Self-propelled vehicles**	**Tractors**	**Other self-propelled vehicles**
Registered in the inspection of Gostekhnadzor (State supervision of the technical condition of self-propelled machines and other types of equipment)	2,371	17,176	10,809	582
Submitted for technical checkup	595	7,398	5,313	149
Passed technical checkup	547	6077	4,252	141
of them after drawing up a report of technical checkup	94	1166	663	68
including within 20 days from the date of registration of the technical checkup report containing information on the non-compliance of the machine with the safety requirements	17	337	271	0
Total of drawn up acts of technical checkup	129	991	730	6
including for the reasons:				
lack of information on the state fee payment for issuing a technical checkup confirmation document	1	63	52	0
failure to submit documents	45	554	374	0
non-conformity with the data specified in the submitted documents	12	35	31	0
non-conformity with safety requirements	71	339	273	6

Source: http://mcx.nso.ru/

Characteristics of the trade-in technology

All violations associated with the operation of the machine and tractor fleet of agricultural producers result in the fact that the costs of agricultural organizations for the repair and maintenance of the acquired equipment reach 80-85% of their book value over the period of operation. In addition, the constant breakdown of equipment during the execution of technological operations significantly prolong their time, which inevitably leads to lost production [14]. At the same time, the annual scrapping of equipment exceeds new machinery put into service. The improvement of machinery for agricultural organizations in the Novosibirsk Region for the period under review was 7-34%, while it was by 80% due to the acquisition of agricultural machinery used in the operation by other organizations.

With a view to increase the efficiency of the material support of agricultural organizations, we propose the sale of agricultural machinery through the trade-in technology, the essence of which is the acquisition by dealers of used equipment from customers as payment for new equipment [18].

The old equipment acquired from agricultural producers is prepared for exploitation in service centers and goes on sale with warranty [13]. Accordingly, some agricultural producers renew their technical fleet, others get an opportunity to purchase more affordable equipment, while dealers expand the circle of customers and increase the sales results [8].

The purchase and sale of equipment under the trade-in scheme involves the receipt of one machine in exchange for another. The cost of the first one is deducted from the cost of the second one, and the difference is paid either by ready cash or by credit [17].

The term "trade-in" means "repurchase" in English. This is a system of offset whereby used equipment can be used as a means of partial payment for new equipment. This principle of sales has been successfully working in America and Europe for many years. Trade-in is the exchange of a used car for a new or another vehicle [6].

In European countries, the trade-in system has been successfully working for several decades. With the help of this scheme, Western companies are constantly updating their fleet of vehicles, acquiring more and more advanced models of equipment. In Russia, this method of payment is already becoming popular in the sales of motor vehicles. As for trucks, buses, special and farming machinery, this scheme is just beginning to be applied [5].

The old equipment purchased from customers under the trade-in scheme undergoes a predelivery inspection with the replacement of all defective units and assemblies, and then is put up for sale [19].

Advantages of trade-in:

(i)An agricultural producer gets rid of unclaimed equipment with minimum fuss, without wasting time searching for a buyer [10].

(ii)The farmer gets new equipment immediately, and not after the old one is sold.

(iii)The agricultural producer minimizes the amount of money needed for the new equipment.

(iv)The agricultural producer optimizes its tax base.

(v)An agricultural producer forms a machine and tractor fleet for specific tasks, exchanging used machinery that is not needed at this point for new one that is required now [16].

A scheme for selling tractors using the trade-in technology

The uniqueness of the trade-in agreement is that it combines two processes: the sale of the old and the purchase of the new equipment [1].

Figure 3 shows a scheme for selling tractors by OOO "Trading Company MTZ-Sibir" through the trade-in technology.

1. An agricultural commodity producer goes to OOO "Trading Company MTZ-Sibir" to purchase a tractor "Belarus". Then a sales contract or a TRADE-IN sales contract can be concluded with a discount and gift to the buyer in the form of a BELARUS brand wrench kit. Also, a service agreement is concluded, within the framework of which it is possible to purchase a package of services allowing the client to apply for services to OOO "Trading Company MTZ-Sibir". Three types of service packages are implemented in

the organization: - Starter Package: warranty service with a dealer guarantee;

- Basic Package: "Starter package" plus 24-hour service response;
- VIP package "Starter package" plus "Basic package" plus offering of replacement equipment for the period of repair.

2. In case of customer complaint on, in his opinion, a poor-quality service, expressed orally or in writing, and requiring a response, reaction of the manufacturer or seller, service specialists will directly visit the agricultural producer. A minor malfunction will be promptly eliminated, and if complicated repairs are required, the farmer will be provided with a similar equipment from the fleet of replacement vehicles of OOO "Trading Company MTZ-Sibir".

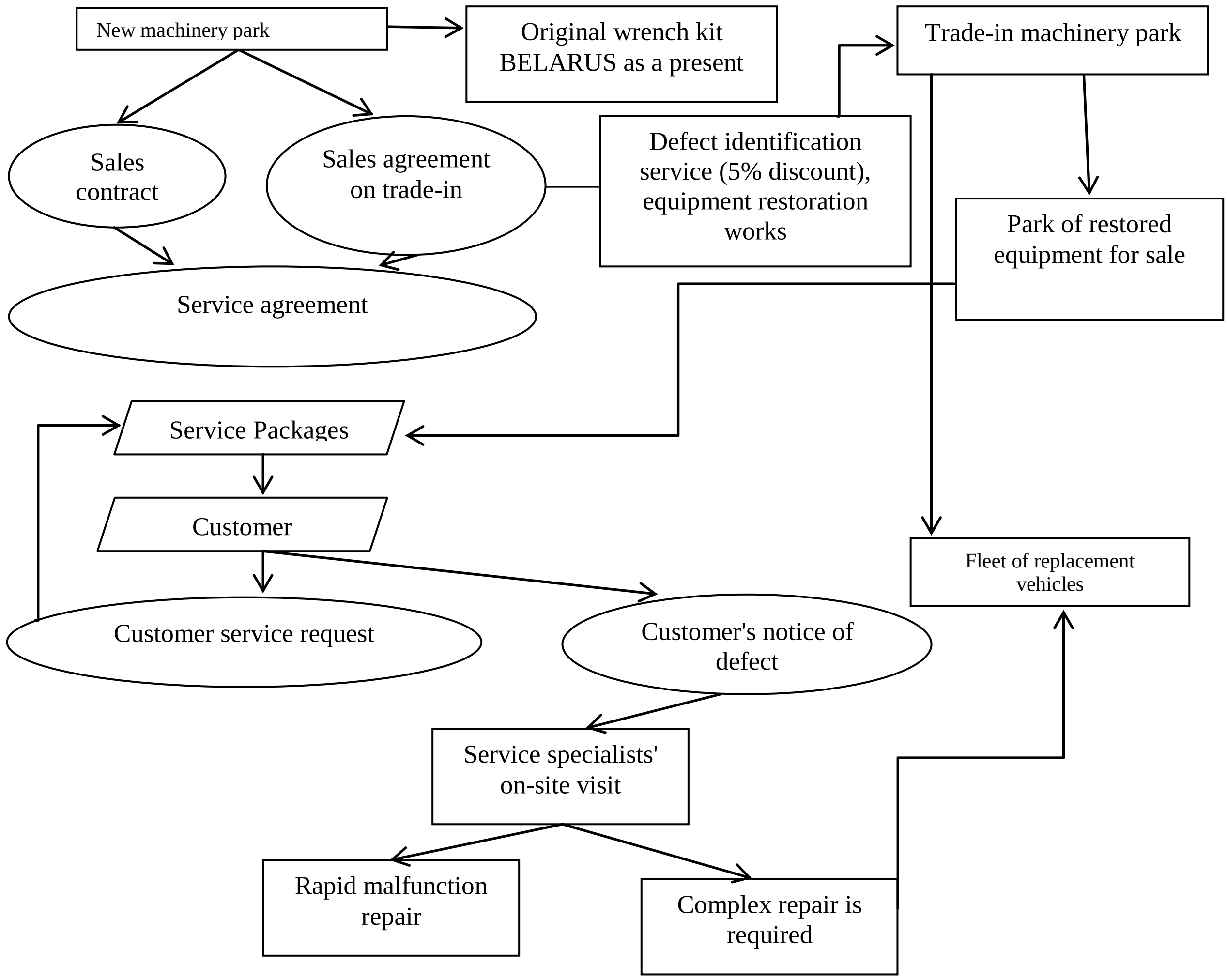


Fig. 3. Mechanism for selling tractors by OOO "Trading Company MTZ-Sibir".
Source: developed by the authors.

The fleet of replacement vehicles is formed through the sale of trade-in sales contracts. After the receipt of used tractors, OOO "Trading Company MTZ-Sibir" carries out a defect identification, as well as works to restore the equipment. As a result, a fleet of replacement vehicles and a fleet of restored equipment are being formed for sale.

In the absence of necessary spare parts and accessories or the occurrence of long-term repairs (complex repairs), the trading company can offer the agricultural producer, for the time of repair, replacement machinery from the TRADE-IN fleet. In case of his consent, an invoice for prepayment is issued and delivery of the equipment is carried out within 5 hours (provided that the remoteness of the farm is not more than 200 km).

OOO "Trading Company MTZ-Sibir" delivers the equipment in accordance with the certificate of delivery and acceptance. After the full repair/renovation of the warranty claim equipment, the calculation of the replacement equipment use is made and the final bill is issued to the agricultural producer. The acceptance of the replacement equipment is also carried out through the act of delivery and acceptance. If the state of the replacement equipment is different from the act of delivery and acceptance, discrepancies marks are made, and the agricultural producer is billed in the case of his fault.

Aftersales service mechanism

Let us consider in detail the mechanism of aftersales service of OOO "Trading Company MTZ-Sibir". Alongside with the purchase of the tractor, the company concludes a service agreement with the customer with the possibility to purchase one of the above service packages. In case of a customer's complaint about any malfunction of the tractor (notice of defect), first, the company's engineer concludes an agreement with him for the provision of services (to be safe), and, secondly, prepares service teams for visit to the site of breakdown. As already mentioned above, simple breakdowns are eliminated on site, and in case of complex ones, the equipment is transferred according to the act and the replacement tractor is delivered from the trade-in fleet for the period of repair works.

At the same time, the service agreement can be concluded not only with the clients of OOO "Trading Company MTZ-Sibir", but with third-party agricultural producers, too.

A notice of defect is a buyer's claim against the seller or supplier regarding the improper quality of the delivered goods during the warranty period.

In that way, the customer's notice of defect is realized as follows (Figure 4):

(i)A customer's notice of defect on the operation of machinery and equipment during the warranty period can be received by the technical service department either in written or oral form. It is accepted by a service engineer.

(ii)Consideration of the application for warranty repair can be initiated if the machinery and equipment:

(iii)were acquired in "Trading Company MTZ-Sibir" (confirmed by the relevant fiscal documents);

(iv)notices of defect on the operation of the machinery and equipment are made during the warranty period of operation of this machinery and equipment as of the date of the customer's appeal;

(v)were serviced by specialists of the maintenance service department, in accordance with the service agreement (if available).

The service engineer is responsible for the quality of work performed in accordance with the requirements of the service agreement, as well as for accepting the results of the work by the customer, including the completion and signing of the relevant fiscal and basic documents. The acceptance and registration of a customer's notice of defect are carried out continuously.

After receiving a client's claim, notice of defect on the operation of the machinery and equipment (hereinafter notices of defect), the service engineer:

-checks for the availability of a concluded service agreement;

-assesses the conditions on the basis of which the equipment will be repaired.

In the event that a service agreement with the customer is not concluded, the service engineer: sends a request to the client to provide a package of documents for the consideration of the notice of defect.

In the event that the service agreement has been concluded with the customer, the service engineer verifies with the customer the fulfillment of the service agreement terms for the machinery and equipment specified in the complaint. On the basis of the documents' analysis (package of documents sent by the client or the service agreement), the service engineer draws up and forwards to the immediate supervisor an acceptance conclusion (or refusal) of the notice of defect for approval. The conclusion on accepting a notice of defect may be a phone call or an e-mail containing a notice that repair works during the warranty period will be initiated after the client has agreed on the terms of an on-sight visit and execution of work (Figure 5).

The conclusion on the notice of defect refusal must be executed in the form of a letter using official or registered correspondence at the stage of consideration of the submitted package of documents and is accepted in the following cases: the contractual warranty period for the machinery and equipment is expired, the installation and operation of machinery and equipment have been performed with violation of its installation and operation conditions; the routine maintenance has not been made, or has not been carried out in full; the notice of defect refers to the machinery and equipment not purchased in the trading company; the received package of documents does not correspond to the requested one, and the submitted documents are issued in violation of the established requirements; there are violations or non-fulfillment of the requirements (conditions) of the contract of sale; there are violations or non-fulfillment of the requirements (conditions) of the service agreement.

Main activities of the service team

The service engineer, following the results of the taken decision, performs the following actions:

(i)if the equipment failure is not recognized as a warranty case, calls up the client, through e-mail or fax sends the client a dismissal of the notice of defect, invites the client to carry out commercial repairs, and issues a provisional invoice;

(ii)if the equipment failure is recognized as a warranty case, specifies information about the nature of the failure, the form of its manifestation, etc., with the purpose of preliminary determining the components, units and assemblies that require repair or replacement (to form a fund of spare parts for the on-sight visit), as well as the probability of the exploitation or manufacture fault;

(iii)in case the client agrees to carry out commercial repairs, requires them to guarantee payment (letter of guarantee);

(iv)after receiving the payment guarantee, organizes a visit to the client.

The service engineer coordinates with the client the terms of departure of the service team for repair works and performs the following actions:

(v)forms the composition of the service team, depending on the complexity group;

(vi)in the event that the customer service is located at a significant distance from the client and the insignificance of the operation of machinery and equipment failure, the service engineer may, in agreement with the immediate supervisor, entrust the elimination of the failure to a third-party organization;

(vii)issues a signed and printed work order to the service team for obtaining spare parts and consumables from the storekeeper;

(viii)instructs the service team on the scope of work to be performed, controls the departure, as well as the preparation of all necessary documents: notice of defect; certificate of completion; invoice.

(ix)notifies the service team of the scope of work to be performed, supervises the departure, as well as the preparation of all the necessary documents (notice of defect, certificate of completion, invoice).

Upon arrival to the client, the service team:

-checks the availability and correctness of registration of the originals of technical and maintenance documentation for the failing machinery or equipment;

-makes a full inspection of the machinery and equipment for detecting violations of operating and maintenance rules.

-if violations of operating and maintenance rules are revealed, notifies the customer about the removal of obligation for warranty, draws up an act of notice of defect, and proposes to eliminate the failure of machinery and equipment on a fee paid basis.

In the event that the client refuses the paid repair, the service team makes a note in the act of notice of defect about the failure in the operation of machinery and equipment by the fault of the client and organizes the signing of the notice of defect by the client.

-in the absence of violations of the rules of operation and maintenance, repairs the machinery and equipment with replacement, if necessary, of damaged parts, assemblies and units with new ones, performs repair work in accordance with agreements with the client.

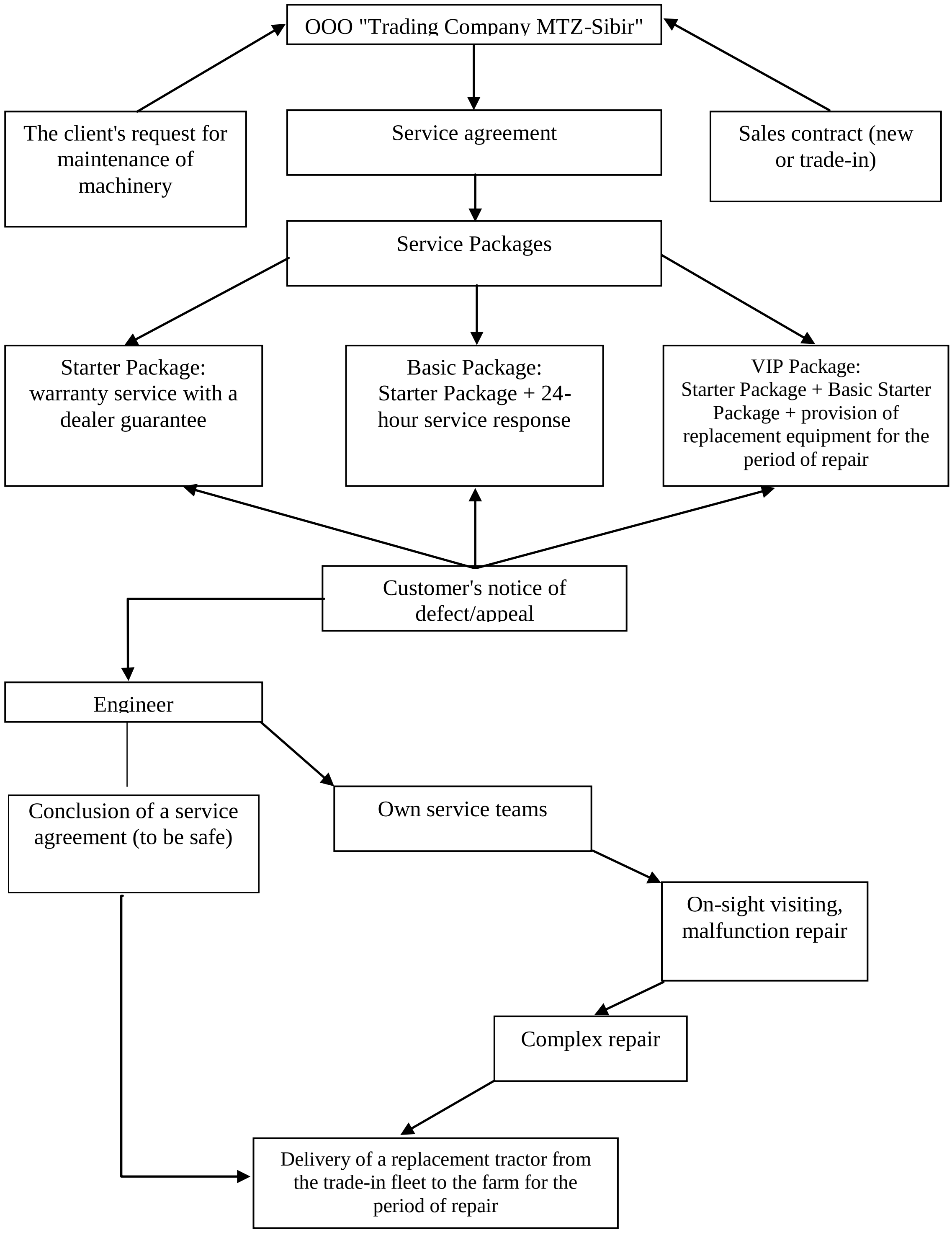


Fig. 4. After-sales service of OOO "Trading Company MTZ-Sibir".
Source: developed by the authors.

When carrying out commercial repairs, the service team transmits the replaced parts, assemblies and units to the customer and issues an invoice. In case of warranty repair, the service team returns the replaced parts, assemblies and units to the warehouse. Regardless of the type of repair (warranty or commercial), the service team, based on the results of the work, makes up two copies of the act of notice of defect and ensures its signing by the client.
-after the completion of the repair work, provides the client with a questionnaire for assessing the customer satisfaction score.
Upon return, the service team hands over a customer satisfaction questionnaire and

documents to the service engineer for releasing an official letter to the client, signs the act of removal of equipment from the warranty service and invoices for the on-sight visit at the immediate supervisor's office.

Specificity of the procedure of the complex repair of equipment

In cases of "complicated repair" (lack of spare parts for repair, repair of equipment for more than 1 day, etc.).

(i)The service engineer, when accepting a notice of defect from the client, initially assesses the scale of repair of the equipment in comparison with a company's capabilities (availability of free service crews, availability of necessary spare parts, conditions for repairs, etc.);

(ii)In the case of "complicated/permanent repair" of equipment, to avoid equipment downtime during the agricultural season and violation of the agrotechnical terms, the service engineer offers the customer a replacement tractor from the fleet of trade in campaign vehicles;

(iii)Given the client's consent, the service engineer:

-chooses the necessary tractor from the trade-in fleet;

-calls up and agrees with the trading company on the delivery of the tractor to the client (a contract with the trading company is concluded in advance);

-calculates the preliminary cost of renting a tractor (the estimated lease time is determined by the tractor's repair time) + shipping cost;

-provides the invoice to the client for tractor rental advance payment, and requests from them a letter of guarantee;

-forms the entire package of documents for the replacement tractor and sends it with the driver to the service team (availability of a laptop and a portable printer within the service team is welcome, as well as a digital device for visualizing the technique during delivery and acceptance);

-when a replacement tractor arrives to the customer, the service team personnel will personally transfer it to the client's representative, after delivery and acceptance, sign the required package of documents and accept from the customer the original prepayment of services guarantee letter;

-the service engineer, having received information from the service team on the tractor's breakdown scale, calls up the customer, and the following is determined:

(a)Repair of the tractor at the customer's sight.

(b)Repair of the reclamation tractor at the service premises of the company (in this case, to motivate the customer, they can be informed that the transportation of the tractor is free of charge).

(c)The customer repairs the tractor themselves (only in case of commercial repairs).

-after the recovery of the client's tractor, they are billed for the services provided (repair + replacement tractor rental);

-after the invoice is paid by the client, the repaired tractor is delivered to them and the replacement tractor is returned according to the certificate of delivery and acceptance. The process of delivery and acceptance of the equipment takes place with the personal presence of a service engineer or service team;

-in the event that a breakdown/defect due to the customer's fault is detected during the delivery and acceptance of the replacement tractor, the service engineer makes a mark in the certificate of delivery and acceptance, notifies/proves to the customer their fault and checks the customer's confirmation of this by their signature (under power of attorney) in the certificate of delivery and acceptance.

When the replacement tractor arrives to the premises of the company, the service engineer performs an identification of defect occurred due to customer's fault, calculates it in terms of value, invoices the customer and monitors the payment from the customer.

Thus, the service system of OOO "Trading Company MTZ-Sibir" is as follows: in case of customer complaint on, in his opinion, a poor-quality service, expressed orally or in writing, and requiring a response, reaction of the manufacturer or seller, the service specialists will directly visit the agricultural producer. A minor malfunction will be promptly eliminated, and if complicated repairs are required, the farmer will be provided with a similar equipment from the fleet of replacement vehicles of OOO "Trading

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Company MTZ-Sibir". This mechanism is an effective tool for increasing the material and technical security of agricultural producers in the Novosibirsk Region as well as for increasing the dealer's sales and improving the quality of services provided [4].

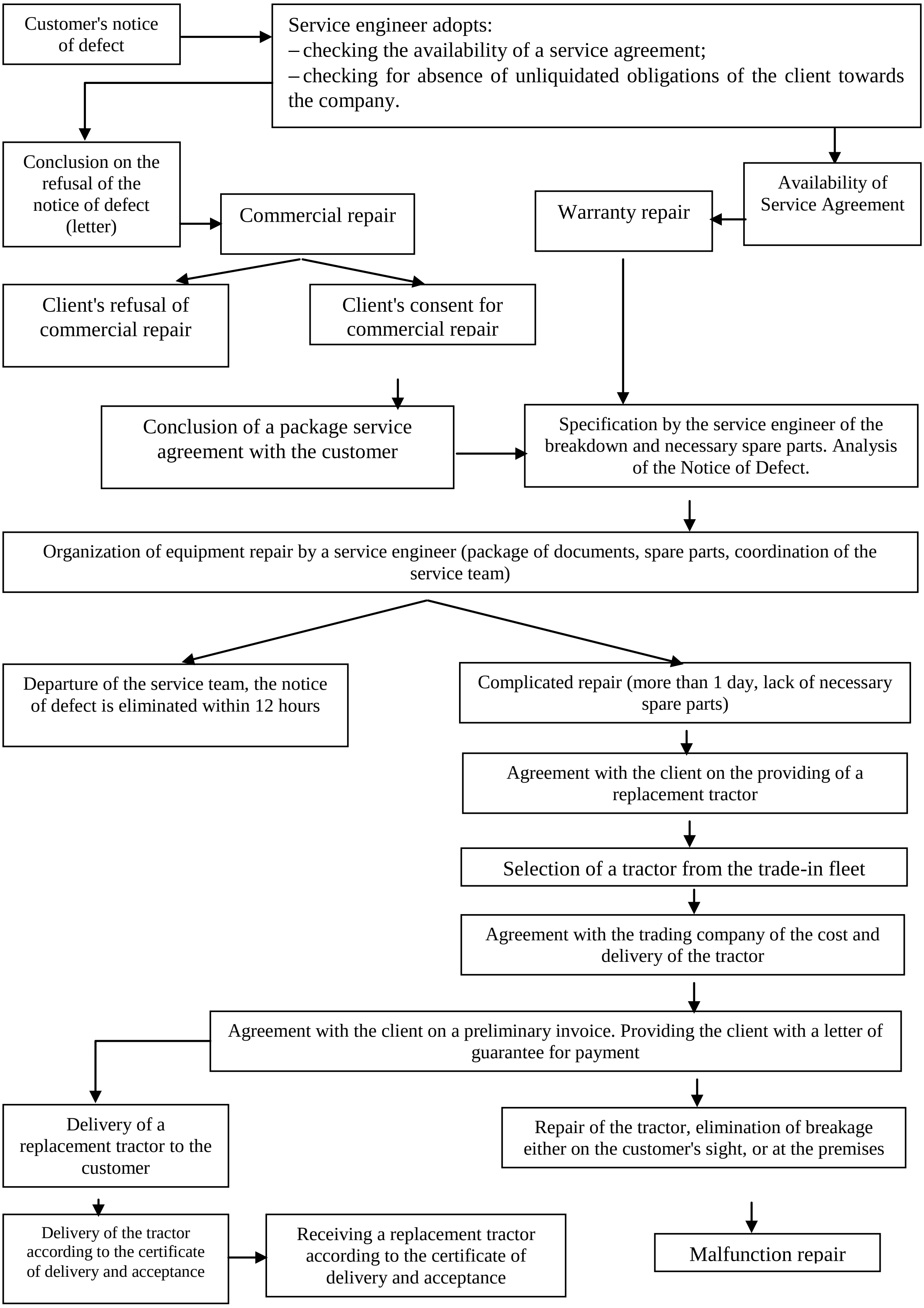


Fig. 5. Algorithm of tractor aftersales service.
Source: developed by the authors.

Losses in crop and animal production as a result of idle machinery

The economic efficiency of the mechanism proposed by us is determined by the reduction in the amount of losses of crop and animal products as a result of the downtime of farming machinery.

Here we calculate the estimated losses per day and per hour (Table 3).

To determine crop losses in crop production due to a tractor failure, we identified 4 types of work carried out by this equipment: tillage, pre-sowing works, sowing and harvesting. Two types of crops were also considered: milling grain (1st class wheat) and coarse grain crops (5th class wheat), which were used to feed animals. The yield index is the average for the last 3 years in the farms of the Novosibirsk Region. For the first type of crops it is 14 dt/ha, for the second one – 17 dt/ha. As a result of determining the approximate losses of crops, it was found that the greatest amount of losses of the1st class wheat occurred during the harvesting period – up to 26.6 kg/ha per day and, respectively, 0.06 kg/ha per hour. For coarse grain crops, the situation was similar, here losses during harvesting and sowing were the same and amounted to 11.9 kg/ha.

To calculate the yield losses in rubles, the average prices for wheat at the end of the year were used during the period from 2015 to 2017. In our case, this was 8,776 rubles per tonne without VAT.

Thus, we identified losses in crop production during the idle time of a single tractor.

Table 3. Crop losses as a result of deviations of the field work completion time from the agrotechnical one

Crop	Type of work	Productivity, dt/ha	Type of CROP	Approximate crop losses, kg/ha		Approximate yield losses, rub/ha	
				per day	per hour	per day	per hour
Milling grain	Tillage	14	1st class wheat	1.54	0.06	13.4	0.6
	Presowing	14	1st class wheat	7	0.29	60.9	2.5
	Sowing	14	1st class wheat	11.2	0.47	97.4	4.1
	Harvesting	14	1st class wheat	26.6	1.11	231.4	9.6
coarse grain crops	Tillage	17	5th class wheat	1.87	0.08	16.3	0.7
	Presowing	17	5th class wheat	8.5	0.35	74.0	3.1
	Sowing	17	5th class wheat	11.9	0.50	103.5	4.3
	Harvesting	17	5th class wheat	11.9	0.50	103.5	4.3

Source: http://mtzsibir.ru/

Now let us calculate the same index for animal production. In this industry, milk losses occur due to untimely feeding of animals and their underfeeding (Table 4).

The intensity of losses in the cases considered differs. As a result of underfeeding of cows in the dry period due to breakage of the tractor, the yield of milk throughout the herd decreases by 10-22%, depending on the degree of underfeeding. In connection with the untimely feeding of animals due to breakage of the tractor, the milk yield is reduced by 5-8% throughout the livestock.

Table 4. Losses in animal production due to idle machinery

Cause of losses in animal production	Average milk yield per cow and day, (l)	Average amount of milk losses, (l/day)	Cost of milk purchase, (rub/l)	Loss of profit from 1 liter, (rub/day)
Underfeeding of cows in the dry period due to breakage of the tractor	11.6	2.6	19	49.4
Untimely feeding of animals due to breakage of the tractor	11.6	0.9		17.1

Source: http://mtzsibir.ru/

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

On an average in the Novosibirsk Region, the daily milk yield per cow is 11.6 liters, of which 2.6 liters are lost as a result of underfeeding, 0.9 liters - as a result of untimely feeding of animals. The average purchase price for milk is 19 rubles per liter. Accordingly, the loss of profit of farms in the first case is equal to 49.4 rubles/day, and in the second case is 17.1 rubles/day on one cow.

Table 5. Calculation of a tractor's idle time

Index	New equipment	Equipment with a useful lifetime of no more than 10 years	Technique, with a useful lifetime of more than 10 years
% of the time for current repairs and service	5	10	20
Number of days in the agr. season (May-October)	180		
Number of work hours per day (08:00-22:00)	13		

Source: http://mtzsibir.ru/

In connection with the absence in the agricultural organizations of a specially dedicated staff unit for calculating the idle time of equipment during the period of agricultural work, the following action plan of actions was made a rule (Table 5).

Downtime calculation

The algorithm for calculating the downtime is as follows: 5% of working time for the new equipment, 10% for the equipment no older than 10 years, 20% for the equipment older than 10 years. The results of the downtime calculation are presented in Table 6.

Table 6. Tractor downtime

Type of equipment	New equipment		Equipment with a useful lifetime of no more than 10 years		Technique, with a useful lifetime of more than 10 years	
Tractor	No. of days per season	No. of hours per shift	No. of days per season	No. of hours per shift	No. of days per season	No. of hours per shift
	9	0.65	18	1.3	36	2.6

Source: http://mtzsibir.ru/

The older the equipment, the more days in a season it costs: 9 days for the new one, 4 times more – 36 days over for the equipment older than 10 years.

Thus, we determined how long the tractor is idle for one agricultural season and how much money is lost by the farm as a result. However, the mechanism for creating a fleet of replacement vehicles prevents these losses.

In the Novosibirsk Region, this mechanism was tested at four farms: ZAO "Kubanskoe" of the Kargatsky district, ZAO "Bobrovskoye" of the Suzunsky District, OAO "Priobskoye" of the Novosibirsk Region, and ZAO "Skala" of the Kolyvan District. The above organizations purchase tractors from OOO "Trading Company MTZ-Sibir". Table 7 shows the number of tractors in these farms.

We will calculate the loss of money by farms as a result of a tractor failure. The age of tractors is no more than 10 years, accordingly, 1 tractor is idle 18 days in a season. As already mentioned above, we identified 4 types of work, to each of which falls within 4.5 days (uniform distribution).

That is, for the 1st class wheat losses of profits will be:

-13.4 rub/ha × 4.5 days = 60.3 rub/ha during tillage;

-60.9 rub/ha × 4.5 days = 274.1 rub/ha during presowing works;

-97.4 rub/ha × 4.5 days = 438.3 rub/ha during sowing;

-231.4 rub/ha × 4.5 days = 1041.3 rub/ha during harvesting.

With the change of the type of work, the value of the crop, which can be lost, grows. In total, due to the downtime of one tractor, the farm will lose 1,814 rubles per each hectare of arable land.

Let us make a similar calculation for the animal production:

-Owing to the underfeeding of cows, 49.4 rubles are lost per one cow per day.

Downtime is 18 days per season.
-Because of the untimely feeding of animals, 17.1 rubles are lost per one cow per day. Downtime is 18 days per season.

Table 7. Availability of tractors with agricultural producers in the Novosibirsk Region, which are using the replacement vehicles fleet mechanism

Organization Name and Location	Tractor Brand	Quantity, pcs.	Total MTZ Tractors in the Farm, pcs.
ZAO "Kubanskoe", Kargatsky district	Belarus-82.1	13	18
	Belarus-82.1MK	2	
	Belarus-922.3	2	
	Belarus-1221.2	1	
ZAO "Bobrovskoye", Suzunsky district	Belarus-80.1	9	20
	Belarus-82.1	6	
	Belarus-922.3	2	
	Belarus-1221.2	3	
OAO "Priobskoye", Novosibirsk Region	Belarus-80.1	2	20
	Belarus-82.1	12	
	Belarus-1223	3	
	Belarus-1221.2	2	
	Belarus-1523	1	
ZAO "Skala", Kolyvan district	Belarus-80.1	6	26
	Belarus-82.1	15	
	Belarus-920	2	
	Belarus-921	1	
	Belarus-922.3	2	

Source: http://mtzsibir.ru/

The economic efficiency of the aftersales service mechanism

Calculations showed that if, in case of a tractor failure, the replacement tractor delivery mechanism did not work, then the farms under investigation would lose considerable money, for example, ZAO "Kubanskoe" would lose more than 13 million rubles per year only in crop production (Table 8).

Table 8. Losses in crop and animal production as a result of one tractor downtime

Name of the company	Area of arable land, ha	Losses in crop production, ths. rub	No. of dairy cows, animal units	Losses in animal production, ths. rub	
				underfeeding	untimely feeding
ZAO "Kubanskoye"	7,312	13,264	1,000	889	308
ZAO "Bobrovskoye"	8,690	15,764	830	738	256
OAO "Priobskoye"	620	1,124	-	-	-
ZAO "Skala"	6,984	12,669	651	579	201

Source: developed by the authors

At the same time, the more the acreage or the number of dairy cows, the greater the loss of production.
As a result, the total losses of agricultural organizations will amount to 14,661 thousand rubles in ZAO "Kubanskoe", 16,758 thousand rubles in ZAO "Bobrovskoye", 1,124 thousand rubles in OAO "Priobskoye", and 13,449 thousand rubles in ZAO "Skala". The result of the proposed measures and shortening the downtime of agricultural machinery will be a significant increase in revenues from the sale of agricultural products, as well as performance indicators of farms: the level of profitability of production and sales, as well as cost recovery of the main production (Table 9).
Next, we will make similar calculation of the total losses of all agricultural organizations in the Novosibirsk Region (Table 10). The number of forage-fed cows in the region is 127.5 thousand animal units, the area of arable land is 2,204.6 thousand hectares.
Consequently, the downtime of just one

tractor for a period of 18 days during the agricultural season leads to a shortage of revenues of agricultural organizations in the amount of 3,999,061 thousand rubles in crop production and 152,618 thousand rubles inanimal production.

Table 9: Calculation of the effectiveness of the proposed measures for selected farms

Activities		ZAO "Kubanskoye"	ZAO "Bobrovskoye"	OAO "Priobskoye"	ZAO "Skala"
Revenues from sales, ths. rub	de facto	181,656	146,883	100,664	113,745
	planned	196,117	163,641	101,788	127,194
Cost of sales, ths. rub	de facto	165,817	128,822	81,447	91,662
	planned	165,817	128,822	81,447	91,662
Gross profit, ths. rub	de facto	15,839	18,061	19,217	22,083
	planned	30,300	34,819	20,341	35,532
Cost of the main production, ths. rub	de facto	211,967	211,812	90,690	153,334
	planned	211,967	211,812	90,690	153,334
Production profitability, %	de facto	9.6	14.0	23.6	24.1
	planned	18.3	27.0	25.0	38.8
Profitability of sales, %	de facto	8.7	12.3	19.1	19.4
	planned	15.4	21.3	20.0	27.9
Main production cost recovery, %	de facto	85.7	69.3	111.0	74.2
	planned	92.5	77.3	112.2	83.0

Source: developed by the authors

Table 10. Calculation of losses of farms in the Novosibirsk Region in 2016 as a result of idle agricultural equipment

Region	Area of arable land, ha	Losses in crop production, ths. rub	No. of dairy cows, animal units	Losses in animal production, ths. rub	
				underfeeding	untimely feeding
Novosibirsk Region	2,204,554	3,999,061	127,500	113,373	39,245

Source: developed by the authors

Using the mechanism of providing the tractor from the fleet of replacement vehicles for the period of repair would allow the region's agricultural organizations to significantly improve their financial results (Table 11).

The result of the use of a tractor from a replacement vehicles fleet will result in an increase in sales revenues by an average of 10.5%, and gross profit by 57.6%. The efficiency of production will also increase: production profitability up to 35.1%, profitability of sales up to 26%, main production cost recovery up to 101.5%.

Table 11. Calculation of the effectiveness of the proposed measures for the agricultural organizations of the Novosibirsk Region

Index	De Facto as for 2016	Planned	Deviation	
			%	±
Revenues from sales, ths. rub	39,550,859	43,702,538	110.5	415,1679.0
Cost of sales, ths. rub	32,338,299	32,338,299	100.0	0.0
Gross profit, ths. rub	7,212,560	11,364,239	157.6	415,1679.0
Cost of the main production, ths. rub	43,039107	43,039,107	100.0	0.0
Production profitability, %	22.3	35.1	x	12.8
Profitability of sales, %	18.2	26.0	x	7.8
Main production cost recovery, %	91.9	101.5	x	9.6

Source: developed by the authors.

As already mentioned above, this calculation was made only for the situation when one tractor broke down. In practice, the number of broken tractors is greater, hence, financial indicators would be higher if tractors from the fleet of replacement vehicles would be used for the time of repair use.

CONCLUSIONS

Constant breakdown of equipment during the execution of technological operations significantly prolong their time, which inevitably leads to the loss of production. At the same time, the annual scrapping of equipment exceeds new machinery put into service. The improvement of machinery for agricultural organizations in the Novosibirsk Region for the period under review was 7-34%, while it was by 80% due to the acquisition of agricultural machinery used in the operation by other organizations.

In order to reduce the downtime of agricultural equipment, we offer a service mechanism based on the creation of a fleet of replacement vehicles at OOO "Trading Company MTZ-Sibir". Alongside with the purchase of a tractor, the trading company concludes a service agreement with the agricultural producer with the possibility to purchase one of the service packages. In case of a customer's complaint about any malfunction of the tractor, first, the company's engineer concludes an agreement with him for the provision of services (to be safe), and, secondly, prepares service teams for visit to the site of breakdown. Simple breakdowns are eliminated on site, and in case of complex ones, the equipment is transferred according to the act and the replacement tractor is delivered from the trade-in fleet for the period of repair works. The fleet of the replacement equipment is created by means of the trade-in mechanism, within the framework of which OOO "Trading Company MTZ-Sibir" purchases an old tractor from the agricultural producer and sells instead a new tractor with a significant discount.

REFERENCES

[1]10 glavnykh prichin polomok selskokhozyaistvennogo oborudovaniya [10 Main Reasons for the Breakdown of Agricultural Equipment]. (2011). Retrieved August 2, 2017, from http://cpectehnika.ru/articles/10_glavnykh_prichin_polomok_selskokhozyaystvennogo_oborudovaniya_5660/

[2]Belaits, D.S., 2017, Analiz sostoyaniya mashinno-traktornogo parka selkhoztovaroproizvoditelei Novosibirskoi oblasti [Analysis of the Condition of the Machine and Tractor Fleet of the Novosibirsk Region's Agricultural Producers]. In Ekonomika i upravlenie v XXI veke: tendentsii razvitiya [Economics and Management in the 21st Century: Progress Trends] (pp. 123-127). Novosibirsk.

[3]Belaits, D.S., 2017, Mekhanizm tekhnicheskogo perevooruzheniya selskokhozyaistvennykh proizvoditelei Novosibirskoi oblasti [The Mechanism of Technical Reequipment of Agricultural Producers in the Novosibirsk Region]. Ekonomika i predprinimatelstvo, 4-2(81-2), 862-867.

[4]Belaits, D.S., 2017, Sovershenstvovanie sistemy servisnogo obsluzhivaniya selskokhozyaistvennoi tekhniki (na primere OOO "TD MTZ-Sibir") [Improving the System of the Farm Machinery Maintenance Service (the Case of OOO "Trading Company MTZ-Sibir")]. Konkurentosposobnost v globalnom mire: ekonomika, nauka, tekhnologii, 5, 10-12.

[5]Chto takoe Trade-in? [What is Trade-in?], 2015, Retrieved August 12, 2017, from http://megapoisk.com/trade-in-pljusy-i-minusy

[6]Deere, J., 2013, Sdelki Trade-in povliyali na rost prodazh tekhniki John Deere [Trade-in Deals Affected the Growth in Sales of John Deere Equipment]. Retrieved September 1, 2017, from http://www.deere.ru/ru_RU/our_company/news_and_media/press_releases/2013/forestry/tradein.page

[7]Effektivnoe obnovlenie parka spetstekhniki po programme Trade-in [Effective Improvement of the Special Equipment Fleet upon the Trade-in Program]. (n.d.). Retrieved September 1, 2017, from http://lifters-loaders.ru/effektivnoe-obnovlenie-spectexniki-trade-in.html.

[8]Ilina, I.V., Sidorenko, O.V., 2008, Vliyanie resursoosnashchennosti na effektivnost selskokhozyaistvennogo proizvodstva [Influence of Resource Endowment on the Agricultural Production Efficiency]. Ekonomicheskii analiz: teoriya i praktika, 1, 45.

[9]Ministry of Agriculture of the Novosibirsk Region, 2017, Sostoyanie selkhoztekhniki (zimoi). Otchetnost na 1 aprelya 2017 g. Operativnyi analiz po Novosibirskoi oblasti [Status of Agricultural Equipment (In Winter). Reporting as of April 1, 2017. Operational Research of the Novosibirsk Region]. Retrieved August 2, 2017, from http://www.mcx.nso.ru/sites/mcx.nso.ru/wodby_files/files/wiki/2014/11/33.2._sostoyanie_selhoztehniki_zimoy.pdf

[10]O proizvoditele [About the Manufacturer]. (n.d.). Retrieved August 13, 2017, from http://mtzsibir.ru/

[11]Perspektivy razvitiya rynka selkhoztekhniki [Prospects for the Development of the Agricultural Equipment Market]. (2012). Retrieved August 10, 2017, from https://agroinfo.com/perspektivy-razvitiya-rossijskogo-rynka-selxoztexniki/.

[12]Polukhin, A.A., 2012, Vliyanie rynochnoi konyunktury na formirovanie traktornogo parka selskokhozyaistvennykh organizatsii Rossii [Influence of Market Conditions on the Formation of the Tractor

Fleet of Russian Agricultural Organizations]. Sovremennaya konkurentsiya, 34(4), 53-60.
[13]Praktika trade-in ukreplyaetsya na rynke selkhoztekhniki [Practice of Trade-in Strengthens in the Market of Agricultural Equipment]. (2013). Retrieved September 1, 2017, from http://agro2b.ru/ru/news/11477-Praktika-TRADE-ukreplyaetsya-rynke-selhoztehniki.html.
[14]Servis i obsluzhivanie selkhoztekhniki [Service and Maintenance of Agricultural Machinery]. (n.d.). Retrieved August 10, 2017, from http://solarfields.ru/blog/sh-mashinostroenie/selskohozyaystvennoe-mashinostroenie/servis-i-obsluzhivanie-selhoztehniki
[15]Shelkovnikov, S.A., Petukhova, M.S., 2015, Otsenka effektivnosti gosudarstvennoi podderzhki tekhnicheskoi modernizatsii selskogo khozyaistva [Evaluation of the Effectiveness of State Support for the Technical Modernization of the Farming Industry]. Ekonomika i biznes. Teoriya i praktika, 1, 122-125.
[16]Shelkovnikov, S.A., Petukhova, M.S., Kononova, N.N., 2015, Razvitie gosudarstvennoi podderzhki tekhnicheskogo perevooruzheniya selskokhozyaistvennogo proizvodstva v Novosibirskoi oblasti [Development of State Support for the Technical Reequipment of the Farming Industry in the Novosibirsk Region]. Ekonomika i predprinimatelstvo, 11(2), 289-292.
[17]Tekhnika Massey Ferguson teper dostupna v trade-in [The Massey Ferguson Machinery is Now Available via Trade-in]. Agrosnabforum, 4(144), 34.
[18]Trade-in. (n.d.). Retrieved September 1, 2017, from http://www.agritech.ru/secondary-market/trade-in/
[19]Ushachev, I.G., 2013, Vybor innovatsionnogo puti razvitiya APK – obektivnaya neobkhodimost [The Choice of an Innovative Way of the Agrobusiness Development is an Objective Necessity]. Ekonomika selskogo khozyaistva Rossii, 9, 10.
[20]Znachenie tekhnicheskogo obsluzhivaniya selkhoztekhniki [The Importance of Maintenance of Agricultural Equipment], 2011, Retrieved August 10, 2017, from http://agroflot.ru/articles/service/.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

AGRICULTURAL LAND UNDER STRESS FACTORS INFLUENCE

Mariana BRAN[1], Iuliana DOBRE[1], Elena SOARE[2]

[1]Academy of Economic Studies, Bucharest, 5-7 Mihail Moxa Street, District 1, 010961, Bucharest, Romania, Phone:+40213119790/112, Emails: mariana.bran@eam.ase.ro, iulya_dobre@yahoo.com
[2]University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +40213182564, Fax:+40213182888, Mobile:+40744 6474 10, Email: soare.elenausamv@gmail.com

Corresponding author: mariana.bran@eam.ase.ro

Abstract

The aim of this paper is to emphasis the main trends on the Romanian vegetal products. Vegetal production has a particular importance because of its contribution to feed people and livestock, on the one hand, and, on the other hand, ensure the income for the farmers from export. The field crops placed under natural environment are constantly under the natural risk factors (weather, producing floods, droughts and so on), with unpredictable repercussions, especially under the current climate and climate conditions. The fertility ensures soil favorability for different uses, such as agricultural crops. Using quantitative statistical methods, the paper proposes an economic analysis in the period 2015-2017. These analysis shows that Romania cultivates large areas with vegetal products, ranking on the highest place to cereals. The role of management and technical methods remains a key element in Romanian agriculture in respect with good practices and sustainability.

Key words: *vegetal production, environment, agricultural land, stress factors*

INTRODUCTION

The life and human activity are food-conditioned and, alongside evolution, to be less dependent on hunting and gathered from wild fruits, people began to produce their own food. But food production leads to a high pressure on the natural balance, knowing that plants form the basis of any food pyramid, not just humans. The production of sufficient food for humans and animals goes hand in hand with keeping of other living organisms under control [17]. If these are removed from the environment (field), there is pressure on biodiversity, both directly and indirectly.

Maintaining life on earth, in its own right, has its origin in agricultural activity and others with natural resource exploitation character. By judicious management of natural resources and by resorting to the latest scientific results in the field, the vegetal products obtained in the field have diversified both by the number of species and by the cultivars, namely varieties and hybrids. It should be stressed that in the temperate climate characteristic of Romania, two productions can be obtained on the same area of land in one year [9].

The plant production is classified from many points of view and is spread under natural and artificial areas. As such, it is proposed to analyze the local Romanian natural environment exploited by field crops, ie, species with a weight in agriculture [10, 11].

As location, in Romania the forms of relief are structurally harmonious, most of the soil types are found on the continent, and the four seasons (Romania is crossed by the 45th Parallel) manage seasonally agricultural crops. The foundation of the agroecosystem, the soil (an indicator of the environmental evolution features), has received several classifications from the Romanian researchers, the latter dividing it into 12 classes. What is important is the mechanism of clay accumulation, an organic matter that, in relation to a multitude of other physic-chemical properties of the soil, promotes fertility. Ecological consequence, fertility ensures soil favorability for different uses, such as agricultural crops. Out of the total agricultural area, about 65% is occupied by field crops. From this area, considering the qualification degree (the classification of the land in quality classes - 5 classes), about 74% belong to the first 3 classes. Therefore, the arable naturally favors plant production (organic fertilizer application is indicated). The plains and partly the hilly regions are the relief forms in which the field crops spread, predominantly on cernisoils, luvisoils, but also at their interference. The soil, constantly adapting to natural and/or artificial changes in the environment, has undergone changes (in the last negative period, according to various practitioners). Managed accordingly to sustainable use, the provision of goods and services is ongoing. Determining the relative value of a land (its cost-effective use) contributes to the foundation of technologies, investments, labor remuneration in agriculture and so on.

MATERIALS AND METHODS

The amount of crop yield per unit area, such as the productivity of crops, depends on the whole set of environmental conditions as well as on the manager's experience, which can alter the natural factors or the crop's qualities to the best of the conditions natural. The soil-plant system involves numerous processes influenced by soil work, herbicide action, crop rotation, and differentiated application, depending on pedoclimatic conditions [1, 2, 4, 5, 8]. The solutions for the rational exploitation of arable land are given by the practical methods and recommended scientific applications [7]. The agronomic technique is based on the notions specific to pedology, microbiology, physics, agro-chemistry, physiology, agricultural machinery, ecology [15]. At the same time, they represent the basis of other disciplines of agronomic specialty (plant, viticulture, vegetable growing, management, agricultural economy).
In order to ensure energy security, many countries have intensified the use of energy from renewable sources such as biofuels, whose production is still - under the current global economic context - an emerging industry [14]. It is active as long as there are enough resources, the technologies are reliable, the transformation yields are high for the whole chain (the final user farmer), and biofuel prices are competitive.
Romania has the higher agricultural potential compared to the world's agricultural potential, but there are some deficiencies (structure of agricultural crops, farming systems, unqualified professional labor force, insufficient endowment and technologically outdated with machinery and equipment) which sporadically, influence economic development [16].
In order to analyze the management of vegetal production it was started from the situation of Romanian agriculture. The analysis was made at the national level for evolution of cultivated areas, yields and weights/ha in main cross in the period 2015-2017. The statistical data used in this study were taken from the National Institute of Statistics and National Agricultural Research and Development Institute. To get an overview of the vegetal production in Romanian agriculture were consulted more specialized materials.

RESULTS AND DISCUSSIONS

The scientific approach of crop yield is based on research about the living conditions and productivity of ecosystems natural and cultivated communities [3]. Based on NIS (Romanian National Institute of Statistics) data, Figure 1 shows percentage differences in cultivated areas, outputs and yields in two consecutive years (2015 and 2016) [12, 13]. There are increases in the areas cultivated with legumes for grains (without soybean) and rapeseed, species where production increases are observed, but also on yield. Decreases in surface area were registered for industrial crops, vegetables and fodder plants, all of which recorded low yields. Quantitatively, variable yields are achieved both due to climatic variability/risk, as well as the contribution of knowledge in the field and the farmer's experience.
The land and the climate provide the *support*, but the profitability is given by the input allocation, the necessity of spending, the higher the intensity of the technological system.

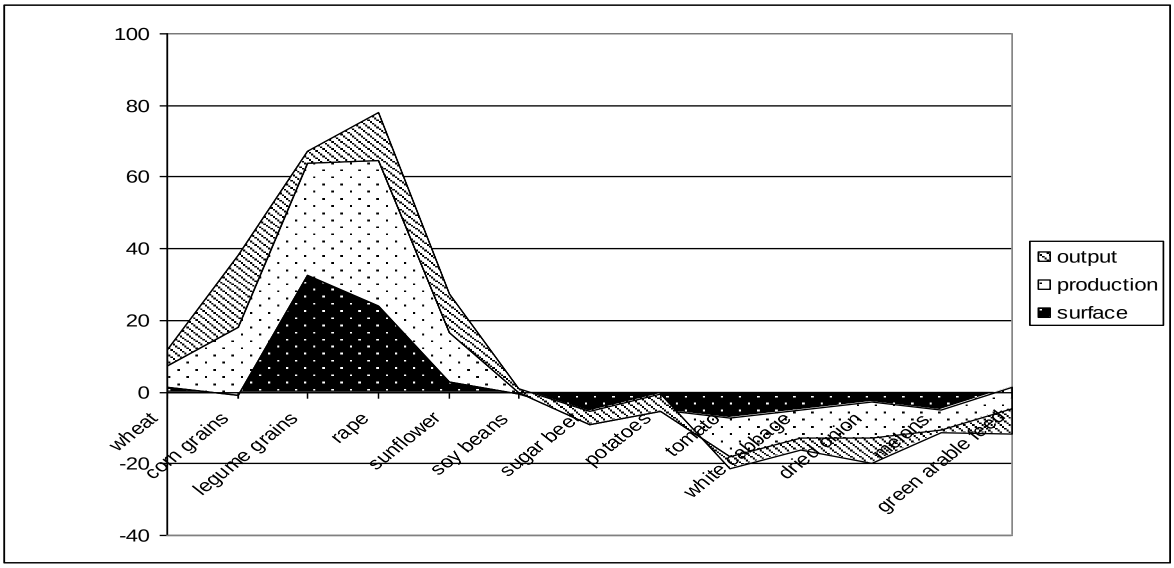


Fig.1. Evolution of cultivated areas, yields and weights/ha in main cross, 2016 as compared with 2015 (%)
Source: NIS, 2017; Author own processing based on data from http://www.insse.ro/, [13]

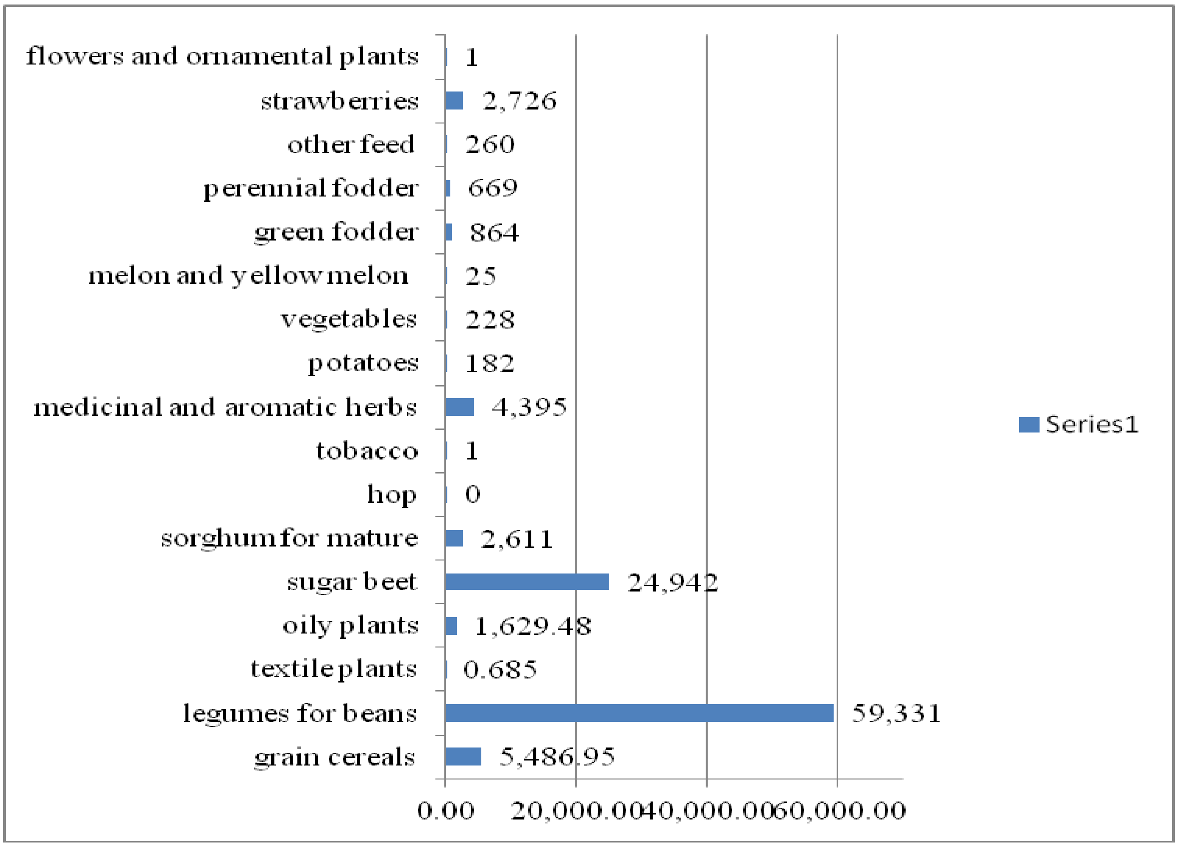


Fig. 2. Area cultivated with groups of species and species cultivated in arable land in 2016 (thousands ha)
Source: NIS, 2017; Author own processing based on data from http://www.insse.ro/, [13]

The environmentally-friendly, eco-efficient systems also require health, investment, the unitary ones being even higher than in the previous case.

Under favorable environmental conditions, mankind is provided with both food and environmental demand [6]. In Romania, crop production in arable land includes small grains, legumes, oil plants, tuber crops, sugar beet, industrial crops, tobacco, medicinal and aromatic plants, fodder plants, vegetables, strawberries, ornamental plants; they have the annual, biennial or perennial vegetation cycle. In 2016, the total area cultivated in arable land was 8,409,242 hectares, of which 4,982,912 ha in individual agricultural holdings (59.25%). The areas occupied by the crops and their structure are presented schematically in the Figure 2.

The weight of the crop species in the cultivated area of Romania in 2016 is presented in Fig.3.

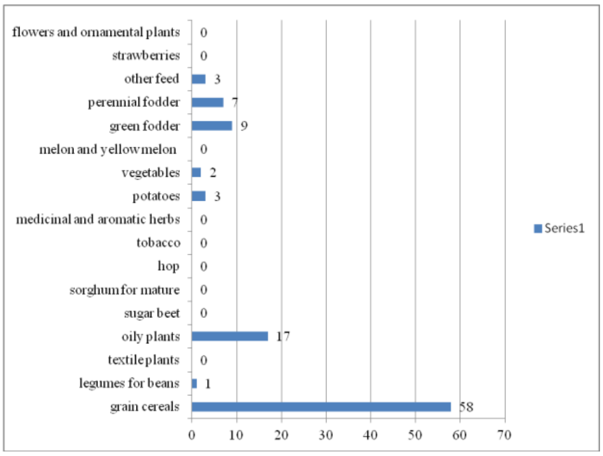


Fig.3. The share of share of crop species in the arable area in 2016 (%)
Source: NIS, 2017; Author own processing based on data from http://www.insse.ro/, [13]

Agricultural crops are important due to the existence of a main product (egg: grains/seeds, vegetative organisms, strains, green or dehydrated plants), which can be the raw matter for the food industry, light industry but also animal and poultry feed and byproduct, useful in animal husbandry or as a source of biodegradable organic matter.

From the Figure 4 it appears that the exploited arable provides large quantities of agricultural products to the population. There is a predominance of cereals, which provides bread and pasta, but also concentrated fodder and industrial raw materials (alcohol, oil, starch and so on).

In the genetic code of each plant species are written requirements for environmental conditions, which, if they are favorable, ensure adequate yields. Therefore, the ecological zoning of cultivated species is the ecological support of the agricultural production area. Thus, in relation to the ecological factors and the ecological optimum, the grouping of the natural areas was achieved by degrees of favorability.

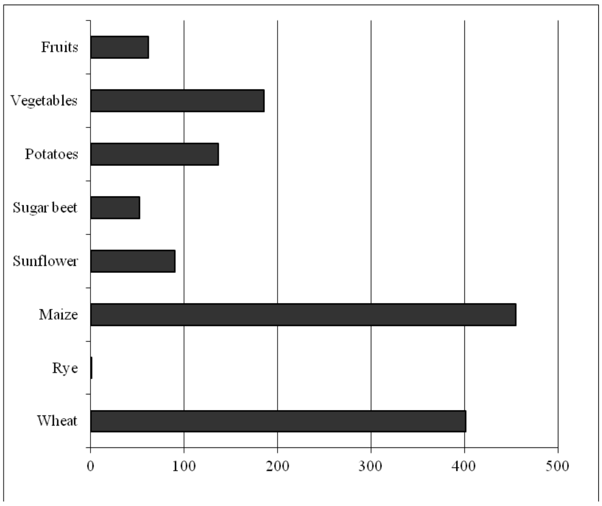


Fig. 4. Yield per capita in 2015, kg
Source: NIS , 2017; Author own processing based on data from http://www.insse.ro/, [12]

Areas are understood to mean several administrative territories that are characterized by the unity of environmental factors and which have more or less similar conditions for agricultural crops. For example, the Romanian Plain (delimited by the Danube River that drives the southern border on a distance of 840 km and north of the Hilly Regions, it is a broad strip of at least 20 km in Oltenia and a maximum of 140 km on the Zimnicea line - Piteşti) was originally dominated by steppe and forestry ecosystems, and nowadays is the area of agroecosystems, respectively fulfilling the most suitable conditions for the field crops, the production of fodder plants (grasses and leguminous plants), vegetables and so on.

However, there are crops which, although ecologically suitable for the area, do not yield yields in this area due to the lack of irrigation systems. The less favorable conditions have been amplified by the degree of land fragmentation and, implicitly, the dominance of semi-subsistence farms.

CONCLUSIONS

Romania's agricultural potential suffers because of the excessive fragmentation of property (the impossibility of intensive agro-cultivation) and the global climate changes, with a reflection on Romania (excessive frequent drought, periodic excess of humidity, erosion). As a result of the emergence of various forms of degradation, arable land losses were reported, limiting the expansion of the performing agriculture. Consequently, there must be a major interest in innovative technologies, sustainable land use systems, preventing or minimizing soil degradation, restoring productive capacity and vital processes of degraded soils.

Taking into account the market requirement, small grains are the first in their preferences, providing light industry with raw matters, fodder concentrate and coarse fodder, and, more recently, the biofuel industry (fossil fuels alternative) with starch products and biomass. Some cereal species are established in the autumn (September - October), and they harness the local moisture and temperature conditions, and others spring (March - May) and are subject to summer moisture stress. Climate risk may exist under both situations, but the farmer must manage the situation through technical tricks. However, the grain harvesting campaign debuts early in the summer and ends at the end of October. Taking into account the sowing and harvesting campaigns, it is found that more than half of the year is working intensively for cereals. National Agricultural Research and Development Institute (NARDI) Fundulea, through the activity of the field researchers, recommends for grain cereals an impressive number of varieties and hybrids (over 250), both of Romanian origin and abroad (acclimatized, but with significantly reduced yields for wheat, for example).

Also worth mentioning are oilseeds, both for the yield of food fats and for the production of biodiesel. As a result, the field species can be successfully introduced into the energy crop group. After harvesting and processing any field crops, the biomass and the biofuel raw materials are generated. The collection of all bio-organic residues in the field (lignocellulosic) is important in order not to hamper soil tillage but to perpetuate diseases and pests of successive crops and, at the same time, to the biofuel industry. The paper shown that for the vegetal production of Romanian agriculture, the following assessments are made:- organic farming has a major contribution to sustainable development and increased interest in rural areas; technologically, at the same investment effort and under the same conditions as labor and on the same soil, economic results depend on natural factors; conventional technologies, although economically efficient, should be gradually replaced by durable, conservative technologies; from the economic point of view, assessments are made (total arable land, crops available - field crops, inputs on crops and the availability of these resources); the viable field holding must comply with some requirements: full cultivation of arable land; cultivating field species in a balanced structure, according to the natural conditions and the market; the possibility to achieve crop rotation and rotation according to scientific criteria; socially, agricultural yield in Romania meets the consumption needs of the local population.

REFERENCES

[1] A.N.P.M., 2010, Raport anual – Starea factorilor de mediu în România. Cap. 5- Protecţia Naturii şi Biodiversitatea, Bucureşti, Romania; (Annual Report- The status of the environment factors in Romania. Chapter 5-Nature protection and Biodiversity), http://www.anpm.ro/anpm_resources/migrated_content /uploads/48584_5.Cap.5.Protectia%20Naturii%20si%20Biodiversitatea.2010.pdf, Accessed September 15, 2017

[2] A.N.P.M., 2010, Raport anual – Starea factorilor de mediu în România. Cap.4 -Utilizarea terenurilor, Bucureşti, Romania; (Annual Report- The status of the environment factors. Chapter 4. The use of lands), http://www.anpm.ro/anpm_resources/migrated_content /uploads/48599_4.Cap.4.Utilizarea%20Terenurilor.pdf, Accessed on September 15, 2017

[3]Bran, M., 2005, Ecotehnica exploatatiei vegetale. Editura Printech, Romania (Ecotechnics of the vegetal holding, Printech Publishing).

[4]Cociu, A., 2016, Long-term effects of tillage systems on winter wheat, maize and soybean grain yield and yield stability under rainfed conditions in the eastern Romanian Danube plain. Romanian Agricultural Research, N0. 33, 97-109

[5] Cociu, A., Alionte, E., 2017, The effect of different tillage systems on grain yield and its quality of winter wheat, maize and soybean under different weather conditions. Romanian Agricultural Research, NO. 34, 59-67, http://www.incda-fundulea.ro/rar/nr34/rar34.8.pdf, Accessed on

September 15, 2017
[6]Comisia Europeană, 2010, EUROPA 2020 - O strategie europeană pentru o creștere inteligentă, ecologică și favorabilă incluziunii, Bruxelles, Belgia. (European Commission, 2010, EUORPA 2010- An European Strategy for an intelligent, ecological and favorable growth of inclusion, Brussels, Belgium) http://www.fonduri structurale.ro/Document_Files//fs20142020/00010115/ohsc1_Strategia%20Europa%20 2020.pdf, Accessed on September 15, 2017
[7]Dobre, I., 2011, Methodologies for analysis and evaluation of risk in agricultural exploitations. Internal Auditing & Risk Management, Year VI, N0. 4(24), 89-97
[8]Florea, N., 2003, Degradarea, protecţia şi ameliorarea solurilor şi a terenurilor. Editura Universitară, Bucureşti, Romania (Soil and land depreciation, protection and reclamation, Univerity Publishing, Bucharest, Romania).
[9]Iagaru, P., Marcuta, L., Marcuta, A., Iagaru, R. 2017, Sustainable management for grassland agroecosystem resources. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 17 (4), 161-166.
[10]Lup, A., Miron, L., Alim, I.D., 2016, Management of land resource, agricultural production and food security. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 16(2), 219-228.
[11]Lup, A., Miron, L., Alim, I.D., 2017, Studies and strategies regarding the evolution of crop yields per unitof land area in Romania. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 17(2), 227-234.
[12]NIS, 2017, Production of the main agricultural products per capita, http://www.insse.ro/, Accessed on September 15, 2017
[13]NIS, 2017, Vegetable production in main crops. http://www.insse.ro/, Accessed on September 15, 2017
[14]Vasile, E., Bran, Ș. D. 2017, Lignocellulose bio resources and renewable energy. Internal Auditing & Risk Management, No. 46, Supplement No 1, 23|30
[15]Vătămanu, V., 2012, Acumularea productiei vegetale si factorii care o conditioneaza (The accumulation of vegetal production and its determinants). http://www.agrimedia.ro/articole/acumularea-productiei-vegetale-si-factorii-care-o-conditioneaza, Accessed on September 15, 2017
[16]Viatte, G., 2001, Adopting technologies for sustainable farming systems: an OECD perspective. In adoption of technologies for sustainable farming systems Wageningen workshop proceedings by Organization for Economic Co-Operation and Development; http://www.oecd.org/greengrowth/sustainable-agriculture/2739771.pdf, Accessed on September 15, 2017
[17]V.I.B, Effect of genetically modified crops on the environment. In Facts Series, 2016. http://www.vib.be/en/news/Documents/vib_fact_genetisch%20gewijzigde%20gewassen_ENG_2016_LR.pdf, Accessed on September 15, 2017.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ANTHROPIC IMPACT STUDIES ON THE AGROCHEMICAL QUALITY CONDITION OF THE SOIL

Mariana BURCEA

University of Agricultural Sciences and Veterinary Medicine Bucharest, Faculty of Management, Economic Engineering in Agriculture and Rural Development, Calarasi Branch, 1, Nicolae Titulescu Street, Calarasi City, Romania, Phone: +40242332077, Fax: +40242332077, Mobile: +40723704868, Emails: burcea_mariana2003@yahoo.com, gideam@yahoo.com

Corresponding author: burcea_mariana2003@yahoo.com

Abstract

The quality of the soil cover due to the use of various agricultural technologies is the subject of this study. The large number of agricultural technological works that are executed under the conventional technologies can reduce the natural soil fertility by modifying the soil agrochemical indicators. These negative phenomena have led to the emergence and development of the concept called "system of agricultural works for soil conservation" [8], according to which the system of works needs to maintain or improve the productive potential of the soil. The paper presents the results of the researches carried out in order to know the effect caused by the long application of the various soil cultivation systems, on the chernozem type of Baragan Plain, soil with very high fertility potential, where the humus content is on average 3.8%. Having as comparison base the classical soil cultivation technology performed by classic plowing (conventional soil tillage), at a depth of 22 cm, various variants with low soil works were taken into consideration, namely the replacement of classical works with disc or chisel works (conservative soil tillage).

Key words: *disking, plowing, chernozem, humus, pH, total nitrogen, conservative soil tillage*

INTRODUCTION

Precision agriculture is the most advanced form of agriculture practiced in developed countries in Europe and US and consists in the involvement of modern technologies, informatics, satellites in the assessment of soil fertility indicators, vegetation factors, in inputs metering and crops protection, in the extension of new generations of agricultural technologies, soil and crops protection [3], [13].

All these requirements of agriculture have led to the introduction and development of a new concept called "system of agricultural works for soil conservation " [9], according to which the system of works should improve the productive potential of the soil.

This soil cultivation technique requires waving at the total or periodic plowing, the rationalization of the number of works and the preservation at the soil surface of at least 15-30% of the total vegetal debris, system which is applied on approx. 45% of arable surface worldwide and is projected to expand to 75% over the next 15 years [11].

MATERIALS AND METHODS

The studies and observations were made on the chernozem type soil with a dusty clay texture, 3% humus content and slightly alkaline reaction (8-8.5) in the Baragan Field, with field experiences with 3 soil work systems and the witness where the normal plowing was applied at 22 cm.

Researches were conducted under a corn crop. The soil works applied on the experimental plots were:

A - annual autumn plowing at 22 cm, (witness variant);

B – Performed in autumn over 3 years with disk harrow;

C – Performed in autumn over 3 years with the chisel;

Chemical analyses were determined in the laboratory through following methods: humus through the determination of organic carbon, pH at 1:25 in aqueous suspension was determined potentiometrically and total nitrogen (N_t) by Kjeldal method.

Determination of humus content is done through the indirect assessment of the content because direct methods are accompanied by errors resulting from Danilic oxidation [6], so the determination of organic carbon [2] is used. Transforming the organic carbon content into humus is done by multiplying these values by a factor (1,724).

For the determination of total nitrogen, the Kjeldahl method was used, based on the wet oxidation method of organic nitrogen compounds in the soil [5].

The methodology for the elaboration of pedological studies (National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection - ICPA) indicates the limits of interpretation of the humus content and the corresponding values of organic carbon content [16], pH values and total nitrogen content [9].

The soil was researched on the 0-30 cm depth, at the corn crop, soil samples being taken from 10 cm to 10 cm.

The calculation of the experimental data was done according to the variance analysis method.

RESULTS AND DISCUSSIONS

The specific climatic conditions of the area and the technological methods of soil cultivation cause changes in the agrochemical quality of the soil.

The native soil has a moderate humus content of 3.8% on the surface, slightly decreasing in profile, reaching about 1.3% up to the depth of 1 m [15].

This type of soil has a poor alkaline reaction across the soil profile. Nitrogen soil condition in the first 20 cm is medium.

In conclusion, we can speak of a soil with a high fertility that ensures to plants a good growth and development.

Table 1. Chemical properties of chernozem soil not cultivated –Baragan Plain

Chemical properties	Horizons and depth (cm)					
	Ap	Aph	Am	AC	Ccl	Cc2
	0-19	19-26	26-42	42-70	70-105	105-180
Soil reaction	7.9	8.0	8.2	8.2	8.4	8.4
Organic matter (%)	3.8	2.7	2.4	1.3	0.6	0.3
Report C: N	12.54	11.01	10.3	9.87	8.35	-
Total nitrogen (%)	0.210	0.148	0.142	0.115	-	-
Calcium carbonate (%)	0.8	3.4	7.6	10.9	17.1	15.5

Source*:* Own research.

After the soil analyzes carried out in the variants with various systems of soil works, the influence of the soil working method on the chemical properties of the chernozem is found. If on a native, non-worked land (Table 1) the soil humus content is in the first 20 cm of 3.8%, we notice that after the application of the technological works it has improved by using the proper crop technologies, reaching 3,9%, under the condition of soil work with the chisel or the disk [4].

Humus content in soil

If the average values of the humus content were 3,80% on the non-cultivated soil in the first 20 cm, after taking the land in the crop, and plowing the crop every year, it reached 3.35% in the year 2014, rising by 0.15% by year 2016, but keeping it below the values of unworked chernozem.

Hence we notice a significant decrease in the humus content of 0.50% when applying this technology (Table 2 and 3).

The work of soil with disk harrows determines the highest accumulation of humus, on the depth of 10-20 cm, reaching average values of 3.86%, after 3 years of works.

Table 2. The humus content modification (%) under the soil works influence, year 2014

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	3.37	3.35	3.30
The annual disk	3.30	2.98	2.85
Chisel plowgh annually	3.36	2.85	2.84
$DL_{5\%}$ (for A- soil works) = 0.04 $DL_{5\%}$ (for B-depth) = 0.02 $DL_{5\%}$ (for AXB) = 0.07			

*DL - the limit difference (variance analysis method)

Source: own research.

The work of soil with the chisel determines the humus content to be close to the limit values of the unworked chernozem.

The humus content is kept in all researched technological variants, on a depth of 0 - 30 cm in average values limits.

Table 3. The humus content modification (%) under the soil works influence, year 2016

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	3.40	3.62	3.50
The annual disk	4.00	3.72	3.59
Chisel plough annually	3.82	3.70	3.25
$DL_{5\%}$ (for A- soil works = 0.06 $DL_{5\%}$ (for B-depth) = 0.09 $DL_{5\%}$ (for AXB) = 0.18			

*DL - the limit difference (variance analysis method)
Source: own research.

In the next 10 cm, the highest humus content, as a result of the applied technological works, was recorded in the variant were the plowing was used, the limits of the humus reached 3.4%, followed by the variant where the soli was worked with the disc each year with an average content of 3.22% and followed by the variant where the chisel was used (3.04%).

Soil reaction

The pH value is a dynamic measure and is affected by the seasonal variation of the hydrothermal regime.

The soil reaction class in which most of the studied variants fall is slightly alkaline, as are the native soil reactions values (Table 4 and 5).

Table 4. The pH values modification under the soil works influence, year 2014

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	7.18	7.44	7.37
The annual disk	7.30	7.31	7.35
Chisel plough annually	7.75	7.66	8.01
$DL_{5\%}$ (for A- soil works) = 0.02 $DL_{5\%}$ (for B-depth) = 0.03 $DL_{5\%}$ (for AXB) = 0.07			

*DL - the limit difference (variance analysis method)
Source: own research.

Only the classical soil tillage (plowing) causes a decrease in the soil's response at 0-10 cm depth reaching values of 7.19 and 7.16 pH units, which puts the soil in the neutral reaction class, values sustained also by other researchers: [14], [7] and [1].

Determinations made on this non-cropped soil type show pH values ranging from 7.90 to 8.34 (low alkaline).

The large number of works carried out in this perimeter led to an improvement in the soil's reaction due to the reduction in the surface of the substances leached by the soil works in the vegetation period.

Soil reaction between years 2014 and 2016, in the first 10 cm, shows an average decrease of up to 7.19 in the case of plowing and 7.38 in the disk work, limits that fall into the neutral-low alkaline field.

Table 5. The pH values modification under the soil works influence, year 2016

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	7.20	7.48	7.62
The annual disk	7.47	7.61	7.85
Chisel plough annually	7.84	7.67	7.74
$DL_{5\%}$ (for A- soil works) = 0.04 $DL_{5\%}$ (for B-depth) = 0.03 $DL_{5\%}$ (for AXB) = 0.08			

*DL - the limit difference (variance analysis method)
Source: own research.

In all experimental variants, the soil reaction is maintained in the same low alkaline range (7.18 - 8.01) due to the high carbonates concentration which increases the pH and due to the climatic conditions with precipitations above the normal average of this region.

In the variant with the chisel work there is a pH decrease from 8.00 to 7.80 pH units, not very significant, due to the leaching of salts in the deeper layers. In this variant the pH maintains the limits of alkalinity.

The content of total nitrogen in soil

Regarding the nitrogen content of the soil, it is assumed that the arable layer of the cultivated soils in the temperate zone contains on average between 0.09-0.38% total nitrogen and is influenced by the climate, the type of vegetation, topography and parental rock [10] and [12].

Table 6. The total nitrogen content of the soil under the influence of soil work method (ppm), year 2014

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	0.265	0.202	0.196
Disk	0.298	0.222	0.172
Chisel plough annually	0.215	0.178	0.173
$DL_{5\%}$ (for A- soil works) = 0.01 $DL_{5\%}$ (for B - depth) = 0.01 $DL_{5\%}$ (for AXB) = 0.02			

*DL - the limit difference (variance analysis method)
Source: own research.

Table 7. The total nitrogen content of the soil under the influence of soil work method (ppm), year 2016

Soil tillage systems	Depth (cm)		
	0-10	10-20	20-30
Plowing (witness)	0.232	0.189	0.180
Disc	0.260	0.225	0.184
Chisel plough annually	0.215	0.186	0.170
$DL_{5\%}$ (for A - soil works) = 0,01 $DL_{5\%}$ (for B - depth) = 0,01 $DL_{5\%}$ (for AXB) = 0,02			

*DL - the limit difference (variance analysis method)
Source: own research.

The total nitrogen content of the soil following the application of various soil works methods, during the period 2014-2016, recorded the highest values after soil work with the disc (0.298%) and the chisel work caused an average drop of 0.035% in the first 10 cm compared with the conventional plowing, being also the variant with the lowest nitrogen content (Table 6 and 7).
The limit for the interpretation of nitrogen content is medium and it is found in all variants with works, only the variant with the disc records large values in the first 10 cm.
On a depth of 10 - 30 cm, during the period 2014-2016, the total nitrogen content is kept within the mid-range limits in all variants with soil works.

CONCLUSIONS

Due to the anthropic activity, especially of the technological works of the soil, the initial aspect of the natural framework can change beneficial or detrimental to the soil nutrient content. The proposed works have the role of intensifying pedogenetic processes for the formation of fertile soil.
Soil works methods have little influence on the humus content, its modification being insignificant and keeping within medium range limits. The work of the soil with the disc harrow determines the highest accumulation of humus, at a depth of 10-20 cm, with average values of 3.50%. The highest humus content is found in the 0-10 cm layer due to an accumulation of organic matter not introduced on the soil depth.
The soil reaction, has passed from the neutral field to the field taken in the crop and ploughed annually by returning the furrow to the native soil where the pH had slightly alkaline values (7.90) under the influence of the soil works. Variants with disk and chisel do not modify significantly the soil's pH, but fall within the lower limit of the low- alkaline interval.
The total nitrogen content in the soil was lower in the variants with plowing and disk works, and the variant worked with the chisel determined the best mineralization of the nitrogen. The difference between the variants in terms of total nitrogen content is generated by the distribution of organic matter on the soil profile and the microbiological activity in the soil and decreases on the depth of the arable layer.

REFRENCES

[1]Alvarez, R., 2005, A review of nitrogen fertilizer and conservation tillage effects on soil organic carbon storage.Soil Use and Management 21.1: 38-52.
[2]Abebe, A.T., Tanaka, T., Yamazaki, M., 1989, Soil compaction by multiple passes of rigid wheel relevant for optimization of trafic. J. Terramechanics 26, p. 139 – 148.
[3] Blevins, R. L., Thomas, G. W., Smith, M. S., Frye, W. W., Cornelius, P. L., 1983, Changes in soil properties after 10 years continuous non-tilled and conventionally tilled corn. Soil and Tillage Research, 3(2), 135-146.
[4] Burcea, Mariana, Mușat, M., 2012, Studies on soil cover and land suitability to various agricultural uses, in the south/east of the Olt county. Scientific Papers-Series A, Agronomy 55: 30-35.
[5]Davidescu, D., Davidescu Velicica, Calancea, L., Handra Margareta, Petrescu, O., 1976, Azotul în agricultură, Ed. Academiei R.S.R., București.
[6]Daniliuc, D., 1964, Determinarea humusului. În ,

Metode de cercetare a solului, Ed. Academiei RPR, Bucureşti.

[7] Dick, W. A., 1983, Organic carbon, nitrogen, and phosphorus concentrations and pH in soil profiles as affected by tillage intensity. Soil Science Society of America Journal, 47(1), 102-107.

[8] Guş P. *et al*., 2004, Criterii şi condiţii de extensie în expoataţiila agricole din zonele colinare ale Clujului, a sistemelor neconvenţionale de lucrare a solului. În "Combaterea integrată a buruienilor", Bucureşti 24 – 25 iunie 2004, p. 283;

[9]Guş P., Rusu T., Bogdan, I., 2003, Sisteme convenţionale şi neconvenţionale de lucrare a solului, Editura „Risoprint" Cluj-Napoca.

[10]Hakanson, I., 1990, Soil compaction control – objectives, possibilities end prospects. Soil Technology, vol. 3, p. 201 – 239.

[11]Rusu, T. şi colab., 1999, Influenţa sistemului de lucrare al solului asupra producţiei de grâu, Simpozionul "Sisteme minime ale solului" U.S.A.M.V Cluj-Napoca, p. 87-92.

[12]Riga, A., Francois, E., Destain, J. P., Guiot, J., Oger, R., 1988, Fertilizer nitrogen budget of Na15NO3 and (15NH4) 2SO4 split-applied to winter wheat in microplots on a loam soil. Plant and soil, *106*(2), 201-208;

[13]Kladivko Eileen, Donald, J., Griffith, R., Mannering, J.V., 1986, Conservation tillage effects on soil properties and yield of corn and soya beans in Indiana.Soil and Tillage Research 8: 277-287.

[14] Nyborg, M., Malhi, S. S., 1989, Effect of zero and conventional tillage on barley yield and nitrate nitrogen content, moisture and temperature of soil in north-central Alberta. Soil and Tillage Research, 15(1), 1-9;

[15] Sistemul Român de Clasificare a Solurilor, 2012, I.C.P.A. Bucureşti, 57 - 78;

[16]The methodology for setting up pedological studies (Metodologia elaborării studiilor pedologice), Part III, 1987, ICPA Bucureşti.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE ROMANIAN RURAL HOUSEHOLD FROM SUSTAINABLE RURAL DEVELOPMENT PERSPECTIVE

Lorena CHIȚEA[1], Ion DONA[2]

[1]Institute of Agricultural Economics, INCE, Romanian Academy, 13 Calea 13 Septembrie, District 5, Bucharest, Phone/Fax:021/3182411; E-mail: chitu_lorena@yahoo.com
[2]University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest, Romania, Email:iondona@yahoo.com

Corresponding author: chitu_lorena@yahoo.com

Abstract

The aim of the paper is to highlight, from the point of view of the specialized literature, the role of the Romanian rural household in rural economy, while taking into consideration the opportunities and constraints of the new rural development paradigm. The basic activity of the Romanian rural household is agriculture, with subsistence as main characteristic; yet it should not be neglected that agriculture must ensure food security, ensure the rural population's stability through job opportunities and decent incomes, contribute to environment protection, hence the need to increase the competitiveness and efficiency of farming activities on the subsistence household farm. The rural household (which partially overlaps with the small peasant farm) has a recognized role in maintaining the rural settlements, being responsible for the preservation of natural, social and cultural resources. The present generation of farmers, according to the European Commission, has the multiple role of farmer, custodian of rural areas and entrepreneur.

Key words**:** *rural household, rural economy, sustainable rural development*

INTRODUCTION

The rural household, as main actor in the rural area, needs to get adapted to the new national and European rural development trends.

Having in view the experience of developed countries, at present, the less developed rural countries are confronted with new challenges and new opportunities that the developed countries had not faced before. The challenges include a more demanding international competitive environment, rural population ageing, depopulation of predominantly rural areas, increased pressure on the limited natural resources and climate changes. The opportunities include technical progress in information and communications, agriculture, energy and health.

Thus, a new paradigm is needed for rural development, which should not neglect the lessons of the past, but also cope with the new challenges and opportunities of the 21st century (climate change, demographic changes, international competition and fast technological changes)[11].

MATERIALS AND METHODS

The methodology used consisted in the European and Romanian literature review with regard to the role of the rural household with agricultural activity in the Romanian rural economy from sustainable rural development perspective.

RESULTS AND DISCUSSIONS

The rural household most often overlaps with the peasant household farm/individual farm, which is a production and consumption entity having agriculture as main activity. The rural household, irrespective of its agricultural dimension, has an important role in maintaining human settlements in rural areas [12].

In Romania, there is a large number of small-sized farms, as subsistence and semi-subsistence farms, operating a significant part of the country's agricultural area. These farms have low productivity and a poor technical endowment, are highly fragmented and apply traditional agricultural practices with low economic efficiency, having difficulties in adapting to the new technologies [7].

The developed countries of the European Union plead for the family farms, the medium-sized farm being considered a model of the agricultural policy in the Community. The family farms, with an adequate size, based on the private ownership upon land, or land lease, on which family labour is the main labour input, with a diversified production out of which a great part goes to the market – are a result of the orientation and support policies in agriculture, taking full advantage of the market laws.

Due to the low diversification level of the Romanian rural economy, the development of the rural area is conditioned by the agrarian economy, by the structure and viability of farms [3].

Brief history of the Romanian rural household

In order to highlight the main demographic, social, economic and cultural characteristics of the Romanian rural households, their evolution in recent history will be investigated, i.e. in the 20th century and early 21st century. This period has been marked by three great restructurings of the political regime and agriculture in Romania. Thus, the first restructuring was triggered by the great reform after World War 1st, followed by the communist restructuring and the post-communist restructuring (transition period and accession to the European Union).

The rural household in the inter-war period had the following characteristics:

- a great number of members on the household, consisting of several nuclei, child-centered households [1];
- the household had a low dependency on the products coming from outside the household;
- excessive fragmentation of property;
- the basic occupation of household members was agriculture;
- the household incomes were insufficient to meet the basic needs – poor population;
- excessive taxation;
- absence of an adequate and coherent credit system.

The rural household in the communist period had the following characteristics:

-diminution of the number of household members, diminution of the number of nuclei;
- expropriation of rural households;
- loss of individual farm autonomy;
-widespread emergence of agricultural workers and commuters;
-emergence of mixed occupations in the family, households consisting of persons working in agriculture and industry;

In the post-communist/present period, the rural household is characterized by:

-diminution of the demographic size of household, the rural household being almost equal to the urban household from this point of view;
-re-emergence of the individual farm resulting from land restitution to former owners;
-small land properties divided into a large number of parcels;
- lack of material endowments to support the agricultural activities;
-large number of persons working in agriculture and forestry;
-demographic ageing and increase of the number of pensioners and people on social welfare;
-weak presence on the market of domestic food products directly from producers;
- low incomes generated from agriculture and lack of non-agricultural activities as an alternative.

Following the empirical analysis by historical periods, we can notice that there are great similarities between the post-war and post-1989 periods; at the same time, during the communist period we can notice that the agricultural property consolidation was hindered, with the loss of production equipment and of the interest in the agricultural activities (through a massive rural exodus in the communist period). Even though the land properties were restituted after 1989, these could be farmed only by resorting to third-party agricultural work, as the agricultural equipment was lacking, and this situation generated high costs that the family could not cover. The repeated changes of the political regime resulted in lack of continuity, stability and sustainability of the Romanian agricultural sector [13].

Present characteristics of the Romanian

rural households in the context of rural area sustainable development

The rural household is the main component of the rural area, providing stability and dynamics to the entire system. The stability provided by households refers to their resilience in the moments of crisis, based on the consumption of own-produced foodstuffs, as well as to the continuity of traditions and customs by household anchoring to the social, economic and social system. The dynamics refers to the moment when the household accepts and acquires the modernization elements and gets adapted to the social and economic behaviour of the new rural development trends. Mitrofan and Ciupercă (1998) reveal that permanent mutual transfers of norms and values are taking place between the rural and urban families [2].

In the year 2015, 43.5% of the number of Romania's households were found in the rural area, accounting for 3,312 thousand households where 9,150 thousand persons were living.

Table 1. Number of households in Romania, by residence areas (number of households)

	Total	Urban	Rural
1992	7,288,676	3,970,435	3,318,241
2002	7,392,131	3,995,239	3,396,892
2010	7,470,429	4,208,032	3,262,397
2015	7,470,000	4,158,000	3,312,000

Source: General Census of Population and Housing 1992, 2002 and 2011, NIS, Living Conditions of the Population in Romania, in the Year 2015, NIS [8]

It is worth noting that there is a general upward trend of households in Romania, yet the number of rural households decreased by 3.96% from the 2002 Census to the Census of 2010. In the period 1992 – 2002, the number of rural households increased by 2.37%. In the urban area, the number of households was higher by 5.98% in the year 2010 as against 1992.

The average size of rural household, in the year 2015, was 2.76 persons/household, down from 3.12 persons/household in 1992 to 2.83 persons/household in 2010, as revealed by the General Agricultural Censuses of Population and Housing, in line with the decreasing trend of the population in Romania. Another reason that led to the decrease of the average household size is the fact that the nuclear family replaced the extended family, as an effect of lifestyle modernization [10].

Table 2. Average household size in Romania, by residence areas (persons/household)

	1992	2002	2010	2015
Total	3.07	2.89	2.67	2.65
Urban	3.03	2.79	2.54	2.57
Rural	3.12	3.01	2.83	2.76

Source: General Census of Population and Housing 1992, 2002 and 2011, NIS

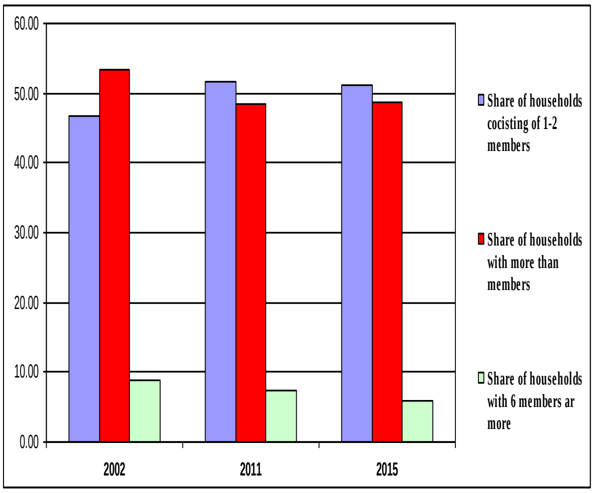


Fig. 1. Share of households by the number of members on household, 2002, 2011 and 2015

Source: General Census of Population and Housing 2002 and 2011, NIS, Living Conditions of the Population in Romania, in the Year 2015, NIS [8]

In the period 2002 – 2005, the number of rural households slightly increased, while the average household size decreased. The structure of households changed in terms of the number of members: the share of households with 6 members or more was down from 8.84% in 2002 to 7.27% in 2011 and 5.98% in 2015; at the same time, the share of households consisting of 1-2 members increased from 46.67% in 2002 to 51.64% in 2011, to reach 51.27% in 2015.

In the year 2015, 51.27% of total rural households had only 1-2 members and only 26.44% had dependent children. These data outline a picture of households with limited demographic reproduction capacity, most households consisting of pensioners. This picture can be completed with the profile of household head: man (75.17% of households), aged 65 years and over (37.70%), with secondary education (78.85%), which reflects the traditional status of the household with man being the chief of the family, old-aged and with low educational level.

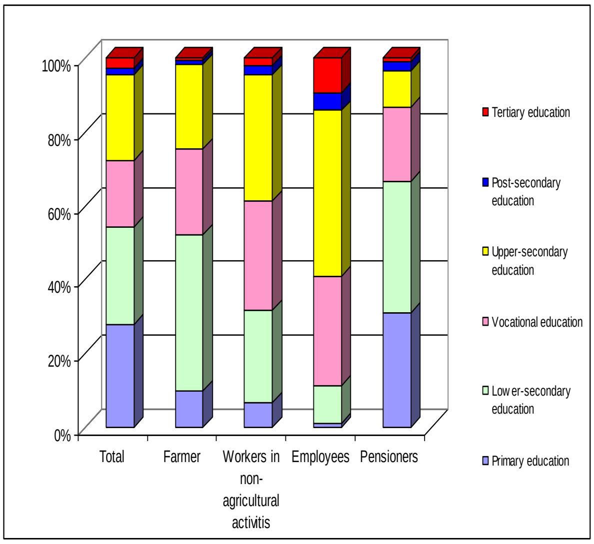


Fig. 2. Educational structure of household heads in the rural area, 2016
Source: NIS, 2017, Coordinates of the Living Standard in Romania. Incomes and Consumption of the Population. Year 2016 [9]

According to the household head's educational level, the lowest educational level is noticed on the households run by pensioners (66.53% graduated only primary and secondary education) and those run by farmers (52.07% graduated only primary or secondary education). The household heads with a non-agricultural activity as main activity, who are employed and work in non-agricultural sectors, have higher educational level (the employees with vocational, high school and post-high school training account for 79.04% and 63.64% of workers engaged in non-agricultural activities).

According to the household head's occupational status, 37.60% are run by pensioners and 31.10% are run by employees and only 18.20% are run by farmers, which means that farming is a subsidiary practice, which generates a subsistence agriculture without positive perspectives in the orientation towards a competitive economic activity.

In the year 2016, the total household income was 2,447.0 RON per household per month and 867.6 RON per person per month in the rural area. The average incomes per household in the rural area were by 26.45% lower than in the urban area, while the average incomes per person by 34.43% lower than in the urban area.

According to the household head's occupational status, the households run by employees and pensioners have the highest average incomes per person in the rural area, i.e. 1,114.81 RON per person and 894.68 RON per person respectively.

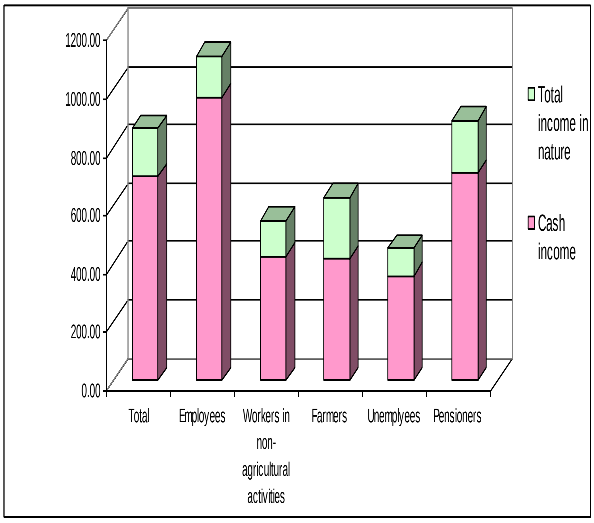


Fig. 3. Structure of total average incomes per person in the rural area, 2016
Source: NIS, 2017, Coordinates of the Living Standard in Romania. Incomes and Consumption of the Population. Year 2016 [9]

In the rural area, farm production was the main source of household incomes, accounting for 24.9% of total incomes, which represented the value of consumption of self-produced agri-food products (17.9% of total incomes), while the value of agricultural products under the form of cash incomes represented only 7.0% of total incomes of households in the rural area.

Wages and social benefits are the most important income categories for the rural household, as they represent 42.2% in the case of wages and 25.6% in the case of social benefits; yet depending on the household head's occupational status, we can notice very great differences in their contribution to the total income per person, namely:

- in the case of wages, their contribution to total income ranges from 10.70% in the case of households run by workers in non-agricultural activities and those run by farmers to 79.00% in the case of households run by employees;
- as regards the social benefits, their contribution to total income ranges from 5.50% in the case of households run by employees to 53.10% in case of households run by retirees.

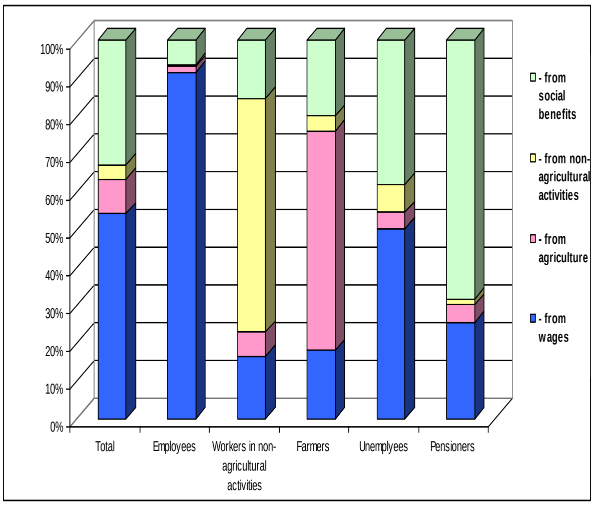


Fig. 4. Structure of cash incomes by origin of money in the rural area, 2016
Source: NIS, 2017, Coordinates of the Living Standard in Romania. Incomes and Consumption of the Population. Year 2016 [9]

Having in view the two main economic activities in the rural area, namely agricultural and non-agricultural, these have a lower contribution to the total average incomes per person, i.e. 7.00% and 3.10% respectively.

The share of expenditures in incomes is relatively similar in the two residence areas, namely 87.86% in the rural area and 84.50% in the urban area, yet the structure of expenditures by the two areas is different. The share of cash expenditures account for 94.8% in the urban area as against 79.7% in the rural area, this situation being generated by the high share of own-produced food in rural areas. The rural households pay less on food and beverages, services and fees, taxes and different social contributions, yet their investment and production expenditures are higher than on urban households.

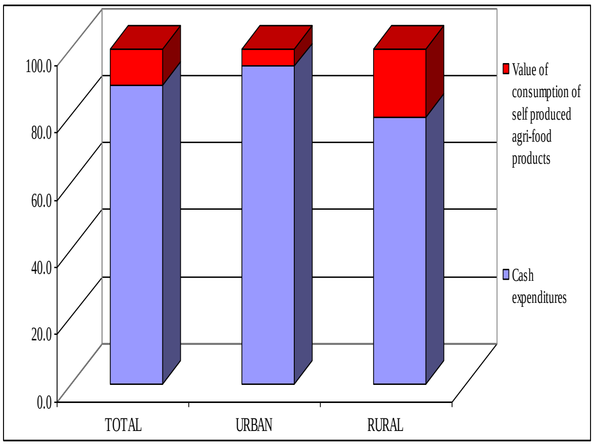


Fig. 5. Structure of average monthly expenditures by residence areas, 2015
Source: NIS, 2017, Coordinates of the Living Standard in Romania. Incomes and Consumption of the Population. Year 2016 [9]

The structure of expenditures by the occupational status of household head reveals certain differences, among which the most important are the following:

- in the case of households of employees, the category of tax expenses, contributions and fees represents 25.5%, as against other households where the share of these expenditures range from 3.3% in the case of households of non-agricultural workers to 9.7% in the case of the unemployed;
- in the case of households of farmers, the greatest expenditures are represented by investments and production, both in value and in percentage terms.

In the year 2016, Romania had 3,300,672 individual farms, accounting for 99.55% of the total number of farms without legal status. These holdings provide a clear/pertinent picture of the farming activity of rural households.[1]

The average size of utilized agricultural area is 2.04 ha.

The distribution of farms by rurality level is the following:

- 59.84% of individual farms are located in the predominantly rural areas, using an average land area of 1.99 ha;
- 39.54% of individual farms are present in

[1] In the absence of data on all indicators analyzed at the level of individual farms, the data on agricultural holdings without legal status will be used.

the intermediate areas, using an average area of 2.15ha;
- 0.61% of individual farms are found in the predominantly urban areas, using an average area of 1.01 ha.

Out of total individual farms, 92.06% have an area up to 5 ha. The medium-sized farms, from 5 to 20 de ha, account for 7.23% of total farms. The developed countries of the European Union have pleaded for the family farm, the medium-sized farm being considered the model of the agricultural policy of the Community, with beneficial effects at economic, social and cultural level as well as in terms of environmental protection.

The structure of individual farms [4] according to the farming activity carried out results in the grouping of farms as follows:
- in the predominantly rural and intermediate areas, 74% of farms were engaged in crop and livestock farming, 24% only in crop farming and 2% only in raising animals;
- in the predominantly urban areas, 52% of farms were involved in crop and livestock farming activities, 44% only in crop farming and 4% only in livestock farming.

Romania's agriculture is at the level of EU-6 from the years 1964-1970:
- The primary production value per hectare on the Romanian farms (900 euro/ha) is almost 2.5 times lower than the EU average (2,000 euro/ha);
- the Romanian farm endowment (350 euro tangible assets) is about 26 times lower than on the average farm in the EU (9,000 euro);
- the banking credits provided to a Romanian farm (110 euro/ha) are 16 times lower than those provided in the EU (2,000 euro/ha) [5].

In Romania there is a large number of small-sized farms (90% individual subsistence and semi-subsistence farms) that use a significant part of the country's utilized agricultural area (56%). These farms have low productivity, a poor technical endowment and fragmented land properties, they apply traditional farming practices with poor economic performance, with great resilience to the process of the new agricultural technology integration.

Under NRDP 2014-2020, support measures to small-sized farms (with an economic size ranging from 4,000 to 11,900 Euro SO) appeared for the first time, in order to improve the small-sized farm management and to increase their incomes). The support will be provided under the form of a lump sum for the implementation of objectives provided for in the Business Plan (sub-measure 6.3.). The number of potential eligible beneficiaries is about 370,000 farms.

Under NRDP 2014-2020, support measures for the small-sized agricultural holdings appeared for the first time, for small farms (with an economic size ranging from 4,000-11,900 euro SO), aiming at improving the small-sized farm management and increasing the market orientation and revenues for this category of farms [7]. The support will be provided under the form of a lump sum for the implementation of objectives established in the Business Plan (sub-measure 6.3). The support provided to small-sized farms is mainly meant to determine the structural change [6] and opening to the market of the small farms with potential to become viable agricultural farms, as well as to increase the capacity to identify new opportunities to sell their products.

Sub-measure 6.5 is addressed to small farmers who participated in the Small Farmer Scheme under Pillar I for one year at least and who commit themselves to definitively transfer their entire agricultural holding and the corresponding payment rights to another farmer. According to APIA data from 2011, the number of potential beneficiaries for the Simplified Small Farmer Scheme under Pillar I was estimated at 840,000 farmers.

This sub-measure takes into account that, in addition to transfers of ownership right, the voluntary transfer of land by some farmers to other farmers can also be achieved by long-time disposal of the right of land use (e.g. land lease), in order to facilitate land/farm consolidation and therefore, alongside other measures, farm restructuring.

CONCLUSIONS

The rural household nowadays has to face the same challenges faced by the rural area it is part of. At present, the farming sector prevails in the Romanian rural economy, and its main characteristic is the high share of subsistence farms, largely overlapping with the rural households, which mainly produce for self-consumption and only occasionally for the market and use the largest part of UAA and a great part of labour input. The farming practice must ensure food security, contribute to the fight against climate change, provide jobs and incomes to the rural population.

The individual rural household represents the basic element in the organization of the contemporary world, representing a way of existence that ensures the maintenance/preservation and functioning of the rural space. This entity must be considered as a living organism, integrated into the natural, social and economic environment, with an important role in the proper operation of the rural society it is part of. The rural household survival is absolutely necessary as its disappearance would have serious consequences, among which the following:

- diminution of workforce that supports environmental and nature responsible activities;
- biodiversity diminution and loss of the genetic fund of plants and animals of autochthonous origin;
- gradual diminution of traditional products;
- gradual diminution of food security and independence;
- loss of cultural peasant identity (traditions, folklore, peasant ethics) and disappearance of specific occupations.

REFERENCES

[1] Bădescu, I., Cucu-Oancea, O., Șiseștean, G., 2012, Tratat de Sociologie Rurală. Editura Mica Valahie. București, pp.59.

[2] Bădescu, I., 2012, Sociologie Rurală. Editura Mica Valahie. București, pp.261.

[3] Bold, I., Dragomir, V., Lăcătușu, G., 2015, Structuri agrare după 25 de ani in ”Economie agrară și dezvoltare rurală. Realități și Perspective în România”. Ediția a VI. Editura ASE. București.

[4]Dona, I., 2015, Economie Rurală. Editura Economică, București, pp.104.

[5] Eurostat Data base, 2018, http://ec.europa.eu/eurostat/data/database, Accessed January 20, 2018

[6] Giurcă, D., Alexandri, C., Rusu, M., 2012, Reforma Politicii Agricole Comune în contextul perspectivei bugetare post-2013. Institutul European din România, București, pag. 131. http://beta.ier.ro/documente/spos_2011/SPOS_2011_-_nr_1_RO-EN.pdf, Accessed January 20, 2018

[7]National Rural Development Program for the period 2014 - 2020

[8]National Institute of Statistics, General Census of Population and Housing 2002 and 2011

[9] National Institute of Statistics, 2017, Coordinates of the Living Standard in Romania. Incomes and Consumption of the Population. Year 2016

[10]National Institute of Statistics, 2016, Living Conditions of the Population in Romania, in the Year 2015

[11]OECD, 2016, A New Paradigm for Rural Development Paradigm for the 21st Century. A Tooklit for developing countries, http://oecdinsights.org/2016/03/31/a-new-paradigm-for-rural-development/, Accessed January 12, 2018

[12]Popescu, G., Istudor, N., 2017, Gospodăria țărănească în economia rurală. Probleme de politică agrară. Colecția 4. Editura ASE, pp. 35

[13] Steriu, V., Otiman, I., P., 2013, Cadrul Național Strategic pentru Dezvoltare Durabilă a Sectorului Agroalimentar și a Spațiului Rural în perioada 2014-2020-2030, Editura Academiei Române, pp. 38.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ROMANIA'S LABOUR FORCE IN REGIONAL PROFILE AFTER THE ACCESSION TO THE EUROPEAN UNION

Mihai Alexandru CHIȚEA

Institute of Agricultural Economics, 13 Calea 13 Septembrie, District 5, 050711, Bucharest, Romania, Phone: +40213182411, Email: mihai_chitea@yahoo.com

Corresponding author: mihai_chitea@yahoo.com

Abstract

The paper approaches the issue of the labour force from Romania in regional profile at a decade after the accession to the European Union. The economic, political, technological and financial changes occurred at different aggregation levels have, profoundly, influenced the volume and structure of the labour force at national level. The analysis is based on statistical data available at national and European level and follows the evolution in regional profile. The result reveal an unprecedented dynamic of the national labour force and support the need for efficient public policies in the field of education and employment, adapted to the new coordinates of the economic activity.

Key words*: *labour force, regions, structural changes

INTRODUCTION

Throughout the 20^{th} century, numerous economist but also representatives of the academic sector have approached the labour force dynamics based on the demand-offer relation, the influence of capital and other factors that determine the behaviour of the labour force. Early American researches from the 1930' pointed out that the unrealistic expectations of the private sector translates into anemic investments plans, determining the economy to follow a downwards trajectory and was advocating for the government's involvement through monetary and fiscal policy in supporting the employment rate's growth [5]. Others, identified a negative relations between the hourly salary level and the participation rate of adult workers on the labour market [16]. Decades later, some approaches shifted towards the determinant factors of the labour force's behaviour highlighting the importance of growth of women's participation on the labour market and of part-time labour. [1]. Other authors recognized , as main factors of the labour force participation, a combination between the economic stagnation and inflation, as well as a persistent, high level of unemployment in western European countries [17]. Researches approaching the labour force at national and regional level and by urban-rural typology, have also been conducted in Romania. Some studies analyze the rural labour force by dynamics, starting from the demographic structure of rural population and its socio economic characteristics with an important role placed on the educational level, professional training and the re-conversion of rural labour force [10]. Others, focus on the participation of rural labour force, compared to urban labour force, pointing out the predominant nature of rural areas as a production space where primary sector's activities hold a high share of its economy [2]. Other authors consider the labour force as a restrictive factor for rural areas' development, having in view a set of characteristics of the rural space as accelerated ageing, low level of professional training, lack of investments and employment opportunities [12]. These researches developed by the academic sector have been complemented by others evolved from the economic and institutional sectors. Some reveal a specialization of Romanian economy in low competitiveness sectors at European level, which generate low added value and turn to cheap and unqualified labour force [11]; others evaluate the labour force market from the perspective of the entrepreneurial environment ant its strategies for adapting to the new economic realities [7].

MATERIALS AND METHODS

The present paper turns to the analysis of official statistical data, regarding the Romanian labour force, and following the typology of regions defined at European level – predominantly rural, intermediate and predominantly urban regions. The data has been extracted from the Tempo online database of the National Institute of Statistics [9] as well as from Eurostat database [3], and processed using standard statistical methods. The graphical representations (maps) have been created by the author based on a specific software for GIS representation – GeoDa.

RESULTS AND DISCUSSIONS

Labour force represents a key element of human capital, both nationwide and at the other (regional, county, local) aggregation levels; its characteristics (volume, professional and vocational training, mobility) significantly influence the economic activity and the specific policies elaborated in this field. At the same time, labour force is influenced by the economic, political technological and financial changes produced at different aggregation levels [13]. Romania's integration into the European Union structures brought about new challenges for the economic activity and labour force, such as the free and fast movement of capital flows and commodities, as well as the great mobility of labour force, determining an unprecedented dynamics of labour, generated by the opportunities provided by its relocation in the developed member states while looking for jobs, which ensures much higher incomes than at national level. Without any doubt, the best product of Romania's export after 1989 was human capital, the vital force of any economy. Migration for employment was the most important component of national migration in the last decades, yet the intensity of this phenomenon has not been fully reflected by the official statistics [14].

"External migration was a very prompt and harsh reaction to the economic situation in the country, on the one hand, and to the advantages provided by the migration to another developed country on the other hand" [4].

Labour market liberalization and the free movement of labour determined by Romania's EU membership led to the intensification of the migration phenomenon. According to the United Nations statistics, by the year 2016, more than 3.4 million Romanians had left to work abroad, or definitively settled their residence there. The financial support provided by them to their families who remained in the country contributed to the increase of their life quality, yet it was doubled by a series of socio-demographic problems: the depopulation of areas of origin, of rural areas in particular, the demographic ageing and degradation of family relations, mainly between the parents who left for work and their children looked after by their relatives [14].

All these added to internal factors, such as rural – urban migration and the strong demographic decline; all these together contributed to the current situation of labour force at national level, its adaptation to the new requirements with regard to the vocational training and stability on the labour market.

Romania's economy is heading towards an acute crisis of the labour market, which might grow stronger in the future, in the absence of integrated educational and employment strategies that should make it possible to develop the labour resources according to the new coordinates of the economic activity.

"There is probably no company in Romania that does not currently face the effects of staffing crisis. Whether we speak about IT programmers, engineers or finance experts, there are more and more companies claiming that they do not find qualified staff. As a proof, NIS statistics reveal that the number of vacancies almost doubled, from 38,625 in 2009 to 59,753 in 2016" [6].

Romania's labour resources have declined after the accession to the EU. They represent that category of population that has all the physical and intellectual capacities enabling it to carry out useful work in one of the activities of the national economy [8].

In the year 2006, Romania's labour resources totalled 13,801.6 thousand persons, out of which 51.75% men and 48.25% women. Out of total labour resources, the resources in the predominantly urban regions accounted for 10.88%, the remaining resources being almost equally distributed between the intermediate regions and the predominantly rural regions, i.e. 44.29% and 44.83% respectively. In the first two years of EU membership, the total labour resources began to decrease slightly, this phenomenon being followed by a period of growth at about the same rate. The year 2011, marked by the peak of the global economic and financial crisis, which had a strong impact in Romania, signals out the beginning of the decline: the labour resources gradually decreased nationwide (mainly in the period 2013-2014) to reach 12,481.1 thousand persons by the year 2015, by 9.56% lower than the value in the reference year.

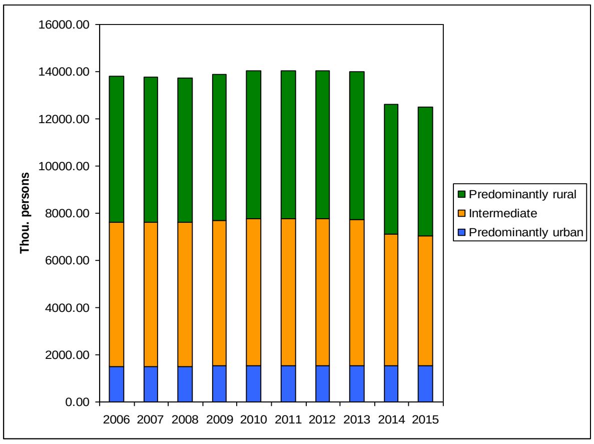


Fig. 1. Labour resources, according to urban-rural typology
Source: Own processing of Tempo Online NIS data.

The strongest decline was found in the predominantly rural regions, where the labour resources were down by 12.13% (750.6 thousand persons); the intermediate regions come next, with 9.85% (602.4 thousand persons). In the same period, in the urban regions, the labour resources slightly increased, by 2.16%; this phenomenon can be explained by the numerous employment opportunities provided by the urban area and the higher incomes that can be obtained. As regards the structure of labour resources, no significant changes were produced in the investigated period, the variation being lower than 1 percentage point in terms of the increase of male resources, respectively the decrease in female labour resources.

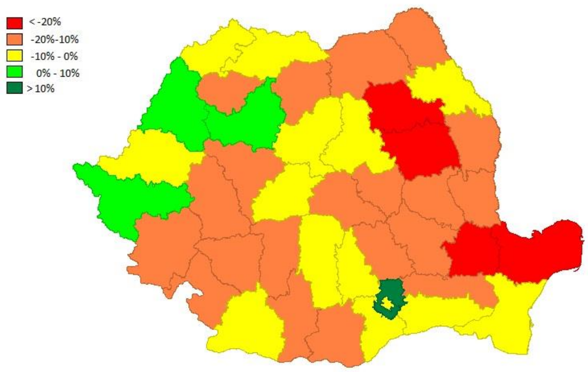


Fig. 2. Labour resources 2015/2006, by county
Source: Own processing GeoDa of Tempo Online NIS data

At county level, the most affected by the decline of the labour resources where the counties from the south-east and north-east regions, namely Neamț, Tulcea, Brăila and Bacău (over 20%); at the same time, only four counties registered higher values compared to the reference year - Ilfov, Timiș, Bihor and Cluj.

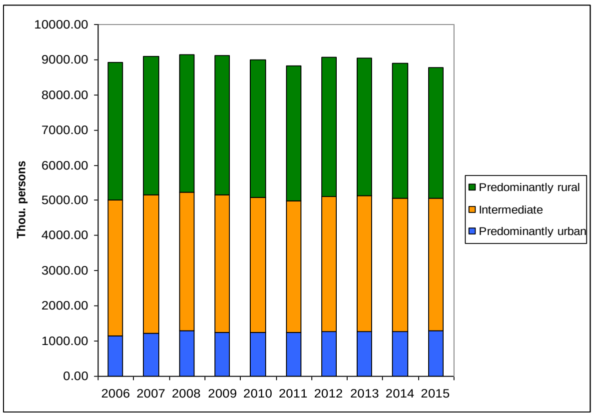


Fig. 3. Active civil population, according to urban-rural typology
Source: Own processing of Tempo Online NIS data.

The labour supply decreased nationwide, throughout the investigated period, the most affected being the predominantly rural regions. The active population represents the potential labour supply, including the employed civil population and the registered unemployed. In the reference year (2006), Romania's active civil population totalled 8,929.8 thousand persons, out of which 52.95% men and 47.05% women. The predominantly rural regions included almost 44% of the active population, followed by the intermediate regions (about 43%) and the urban regions (almost 13%).

The first two years of EU membership were marked by the increase in number of the active civil population, mainly in the intermediate and predominantly urban regions, followed by three consecutive years when the number of the active population decreased, under the background of the global economic-financial crisis. The strongest impact was felt in the intermediate and predominantly rural regions, the active population decreasing by 270.1 thousand persons on cumulated basis in this period. After a temporary recovery in the year 2012, the active population resumed its downward trend, to reach 8,776.8 thousand persons at the end of the period, down by 1.71% than its value in the reference year. Throughout the period 2007-2015, the active civil population had successive periods of growth and decrease; **the predominantly rural regions were mostly affected by the decrease of the active population volume** (about 5%), followed by the intermediate regions, with about 2.5%, while the predominantly urban regions experienced a significant growth of the active population, by about 12%; in this context, at the end of the period, the share of active population in the predominantly urban regions represented about 15% of total active population. In terms of gender structure, the active population experienced a slightly increase of the share of male population – about 54%, compared to the reference year.

The predominantly urban areas as polarizing centres for the workforce. The indicator *Employed population* includes all the persons aged 15 years and over who were engaged in an economic activity producing goods or services for at least one hour during the reference period. In the investigated period, the employed population had a similar evolution to that of the active population, in close connection to this: a first growth period (2007, 2008), under the background of the economic activity dynamics generated by the accession to the European Union, followed by three consecutive years of decline (2009-2011), which coincided with the restructuring of activity in the public and private sectors determined by the financial-economic crisis; the slight recovery in the year 2012 was followed by another period of three years of decline, with the active population reaching 8,340.60 thousand persons by the end of the period, down by 1.5% compared to the reference year (2006). In this case as well, throughout the investigated period, **the predominantly urban regions were the net beneficiary of the labour force transfer between the three regions** (mainly from the predominantly rural regions); in this case, the employed population increased by 12.8%, while in the predominantly rural and intermediate regions, the employed population volume decreased by 5.2% and 2.2% respectively.

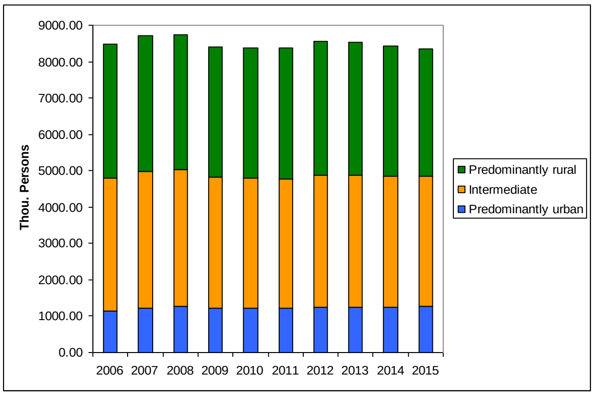


Fig. 4. Employed population, according to urban-rural typology
Source: Own processing of Tempo Online NIS data.

Besides the decrease in the volume of the employed population, changes were also produced in terms of its structure by main activity sectors in the period 2008-2015. At national level, **the most dynamic sector was the tertiary sector,** the sector of services, as this attracted an increasingly larger part of the labour force each year; in the year 2015 this sector accounted for 45.83% of total employed population, as against 41.92% at the beginning of the investigated period. At the same time, the secondary sector, the sector of industries and constructions, the second as share in total employed population, had an oscillating evolution, marked by consecutive ups and downs, at the end of the period reaching a similar share to that in the reference period, i.e. around 30%. As regards the primary sector, i.e. agriculture, forestry and fisheries, after a consecutive growth period of its share in total employed population, in the period 2009-2012 (which confirms the hypothesis regarding **the character of the rural space, as a temporary space of refuge for the labour force**, in the economic recession periods), a decline period followed, to reach 24.02% in 2015 (as against 27.52% in 2008).

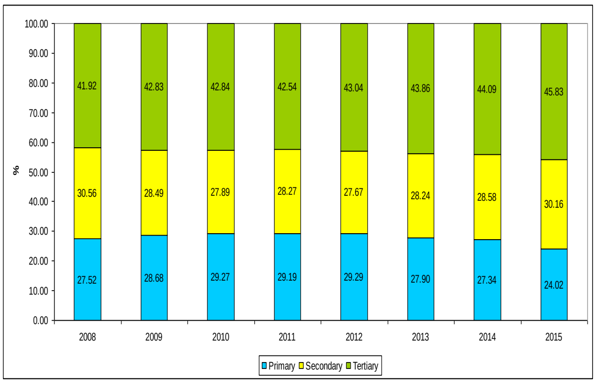


Fig. 5. Structure of employed population, by activity sectors
Source: Own processing of Tempo Online NIS data.

This situation is also present at the level of the urban-rural typology, with **the tertiary sector taking the largest share of the employed population** in all the three regions: predominantly urban – 71.33%, intermediate – 45.00%, predominantly rural – 37.76%, followed by the secondary sector, i.e. industry and constructions. The predominantly rural regions are an exception, where although the primary sector experienced a restructuring process in the investigated period, this continues to be the second activity sector in terms of its share in the employed population structure, with 33.40%.

The employed population structure continues to reveal a high share of employment in activity sectors with low productivity and value added (the primary sector), which is the largest share in EU, at great distance from the next countries in the ranking [15].

The counties from the south and north-east regions stand out in this hierarchy, values over 40% (population employed in the primary sector - agriculture) being registered in Olt, Teleorman, Giurgiu, Călărași, Ialomița, Vaslui and Botoșani conties.

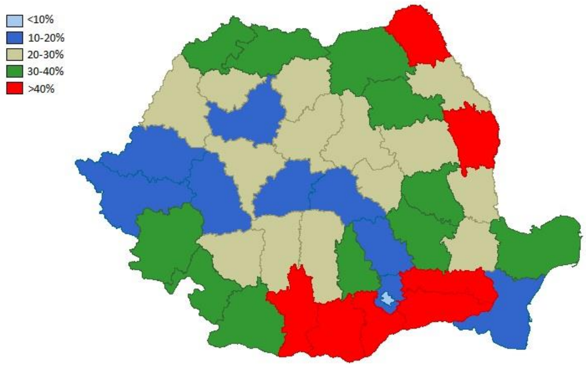


Fig. 6. Share of employed population in agriculture, 2015, by county
Source: Own processing GeoDa of Tempo Online NIS data

The employment rate – increasing trend, yet continues to be under the EU level. The employment rate of the population of working age at national level followed an upward trend in the period 2007-2015, yet continuing to be under the EU-27 average, by about 4 percentage points. Depending on the urban-rural typology, the most important increase of the employment rate was noticed in the predominantly rural regions, this exceeding the national average beginning with the year 2012, to reach 63.5% (71.7% in men and 54.9% in women) in the year 2015.

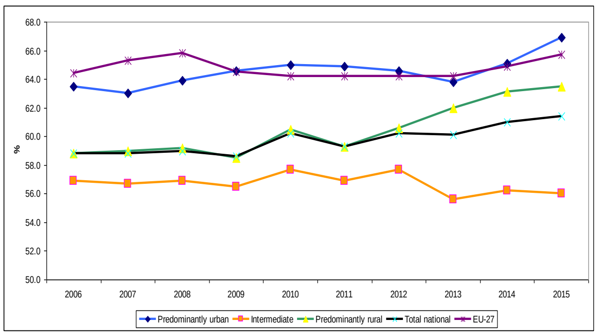


Fig. 7. Employment rate of the population of working age, according to urban-rural typology
Source: Own processing of Eurostat data.

As regards the **predominantly urban regions**, these had **the highest values of the employment rate**, throughout the investigated period; in the year 2015, the employment rate was 66.9% (74.4% in men, 59.9% in women). The only regions where a decline was noticed in the employment rate in the period 2007-2015 were the intermediate regions, with values significantly lower than those in the urban and predominantly rural regions – at the end of the period, the employment rate in the intermediate regions was 56% (64.1% in the case of men and 47.8% in the case of women).

Unemployment – decreasing trend, values under the EU average, yet continues to be high in the case of young population. Unemployment is another important indicator – expressed as number of persons looking for a job, as unemployment rate respectively.

The number of the unemployed people had a decreasing trend nationwide in the investigated period, to reach 623.9 thousand in 2015, by 14.34% less than its value in the reference year (2006)[3]. The structure of the unemployed by gender was 63.3% men and 36.7% women, quite similar to that in the reference year. According to the urban-rural typology, the regions where the number of the unemployed people decreased, in the period 2006-2015, were the intermediate regions (by 90.2 thousand persons) and the predominantly rural regions (by 16.6 thousand persons). In the same period, in the predominantly urban regions, the number of the unemployed rose by about 3%, under the background of rising unemployment among men. However, the predominantly rural regions still had the highest share in the total number of the unemployed – about 59%, followed by the intermediate regions – about 29% and the predominantly urban regions – 12%.

Nationwide, the unemployment rate followed a trajectory similar to that of EU-27, yet with lower values compared to this. Under the background of the development of the economic activities in the first years of EU membership, unemployment rate began to decrease, as against the reference year, to reach a minimum value of 5.6% in the year 2008. The effects of the global economic-financial crisis that followed, transposed into the restructuring of the economic activities, both at national and European level, determined the increase of the unemployment rate up to 7.2% (2011), which is identical to its value in the reference year.

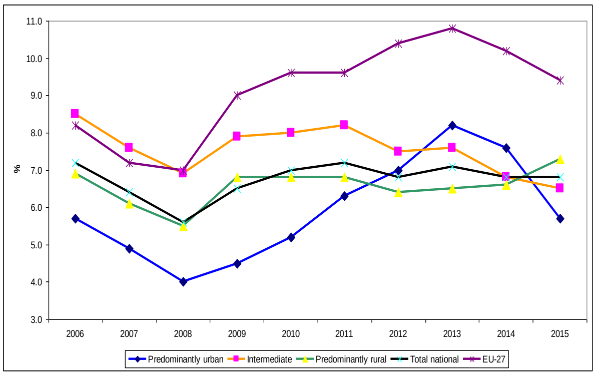


Fig. 8. Unemployment rate, according to urban-rural typology
Source: Own processing of Eurostat data

The effects were also felt after this moment, as the unemployment rate began to decrease slightly, with a relatively constant value around 6.8%, by 2.6 percentage points lower than the EU-27 level (year 2015). According to the urban-rural typology, the predominantly urban regions had lower unemployment rates in the investigated period as against the intermediary and predominantly rural regions, except for the years 2013 and 2014, to reach the value of the reference year by the end of the period, i.e. 5.7%. Although the predominantly rural regions had lower unemployment rates compared to the intermediate regions, throughout the investigated period, in the last year of the investigation (2015) they reached the highest value in the three regions, namely 7.3%, higher than the level in the reference year, i.e. 6.9%.

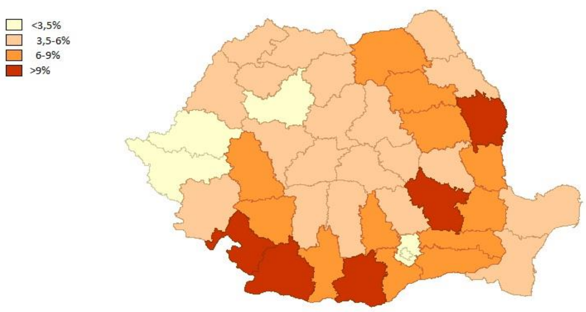


Fig. 9. Unemployment rate, 2015 by county
Source: Own processing GeoDa of Eurostat data

At county level, the highest unemployment rates in 2015 were concentrated in the south-west, north-east and south-east regions, while lower levels where registered by counties from central, north-west and west regions.

The unemployment rate in the young

population (15-24 years) also had a similar evolution in the predominantly rural regions, to reach 21.7% in the year 2015 (as against 20.7% - the value of the reference year), yet ranking second in size, next to that of the intermediate regions – 22.8%. Both values were above the national average – 20.6% and the EU-27 average – 18.6%. The predominantly urban regions were an exception, where the unemployment rate in the young population was under the (national and EU-27) reference values, with 18%. Unemployment in the young population represents a very important social problem; in order to solve this problem, efficient policies are needed in the field of education and employment. In the absence of these, the young people continue to depend on their families and are not motivated to carry out an income gaining activity. This type of socio-demographic pressure is also doubled by the **dependency rate**[2], which reveals the level of support that the young generation and/or elderly people need from the population of working age. In the year 2016, **the young people's dependency rate** (calculated as ratio of population under 15 years old to the population of working age, 15-64 years) at national level, was 23.12%, above the EU average (21.99%), lower in the case of predominantly urban regions and the highest in the predominantly rural regions (24.30%). This situation is also found in the case of **the dependency rate of elderly people** (above 65 years), the predominantly rural regions having the highest value, 27.84%, yet under the EU average of 28.86%. Thus, the accelerated demographic decline that the predominantly rural regions from Romania had to face in the last decade, and the need for a strategic approach to their development, are highlighted once again.

CONCLUSIONS

Overall, in the period 2007- 2015, the labour force at national level followed a downward trend in terms of volume indicators (resources, active population, employed population), with consecutive periods of growth and decrease, being influenced by the changes determined both by the EU membership and by the economic restructuring that followed after the global economic-financial crisis of the period 2008-2011, whose effects can be also felt at present. Opening up the European-wide labour market for the citizens of the EU member states has generated unprecedented mobility of the local labour force mobility, looking for jobs to ensure a much higher level of incomes; at the same time, **at national level an increasing mobility between the rural and urban regions can be also noticed,** the latter having an upward evolution of the specific indicators, supported by the accelerated development and the multiple opportunities provided to labour force in terms of diversity of activities and higher incomes. At the same time, **the predominantly rural regions were mostly affected**, the specific volume indicators having significantly lower values as against those in the reference year. These add to a structure of employed population dominated by the primary sector (agriculture); its values, although decreasing throughout the investigated period, continue to be much higher than those at national and EU-27 level, which reveals a **still high dependency on agriculture of the population from these areas** and the lower opportunities, compared to the other employment areas in the secondary and tertiary sectors. The unemployment phenomenon also contributes to the overall picture, which mainly affects the young population (15-24 years) and having higher values than at national and EU-27 level; this calls for a deep reform of the educational system, in general, and of the technical education in particular, in order to ensure its correlation with the current requirements of the labour market as regards professional and vocational training, thus providing for real employment opportunities for the young population.

REFERENCES

[1]Bancroft Gertrude, 1958, The American labor force: its growth and changing composition, New York. John

[2] Processing of NIS, Eurostat data.

Wiley and Sons
[2]Dona, I., Dobre Carina., Gergely Silvia, 2005, Dezvoltare rurală, Note de curs, sinteze, Universitatea de Științe Agronomice și Medicină Veterinară București (Rural development, Course notes. Syntheses. University of Agricultural Sciences and Veterinary Medicine, Bucharest).
[3]Eurostat, Statistics Explained Data Base, 2018, www.ec.europa.eu/eurostat, Accessed on February 4, 2018
[4]Ghețău V., 2016, citat de Știrile ProTV (Cited in ProTV news): http://stirileprotv.ro/stiri/social, Accessed on February 4, 2018.
[5]Keynes, J.M., 1936, The General Theory of Employment, Interest and Money. London. UK
[6]KeysFin, 2017, Studiu KeysFin de 1 Mai: Profilul angajatului român, la 10 ani de la aderarea la UE, Ultima ora, (KeysFin Study of 1st May: Profile of the Romanian employee at 10 years since the accession into the EU), http://ultima-ora.ro/studiu-keysfin-de-1-mai-profilul-angajatului-roman-la-10-ani-de-la-aderarea-la-ue/?mobile_switch=desktop, Accessed on February 4, 2018.
[7]Militaru Mădălina, Iordache Ștefania Cristina, Pandioniu Mihaela Luiza, 2015, Tendințe comportamentale pe piața muncii. O abordare macroeconomică, Banca Națională a României, Direcția Studii Economice (Behaviour trends in the labor market. A macro-economic approach, National Banl of Romania, Division of Economic Studies).
[8]National Institute of Statistics, 2016, Forța de muncă în România, ocupare și somaj 2016, www.issse.ro, Accessed on February 4, 2018.
[9]National Institute of Statistics, 2018, Tempo-online Data base, www.insse.ro, Accessed on February 4, 2018.
[10]Palicică Laura Ioana, Palicică Maria, 2005, Resursele umane și pregătirea forței de muncă din mediul rural, Editura Orizonturi Universitare, Timișoara (Human resources and the training of labor in the rural areas, University Horizons Publishing, Timisoara).
[11]Patronate of the Romanian Investors PIAROM, 2016, Studiu privind analiza forței de muncă la nivelul regiunilor de dezvoltare ale României, aferent anului 2015, disponibil la https://www.piarom.ro/studiu-privind-analiza-fortei-de-munca-la-nivelul-regiunilor-de-dezvoltare-ale-romaniei-aferent-anului-2015/, Accessed on February 4, 2018.
[12]Popescu Agatha, 2011, Labor resource- a restraining factor of rural areas development. Agricultural Management, Series I, Vol. XIII (1): 91-98, Agroprint Publisher, Timișoara
[13] Regional study - The situation of the labour force in the Central Region and the needs of development of the vocational system (In Romanian: Studiu Regional - Situația forței de muncă în Regiunea Centru și nevoile de dezvoltare ale sistemului de formare profesională, 2016, Agency for Centre Regional Development (Agenția pentru Dezvoltare Regională Centru), Available at: http://www.adrcentru.ro, Accessed Fabruary 4, 2018.
[14]Roman Monica, Voicu Cristina, 2010, Câteva efecte socioeconomice ale migrației forței de muncă asupra țărilor de emigrație. Cazul României în*:* Economie teroretică și aplicată, Volumul XVII, Nr. 7(548): 50-65, Asociația Generală a Economiștilor din România.(A few socio-economic effects of labor migration on the emigrant countries. The Case of Romania. Theoretical and Applied Economy, Vol.XVII, No. 7(548): 50-65, General Association of the Economists in Romania).
[15]Romania has the highest share of occupied population in agriculture (România are cea mai mare pondere a populației ocupate în agricultură), 2016, Agerpres, data from National Institute of Statistics, Available at: www.economica.net, Accessed Fabruary 4, 2018.
[16]Schoenberg, Erika, H., Douglas P.H (1937), Studies in the supply curve of labor: the relation in 1929 between average earnings in American cities and the proportions seeking employment in: Journal of Political Economy, no. 1: 45-79, edited by E.J. Hamilton et al. University of Chicago Press
[17]Tilly, C., 2004, Essay for Poverty ans Social Welfare in the United States: An Encyclopedia:1-14

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EVALUATION OF PHYSIOLOGICAL DEVELOPMENT OF THE PEAS UNDER THE INFLUENCE OF WORM COMPOST

Larisa CREMENEAC, Tatiana BOCLACI

Scientific and Practical Institute of Biotechnologies in Zootechny and Veterinary Medicine, 15 Strada Şcolară, 6225, village Maximovca, District Anenii Noi, Republic of Moldova, Phone: +373-22-359-351, Fax. +373-22-359-350, Email: kremeneak@yandex.ru, draganta8@gmail.com

Corresponding author: kremeneak@yandex.ru

Abstract

In order to evaluate the influence of the worm compost on the physiological development of the peas, depending on the phenological phases, the researches were carried out during the first year of action of two types of worm compost: worm compost I - obtained using as the bio transformer of the Red Hybrid of California and worm compost II – using descendant F_2 of the new line of earthworms, obtained by crossing the California Red Hybrid earthworm with local rubbish earthworm. Materials for research were: worm compost, the soil and the peas variety "Renata". The worm compost was incorporated into the soil, early spring, on the autumn plowing taking into account the dose of 4 t / ha (or 40kg/acres). Previously the worm compost and soil samples taken according to the usual methods were subjected to biochemical analyzes. At the end of the experiment, essential changes in the soil samples were not found, except for the content of organic matter and humus, which in the soil samples of the experimental lots exceeded that in the samples of the control lot, respectively by 10.00% -21, 12%; 10.34% -22.05% and 17.14% -19.74%; 11.43% -13.16%. As a result of the study of the phenological phases of the development of peas, it was found that peas cultivated with worm compost fund (experimental lots) developed for 5-9 days earlier than the cultivated with natural background (the control lot).
Thus, using the usual methods, the influence of worm compost on the physiological development of peas was evaluated.
Key words: *organic fertilizer, peas, phenological phases, soil, worm compost.*

INTRODUCTION

Obtaining organic farming is a social issue of global importance. The global environmental situation, including the region, has worsened in the last century due to the industrialization and chemicalisation of agriculture, the increase in the number of means of transport, the storage, the preservation and the non-use of organic waste, etc. These have resulted in pollution of the environment and its components.
A special role in the improvement of the environmental situation lies to the technology of bioconversion of organic waste by worm-cultivation and the use of its products in order to solve problems in the agrarian sector [1], [2].
Bioconversion of organic waste through worm cultivation as a new direction of science and agro biological practice deserves a special attention with fundamental research [3], [4]. Science and world practice conducted research aimed at moving the negative influence of harmful substances on the organisms, paying special attention to the problems of bioconversion, through worm cultivation, of organic waste from various branches of the national economy, including agriculture. The aim of this biotechnology is the obtaining of the organic ecological fertilizer, the worm compost, the incorporation of which in the soil increases the amount of humus [11].
In recent years there has been a significant decrease in the amount of humus in the soil. The loss of annual humus in soil constitutes 0.5-0.7 t/ha. In order to bring the humus balance to the level without deficit (zero), it is necessary to incorporate in soil about 6.3 t/ha of the obtained compost [10].
The amount of humus in the soil is one of the main indicators of soil fertility. Humus has a multilateral influence on agrochemicals, hygroscopic, thermal, technological and biological soil activities. In humus, are concentrated up to 98% of nitrogen reserves, 60% phosphorus, 80% sulphur, essential

quantities of other micro- and microelements.
Under natural conditions the accumulation of humus in the soil flows very slowly. For the formation of one centimetre of soil it is necessary to pass a period of 100 years. Under the influence of the anthropogenic factor, this process may take 3-5 years. The incorporation into the soil of the traditional compost obtained from the manure of different animals is effective but costly because only 20 kg of humus is formed from a tone of compost [7].
The incorporation of the worm compost in a dose of 4-8 tons/ha, depending on the amount of humus contained in the soil, essentially improves its quality, because in a tone of worm compost it is contained from 270 to 300 kg of humus. Therefore, the use of worm compost allows the essential reduction of the period of completing the humus deficit in the soil [10].
According to the research carried out, it has been found that the incorporation of the worm compost into soil increases not only the quantity of nutrients but also the biological activity of the soil. Also, the worm compost reduces soil density (from 2.70 to 2.67g / cm^3), maintains the humidity in the soil. The incorporation of the worm compost into the soil contributes to the reanimation of soil fertility and its purification of toxic substances [10].
As a result of the research it was found that the worm compost has a beneficial effect on the physiological development of crops, quality, quantity of production, acceleration of the baking process, resistance to unfavorable climatic conditions and different diseases of agricultural crops, but also to the process of obtaining ecologic agricultural production [5], [6].
The article presents the results of the research conducted on the evaluation of the physiological development of peas, in various phenological phases, in the first year of action of the worm compost, incorporated into the soil, taking into account the dose of 4 t/ha (or 40 kg/acre).
It has been found that worm compost reduces the duration of plant phonological phases, increases plant resistance to phytopathogenic attack and unfavorable climatic conditions, improves production quality and increases crop productivity [10].

MATERIALS AND METHODS

For conducting research on the evaluation of the physiological development of peas, in various phenological phases, in the first year of action of the worm compost, under the practical conditions of the TES "Maximovca", was organized an experiment according to the scheme outlined in the Table 1.

Table 1.Experiment Scheme

The lot number	The conditions of the experiment	Investigations during the experiment
I. Control	Natural background	- Biochemical investigations of worm compost (active acidity, humidity, dry substance, organic matter and humus); - Observations on the physiological development of peas
II. Experimental I	Worm compost I – 40 kg/acre	
III Experimental II	Worm compost II – 40 kg/acre	

Source: Own design.

The research material served: the soil, two types of worm compost (worm compost I - obtained using as the bio transformer the Red Hybrid of California earthworm and worm compost II - using F_2 descendants of the new line of earthworms, obtained by crossing the Red Hybrid of California earthworm with the rubbish local earthworm) and peas soul "Renata". In the experiment were used three lots with the surface of one are, including a control lot and two experimental lots. On the control lot the plants were cultivated with natural background, and on experimental lots - with a worm compost background.
In the experimental lots, until the sowing of the peas were incorporated as fertilizers worm compost I and worm compost II, at a dose of 40 kg /acre, taking into account the dose of 4 t/ha. Until the incorporation of fertilizers into

the soil their biochemical quality was determined. From each lot, up to the incorporation of fertilizer, and 3 months after incorporation, soil samples were taken from the depth of 0-10 cm and 15-20 cm for the purpose of determining the active acidity, moisture content, dry matter, organic substance and humus. During the experiment, observations were made on the physiological development of peas depending on four phenological phases (emergence, beginning of blooming, end of blooming and beginning of pods formation and final baking). The duration of the experiment constituted 3 months.

The biochemical analysis of worm compost and soil was performed according to the usual methods presented in Razumov B.A.'s manual „Handbook of the laboratory assistant chemist for analysis on feeds" [12] and in the Standards [8], [9].

RESULTS AND DISCUSSIONS

Analyzing the obtained results regarding the quality indicators of the I and II worm compost (Table 2), it was found that the value of the active acid (pH) does not differ essentially. The content of humidity, dry matter, organic matter and humus in the samples of the worm compost I are different from those of worm compost II.

Table 2.Quality indicators of worm compost

Crt. No.	Indicators	Name of fertilizers	
		worm compost I	worm compost II
1	Active acidity, u.c.	7.23 ± 0.002	7.21± 0.02
2	Humidity, %	61.08 ± 0.05	51.20± 0.01
3	Dry substance, %	38.92± 0.05	48.80±0.01
4	Organic substance, %	30.85 ± 1.65	28.40 ± 0.90
5	Quantity of humus,%	36.40 ±4.20	30.87 ± 2.27

Source: Own results.

Thus, it was found that the value of humidity, organic matter and humus in the samples of the worm compost I increased, corresponding to 19.30%; 8.63% and 17.91%, and the content of dry matter decreased by 20.25%, compared to the same indicators of worm compost II.

As a result of the analysis of the obtained data (Table 3), it was found that in soil samples collected from lots, from the deep of 0-10 cm and 15-20 cm till the sowing of the peas, the quality indicators are not essentially different.

The results of the research shown in Table 4 demonstrate that after 3 months of the incorporation of the fertilizers, the biochemical indicators of the soil taken from different levels during the experimental.

Table 3. Particularities of the biochemical composition of the soil until the incorporation of the fertilizer

Lots and sampling depth, (cm)	Biochemical indicators, (M ± m)				
	Active acidity, u.c.	Humidity, %	Dry substance, %	Organic substance, %	Humus content, %
I – control a) 0-10 b)15-20	7.22± 0.10 7.28± 0.12	13.10± 0.07 17.10± 0.10	86.90± 0.07 82.90±0.10	4.38±0.07 4.43±0.09	3.30± 0.08 3.50± 0.40
II – exp. a) 0-10 b)15-20	7.21± 0.05 7.14± 0.10	12.20±0.00 15.55±0.14	87.80±0.00 84.45±0.14	3.68±0.26 5.37±0.10	3.50± 0.12 3.50 ±0.07
III – exp. a) 0-10 b)15-20	7.30 ± .05 7.25 ± .08	8.11± 0.10 17.45±0.05	91.89± .10 82.55±0.05	5.28±0.10 5.28±0.10	3.30± 0.12 3.70 ± .15

Source: Own results.

The results of the research shown in Table 4 demonstrate that after 3 months of the incorporation of the fertilizers, the biochemical indicators of the soil taken from different levels during the experimental period did not change significantly. However, the value of organic matter and humus in samples taken from the depth of 0-10 cm of experimental lots II and III increased respectively, by 10.00%; 22.05% and 19.74%; 13.16%, and in the ones taken from the depth of 15-20 cm respectively increased by 21.12%; 10.34% and 17.14%; 11.43%, compared to the same soil indicator of the control lot.

So, as a result of the research, it was found that in the first year of action of the worm compost soil fertility was partially improved by increasing the amount of organic substance and humus.

Table 4. Particularities of the biochemical composition of the soil after incorporation of the fertilizer

Lots and sampling depth, (cm)	Biochemical indicators, (M ± m)				
	Active acidity, u.c.	Humidity, %	Dry substance, %	Organic substance, %	Humus content, %
I – control a) 0-10 b)15-20	 7.17 ± 0.28 7.29 ± 0.50	 13.55±0.18 17.42±0.34	 86.45±0.18 82.58±0.34	 4.40±0.03 4.45±0.02	 3.80± 0.15 3.50 ± 0.07
II – exp. a) 0-10 b)15-20	 6.93 ± 0.24 7.01± 0.20	 13.73±0.19 18.03±0.41	 86.27±0.19 81.97±0.41	 4.84±0.10 5.39±0.02	 4.50± 0.01 4.10 ± 0.15
III – exp. a) 0-10 b)15-20	 6.80 ± 0.17 6.82 ±0.17	 9.81± 0.16 18.98±0.34	 90.19±0.16 81.02±0.34	 5.37±0.02 4.91±0.11	 4.30± 0.07 3.90 ± 0.07

Source: Own results.

As a result of the conducted observations during the first year of action of the fertilizers on the phenological phases (Table 5), it was found that the peas cultivated with the worm compost fund of the experimental lots I and II had properly grown on the 10-th and 11-th day after sowing. Peas from the control lot cultivated with natural background began to rise on the 16-th day after sowing.

Table 5. Evaluation of the influence of the worm compost on the phenological phases of peas

Lots	The period of the phenological phase (after sowing) – days			
	Emergence	Beginning of blooming	Beginning of pods formation	final baking
Control (natural background)	16	49	57	88
Experimental I (worm compostl I)	10	40	48	80
Experimental II (worm compost II)	11	41	49	81

Source: Own results.

From the above mentioned it was found that the peas cultivated on the lots with the worm compost I and II, rose by 6-5 days earlier than the one on the control lot.
The blooming of peas on experimental lots I and II (with a worm compost background) (photo 1 and photo 2) started properly on the 40-th and 41-th day, after sowing.

Photo 1. The physiological development of cultivated peas with a worm compost background (the I experimental lot), in the second phenological phase
Source: Original.

Photo 2. The physiological development of cultivated peas with a worm compost background (the II experimental lot), in the second phenological peas
Source: Original.

Analyzing the results in the Table 5, it was found that the plants in the control lot (Photo 3) began to blossom on the 49-th day after sowing.

Photo 3. The physiological development of cultivated peas with natural background, in the second phenological phase
Source: Original.

Thus, as a result of the observations, it was found that in this phenological phase the peas on the experimental lots, with a worm compost background, developed by 9-8 days earlier than the one cultivated with natural background (the control lot). The mass blooming of the plants and the formation of the pods grown on the lots with a worm compost background took place after 48 and 49 days, and on the control lot after 57 days after sowing. According to the obtained results in this phenological phase, the physiological development of peas, on the experimental lots, took place by 9 and 8 days earlier than the one on the control lot.

As a result of the observations made, it was found that the same phenomenon was also manifested in the last phenological phase of peas development (the final baking phase). Peas on experimental lots reached the final baking stage by 8 and 7 days earlier than that on the control lot.

Therefore, as a result of the carried out research, it was found that in all phenological phases peas on experimental lots cultivated with organic fertilizer background (worm compost I and II) had an earlier development than that on the control lot.

Thus, the physiological development of peas was evaluated under the influence of the worm compost in its first year of action.

CONCLUSIONS

As a result of the research it was found that: - the value of humidity, organic matter and humus in the samples of the worm compost I increased, corresponding to 19.30%; 8.63% and 17.91%, and the content of dry matter decreased by 20.25%, compared to the same indicators of worm compost II;

-in soil samples collected from lots, from the deep of 0-10 cm and 15-20 cm till the sowing of the peas, the quality indicators are not essentially different;

-after 3 months of the incorporation of the fertilizers, the biochemical indicators of the soil taken from different levels during the experimental period did not change significantly, however, the value of organic matter and humus increased compared to the same soil indicator of the control lot;

-in the first year of action of the worm compost soil fertility was partially improved by increasing the amount of organic substance and humus;

-the fertilization of the soil with two types of worm compost (worm compost I - obtained using as the bio transformer the Red Hybrid of California earthworm and worm compost II - using F_2 descendants of the new line of earthworms, obtained by crossing the Red Hybrid of California earthworm with local rubbish) improved soil quality and reduced the duration of the physiological development of the peas: emergence for 5-6 days, the beginning of the bloom, the appearance of the pods and the final baking by 8-9 days.

REFERENCES

[1]Cremeneac, L., Abramova, V., Bahcivanji, M., 2002, Bioconversion of organic waste and environmental protection. Recommendations, Chisinau.
[2]Cremeneac, L., 2003, Bioconversion of organic waste in Moldova, Science information, Chisinau.
[3]Cremeneac, L., Boclaci, T., Chiruneţ, Z., 2012, Technology of bioconversion of organic wastes and the use of the obtained products. Recommendations.

Typography „Print-Caro”, Chisinau.
[4]Cremeneac, L., Boclaci T., 2013. General aspect of management of organic waste in sustenable development of agriculture, Scientific bulletin. Series F. Biotechnologies, Volume XVII, Bucharest, 43-49.
[5]Cremeneac, L., Boclaci, T., Brad, T., 2014, Evaluation of the quality and productivity of maize grown with worms compost. Book of abstract. 12th International Symposium of Animal Biology and Nutrition. Balotești, România, 31.
[6]Cremeneac, L., Boclaci T., 2015, The role of worm compost in improving the quality and increasing the productivity of maize. Magazine Moldovan agriculture, No. 1, 26-28
[7]Gorodnyi, N., M., 1996, Bioconversion in the management of agroecosystems. Kiev.
[8]GOST 26204-84 - 262013-84, 1984. Soils. Methods of analysis, Moscow.
[9] GOST 26712-94,1988. Organic fertilizers. Methods of analysis, Moscow.
[10]Kosolapova, A., 1996, Worms culture and its capabilities, Ryazan, 20-25
[11]Melnik, I.,A., 1996, Bioconversion of organic waste and environmental protection. Abstracts of the IV International Congress "Bioconversion of Organic Waste and Environmental Protection", Kiev, 2-5.
[12]Razumov V., 1986, Handbook of the laboratory ssistant chemist for analysis on feeds „Rosselkhozizdat”, Moscow, 89-92; 144-148

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE MANAGEMENT OF THE PLOTS AND OF THE PLUM ORCHARDS USING AN EXPERT SYSTEM-CROM

Daniela DANA[1], Irina-Adriana CHIURCIU[2], Valentina VOICU[3], Elena SOARE[4]

[1]Technological Secondary-School Prundu, Giurgiu, Mihai Viteazul Technological Secondary-School, 17 Bucharest-Giurgiu, Călugăreni, Giurgiu, Romania, danad8136@gmail.com
[2,4]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania, irina.chiurciu@yahoo.ro, economiegen2009@yahoo.com
[3]National Research Institute for Soil Science, Agrochemistry and Environment Protection, 61 Marasti Blvd, District 1, Bucharest, Romania, valy_c76@yahoo.com

Corresponding author: irina.chiurciu@yahoo.ro

Abstract

The paper presents aspects concerning the management of natural resources (climate conditions, soil fertility and relief conditions) and anthropic resources (the orchard infrastructure), as well as the quantification and characterization of the indicators of these resources in an expert system-CROM. The main objective of this study was the monitoring of the natural and anthropic resources, at the private farm in Domasnea locality, in order to establish the restrictions and recommendations for the improvement of the plots and of the plum orchards.

Key words**:** *plum trees, plots, orchards, expert system*

INTRODUCTION

It is unanimously admitted that a category of assortments can achieve its biological potential only if the ecological offer of the area optimally satisfies the biological needs. [2, 6]
The model applied in the expert system-CROM is comparable with similar systems in Germany, Czech Republic, Slovakia and other states from the European Union. The advantages are the different approach, more appropriated for the local conditions, the more technical and economic rapport between the baseline resources and the direct consequences on production and quality of fruits and on the socio-administrative field. [2, 4]
The private farm where the expert system-CROM was applied is located in the Domaşnea locality, the Fourth Development Macro Region, the West Region, in the south-eastern part of Caras Severin County, in the north of the Domaşnea-Mehadia depression, at an altitude of 492 m. The nearest town (Herculane resort) is 25 km away. [3]
The study was made on the fruit trees of the species Prunus, the variety Early Tuleu and Anna Spath. The species of the rootstock is Prunus and the variety used is the Cherry plum. The tree age in the orchard is 17 years old.

MATERIALS AND METHODS

In order to characterize the natural and anthropic resources at the private farm in Domaşnea, an integrated expert system was used. The expert system-CROM was developed in accordance with an original methodology by I.C.P.A. [2, 8, 9, 10], which quantifies by addition points and depreciations points the climate resources, the soil and infrastructure resources, the production and the quality of fruits.
In this system:
- The meteorological elements are quantified in accordance with the frequency of repetitiveness of optimal climatic intervals and thresholds for each fruit tree category, in ten years. Climate resources can get between 0 and 40 addition points;
- The soil conditions are granted with 0-25 addition points;
- The relief conditions depending on their role in the fruit tree ecosystem are granted with 0-15 addition points;
- The indicators for orchards characterization can get between 20 and 100 addition points;

- The orchards infrastructure can receive 0-35 depreciation points.

To evaluate the fruit tree lands and orchards in the expert system, from the sum of the addition points the depreciation points will be subtracted. Depending on the obtained values, the fruit tree lands and orchards will be grouped in three categories: without natural and anthropic restrictions, with natural and anthropic restrictions, improper for fruit tree cultivation.

For this study statistical data from the National Institute of Statistics (INS) were collected and processed and they were used indicators such as: the number of plum trees; the total plum production; the average production per plum tree for the period 2005-2016.

RESULTS AND DISCUSSIONS

Climate resources expertise

The following indicators were used for the expertise of the climatic resources at the private farm in Domașnea, Caraș-Severin: the average air temperature, the absolute minimum temperature, the thermal amplitude in November-February and the rainfalls in the period between the V-VII months.

For the plum tree cultivation, the optimal average air temperature is between 7^0C and 10^0C. In the study period it was 10.3^0C and the frequency of repetitiveness of the optimum intervals was 90%.

The absolute minimum temperature of -22^0C for plum species was not recorded. The thermal amplitude in November-February greater than 20^0C had a frequency of repetitiveness about 40% (Figure 1).

The rainfalls were quantified for May-July, and the optimum quantity of 200-260 mm was recorded with a frequency of repetitiveness of 40%.

The obtained yields for the 2 varieties of plum trees at the private farm in Domașnea were studied in relation to the thermal amplitude. For the studied years the plum yield fluctuated according to the climate and to the thermal amplitude. The yield decreases while the quantum of the thermal element is higher than 20^0C (Figure 1).

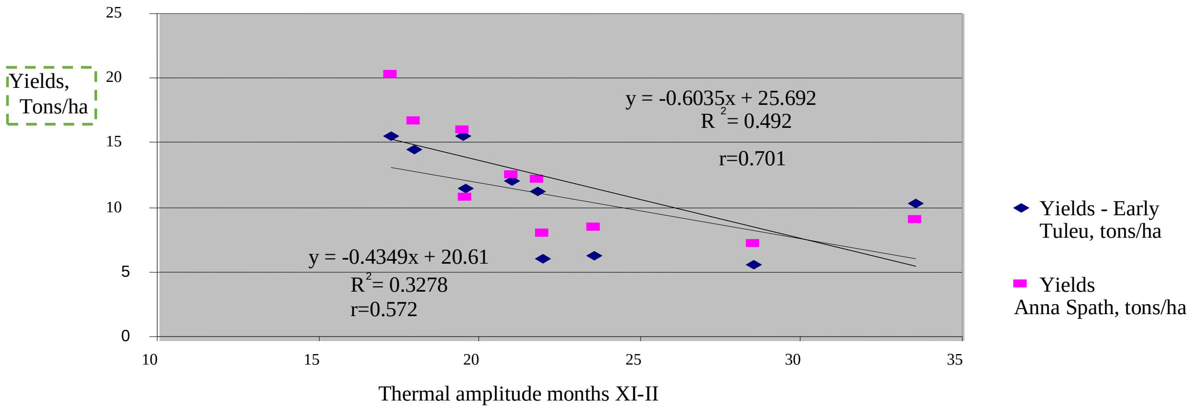


Fig.1. The relation between the yields and the thermal amplitude (^{0}C, XI-II months) for plum trees, Early Tuleu and Anna Spath varieties, at the private farm in Domașnea, Caraș-Severin

Table 1. The quantification of the climatic resources for plum trees, Early Tuleu and Anna Spath varieties, at the private farm in Domașnea, Caraș-Severin

Species/variety/ rootstock/age	Class of expertise	Addition points
Prunus/Early Tuleu/ Anna Spath/ Cherry plum /17	With climatic restrictions	39

From the quantification of the climatic resources for plum trees, in the expert system-CROM, 39 addition points were obtained (Table 1).

Soil resource expertise

In order to expertise the soil resources for plum trees the following indicators were used: the active edaphic volume, pH, salinization, alkalization, exchangeable Al content, $CaCO_3$ with depth of horizons Cca, Cpr, Rz, active $CaCO_3$ from carbonates horizon and the effect of the industrial pollution. Depending on the baselines values, the soil properties, at the private farm in

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Domaşnea, receive 25 addition points. The plots and the plum orchards were included in the class without soil restrictions (Table 2).

Table 2. The quantification of the soil resources for plum trees, Early Tuleu and Anna Spath varieties, at the private farm in Domaşnea, Caraş-Severin

Species/variety/ rootstock/age	Class of expertise	Addition points
Prunus/Early Tuleu/ Anna Spath/ Cherry plum /17	Without soil restrictions	25

Land resources expertise

For characterization of the plum plots resources the indicators concerning the relief conditions (slope, aspect, surface and deep erosion, landslides) and drainage conditions (un-negleyed non-pseudogleyed soil volume and aeration porosity) were used. The relief conditions and the drainage conditions are granted 15 addition points using an expert system-CROM and the plum tree lands and the orchards were included in the category without land restrictions (Table 3).

Table 3. The quantification of the plot resources for plum trees, Early Tuleu and Anna Spath varieties, at the private farm in Domaşnea, Caraş-Severin

Species/variety/ rootstock/age	Class of expertise	Addition points
Prunus/Early Tuleu/ Anna Spath/ Cherry plum /17	Without land restrictions	15

Expertise for plum orchards characterization criteria, production and the quality of the fruit

The criteria for the characterization of the plum orchards are: the age of the trees, the assortment of species, the varieties and the rootstock, the stage of vegetation for the orchards, the production and the quality of the fruits. All of these are granted 91 addition points in an expert system-CROM (Table 4).

Table 4. The expertise of plum orchards, Early Tuleu and Anna Spath varieties, at the private farm in Domaşnea,Caraş-Severin

Species/variety/ rootstock/age	Class of expertise	Addition points	Indicators of characterization
Prunus/Early Tuleu/ Anna Spath/ Cherry plum /17	5-10 years	34	Age of plum trees
	High	40	Assortment of species
	Good	17	Stage of vegetation for the orchards
	Total addition points	91	-

Expertise for the plum orchards infrastructure

To characterize the plum orchards there are quantified: the equipping degree of the plots and plantations, the possibilities for valorising fruit production, the possibilities of access to the market and the degree of modernization of the transport routes. In this case 5 depreciation points are marked, for the possibilities of access to the market (Table 5).

Table 5.The expertise of plum orchards infrastructure, Early Tuleu and Anna Spath varieties, at the private farm in Domaşnea, Caraş-Severin

Species/variety/ rootstock/age	Class of expertise	Depreciation points	Indicators of characterization
Prunus/Early Tuleu/ Anna Spath/ Cherry plum /17	High	0	The equipping degree of the plots and orchards
	High	0	Possibilities for valorising fruit production
	High	0	Proximity of the market
	Low	5	Possibilities of access to the market
	Depreciation points	5	-

If the production potential is not in a proper balance with a proper management the economic indicators and the profitability of the investment are affected.

The statistical data that have been processed and will be presented later highlight the leading position of Caras-Severin County in the cultivation of plums.

The analysis of Figure 2 shows that the Fourth Macroregion has the largest number of plum trees (the state and private sector), compared to the other Macroregions of development, during 2005-2016.

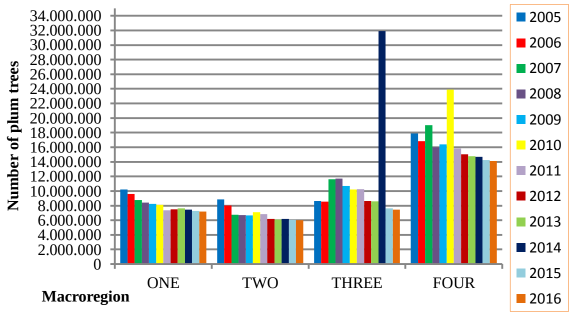


Fig.2. The dynamics of the total number of plum trees per Macroregions of development
Source: [5], own interpretation.

This number is decreasing, with the highest value registered in 2010 - 23,903,571, and the lowest in 2016 - 14,102,572. The decrease in the total number of plum trees is registered also for the other Macroregions of development.

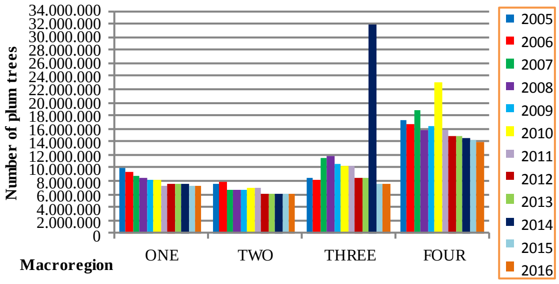


Fig.3. Dynamics of the number of plum trees in the private sector, by Macroregions of development
Source: [5], own interpretation

Regarding the number of plum trees in the private sector during the period 2005-2016 (Figure 3), on the first place is the Fourth Macroregion, with the highest number in 2010 - 23,184,272 plums, and the lowest in 2016 - 14,082,023 plumes. Remarkable is the same tendency to decrease the number of plums also in the private sector.

The share of plum trees cultivated in the private sector, total of plum trees - for the Fourth Macroregion - ranges between 96.99% (2010) and 99.96% (2013).

Figure 4 shows the number of plums cultivated in the private system in the West Region, part of the Fourth Development Macroregion. Caras Severin County, where Domaşnea is located, has the largest number of plum trees cultivated in the private system. The highest value was registered in 2007 - 6,009,678 plum trees, and the lowest in 2012, 2,034,827 plum trees.

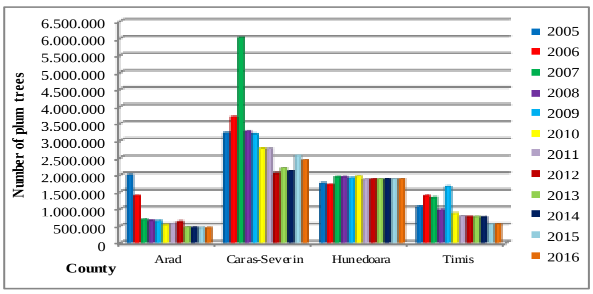


Fig.4. The dynamics of the total number of plum trees in the counties of the Fourth Macroregion of development
Source: [5], own interpretation

The largest plum production in the West Region, in the period 2005-2016, in the private sector, was obtained in Caras-Severin County, in 2008 - 31,654 tons (Figure 5). For the same county, the smallest production was 17,798 tons in 2016.

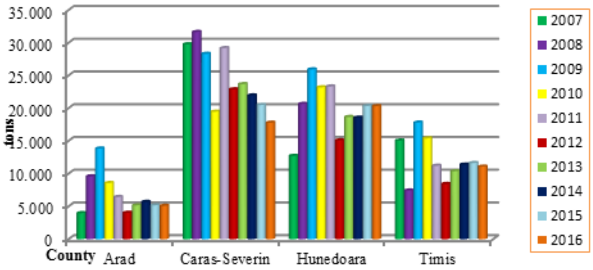


Fig.5.The plum production in the private sector of the West Region by county
Source: [5], own interpretation

Figure 6 shows the average plum production, in kg /plum tree, obtained in the West Region,
in the private sector, during 2007-2016.

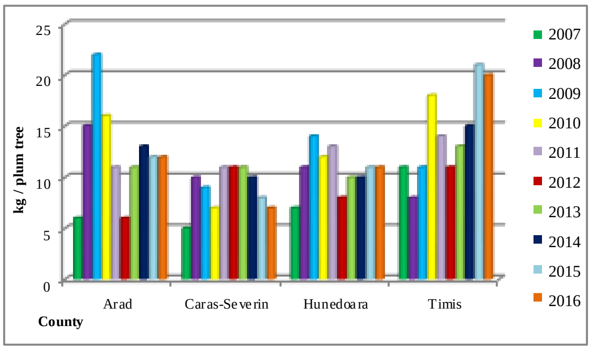


Fig.6. Average plum production obtained in the Western Region in the private sector
Source: [5], own interpretation

For Caras-Severin County, the smallest production 5 kg / plum tree was harvested in 2007, and the highest was 11 kg / plum tree (2011, 2012, 2013).

Regarding the average plum production, in Arad County and in Timis County, they recorded the highest values (Arad 22 kg / plum tree - 2009, respectively Timis 21 kg / plum tree - 2015).

In areas with natural favourability or with potentiated favourability (in the condition of the irrigation facility) equal to or higher than 2, (Annexe 7 "areas STP" 4.1a, [1]) the cultivation of plums or fruit trees in general represents a business opportunity.

The statistical data show that the number of people leaving the city is higher than those who leave the rural environment [7].

The EU non-reimbursable funds that can be accessed through the Romania's Agency for Rural Investment Financing (AFIR, [1]) constitute a point of interest for those who give up city life in favour of the rural environment, as well as for the agricultural education graduates.

CONCLUSIONS

Following the application of the expert system-CROM, the plum plots and the orchards at Domașnea private farm received 175 points and were included into the category: with natural and anthropic restrictions.

Natural conditions favour plum trees cultivation, only the thermal amplitude (XI-II months) greater than 20^0C has negative effects on the plum yields. The Anna Spath variety was less affected than the Early Tuleu variety.

In order to avoid production fluctuations, it is recommended to use a larger assortment of varieties to compensate the decrease of plum yields caused by the climatic factor.

To improve access to the market, it is recommended to build asphalt roads.

The largest number of plum trees in the private sector is cultivated in the Fourth Development Macroregion.

The County of Caras-Severin ranks first in the West Region in the number of plum trees cultivated in the private sector. The highest value was recorded in 2007 - 6,009,678 plum trees, and the smallest, in 2012 - 2,034,827 plum trees.

The largest plum production in the West Region, in the period 2007-2016, in the private sector, was obtained in the county of Caras-Severin in 2008 - 31,654 tons.

The average plum production obtained in the Caras-Severin county ranges between 5-11 kg/ plum tree.

European non-reimbursable funds are one of the reasons why young people choose to return to rural areas.

ACKNOWLEDGEMENTS

This research was carried out with the support of the Ministry of Education, AMCSIT-Politehnica Bucharest, project 3707 CEEX.

REFERENCES

[1] Agency for Rural Investment Financing (AFIR) - www.afir.info, Accessed on 19.02.2018

[2] Dana, D., Lazar, C., Raducu, D., Stefanescu, S. L., Voiculescu, N., 2008, Operational handbook for evaluation of the fruit trees lands and orchards using expert systems, Estfalia, Bucharest, 3-89

[3]Domaşnea's home page, www.domasnea.com, Accessed on 19.02.2018

[4]Land use change and land degradation in southeastern mediterranean spain - Symeonakis, E., Calvo-Cases, A. & Arnau-Rosalen, E. Environmental management (2007) 40: 80. https://doi.org/10.1007/s00267-004-0059-0.

[5]National Institute of Statistics (INS) - www.insse.ro, Accessed on 18.02.2018

[6]Platon I., Stanica F., 2011, Effects of planting systems on Florina and Generous apple trees grafted on M 26 rootstock, Acta Hort. (ISHS) 903, 633-640

[7]Tindeche, C., Marcuta, A., Marcuta, L., 2014, Importance of the agricultural sector as a branch of the national economy, Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 14(4) 299-305.

[8]Voiculescu, N., 1999, Ecopedology of fruit trees, Romanian Academy, Bucharest, 4-325

[9]Voiculescu, N., Cepoiu, N., Leca, M., 2001, The ecopedological bases of the nutrition of the fruit species, Muntenia-Leda, Constanta, 7-296

[10]Voiculescu, N., Hoza, D., Spita, V., 2006, Land reference values in the absorption and migration of nutrients in fruits, Elisavaros, Bucharest, 19-291.

INFORMATION TECHNOLOGIES AS AN INCENTIVE FOR RUSSIAN AGRICULTURE

Mihail Nikolaevich DUDIN[1], Ksenia Pavlovna PAVLOVA[1], Evgenia Evgenevna FROLOVA[2], Tatiana Mihailovna SAMUSENKO[3], Iuliia Yuryevna POPOVA[3]

[1]Russian Presidential Academy of National Economy and Public Administration (RANEPA), 119571, Russian Federation, Moscow, 82, Vernadsky Av., Phone: +7 499 956-99-99, Emails: dudin.n.mihail@mail.ru; ksenia-pavlova@list.ru
[2]Institute of State and Law of the Russian Academy of Sciences, 119019, Russian Federation, Moscow, 10, Znamenka Str., Phone: 8 (495) 691-88-16. E-mail: evgevgfrol@mail.ru
[3]Law school, Far Eastern Federal University, 690950, Russian Federation, Vladivostok, 8, Suhanova Str., Phone: 8(800)5550888, Emails: tatiana.samusenko@bk.ru; iuliia.y.popova@mail.ru

Corresponding author: dudin.n.mihail@mail.ru

Abstract

This article presents the findings of evaluating the level of ICT (*information and* communication *technology) advancement in the agricultural production of the Russian Federation. The primary goal of this paper is to identify priority areas for intensifying agriculture using information and communication technologies for the ICT advancement in agricultural production. The study is based on application of theoretical and general scientific research methods, as well as comparative analysis of statistical data reflecting the development of information and communication technologies in rural areas of the Russian Federation. Analysis of the current state of informatization of the agricultural industry in the Russian Federation allows to draw a conclusion that information systems enabling automatization of the processes to ensure national food security in state authorities have been established in the country by now. At the same time, the information resources required by agricultural producers are rather scattered and poorly systematized. Evaluation of the ICT utilization in agricultural production of the Russian Federation reveals that the state of the information infrastructure and the advancement of information technologies among rural population are much inferior to similar indicators in urban areas. A positive trend should be noted: ICTs are increasingly spreading in rural areas, and differences between the city and the countryside are fading. The author agrees with the opinion of experts who claim that the task of information technologies is to maximize automation of all stages of the production cycle to reduce losses, increase business productivity and optimize resource management. In the author's opinion, two key areas of the agricultural production intensification with the use of information technologies can be identified: creation of a unified information base on resources for agricultural producers and introduction of the Internet of things (IoT), and digitalization of agricultural production in the Russian Federation.*

Key words: *information technologies, agricultural industry, agriculture, ICT, informatization, mobile technologies, digitalization, internet of things*

INTRODUCTION

The demand for food is expected to increase by 60% over the next 35 years, since the world's population is estimated to reach 9.2 Billion people by 2050 [14]. Agriculture is a vital sector for the survival of mankind and a driver of international trade. If this production problem cannot be solved, food shortages may occur, which would entail social and political instability, and the global security may be threatened.

Agricultural production is currently developing under the conditions of stagnating expansion of arable land, lack of water resources, environmental degradation, negative effects of climate change, rapid urbanization, and reduction in agricultural labor.

Coordinated and concerted efforts are required from all stakeholders, including the public and private sectors, in order to solve the problem of food security. Achieving improved and sustainable agricultural production and productivity growth largely depends on the advancement of agricultural research and its efficient application in farmer fields through the transfer of technology and innovation.

FAO (Food and Agriculture Organization) estimates that 91% of the global food production will increase until 2050; one should proceed from the increasing yield of existing arable land through the promotion of agricultural research, as well as its application and transfer to farmers through efficient research links. ICTs, geoinformation systems, remote probing, precise agriculture and many other technologies or processes have an enormous potential in the development of agriculture and advancement of the national food security [13].

Mobile technologies will efficiently improve the transfer of agricultural research findings for use in farmer fields [16]. Timely reporting of transboundary animal diseases using mobile technology will save lives of a large number of animals and minimize financial losses [30].

At the same time, the ICT utilization in agricultural production is significantly lower than in other branches of the economy and is constrained by a number of problems, including insufficient technological and intellectual training of employees at agricultural enterprises.

Creation of a system of state information resources that support electronic accounting in the agricultural sector remains among the topical issues.

The goal of this paper is to evaluate the intensity of the information and computer technologies application in the agricultural sector of the Russian Federation and define the priorities for the ICT development in agricultural production.

Literature review

The review of international practices on the ICT usage in agriculture of various countries indicates that the scope of its application is quite extensive [20].

ICTs in agriculture are used for [1]:

(i)Promoting multiple innovations.

As the innovation activity in agribusiness intensifies, the role of information and communication services increases, since information and knowledge act as the most important production resources for shaping sustainable agriculture [15].

An innovative approach to agriculture development requires creation of a strong favorable environment (supporting and efficient legal, tax and political regimes) and adequate infrastructure systems (roads, transport, telephones, means of storage, processing and marketing, as well as information systems) [26].

(ii)Obtaining pricing information and analysis of prices for commodities and stock markets.

Not only information on agricultural marketing available to farmers helps them sell their products at more favorable prices, but also provides reliable information about prices for products to policymakers in order to prevent price volatility and speculation. This contributes to improving food security [35].

(iii)Collecting meteorological data.

Regular monitoring of global food reserves, including mapping of agricultural production and areas where food shortages exist, is the first step towards ensuring food security [36]. Information and communication technologies (ICTs) are primary tools for monitoring the environment and climate and predicting climate change at the global level [2].

(iv)Providing farmers with consulting services relating to agricultural production expansion.

Consulting services are arranged and provided via various information channels, of which the Internet and mobile telephony are most often used [25]. However, the development of ICT infrastructure – especially access to the Internet, and hence access to the necessary and timely information, – remains challenging in rural areas [6].

(v)Establishing an early warning system for disaster prevention and control;

(vi)Collecting statistical data in agriculture, etc.

Farms, which form the basis of agricultural production (AG) worldwide, are the key factor for the industry development. To meet the growing demand for food, small farmers need to achieve critical success in managing tasks, create an efficient system for monitoring crops and livestock breeding, and move on to efficient agricultural practices [37].

ICTs will play a critical role in achieving the goals set by providing integrated and available cyber physical systems (CPS) that are able to measure, analyze and control AG operations [32].

Contemporary studies note that ICTs include hardware, software and applications for creating, managing and presenting digital content (for a user), knowledge management and shared use, as well as aspects of institutional management and organizational structures associated with information, data and knowledge sharing [33].

This set of technologies and processes is called the Information and Communication Management (ICM) [22, 23].

Challenges of ICM of agricultural production in developing countries are reviewed in the papers of Chalemba, L. [5], Nelcon, R. and Coe, R. (2016), Jukan A., Masip-Bruin X. and Amla, N. [17], Cáceres R., Pol E., Narváez L. [4] and others.

Impact of ICT on knowledge management processes in the agricultural sector attracts particular attention of modern researchers [34].

Rizvi, S.M.H., Dearden, A. note that advances in the field of ICTs and their application in the fields of development have significantly improved the prospects for human development [29].

Kelly N., Bennett J.M., Starasts A. theoretically justified the adoption of the network paradigm of training agricultural producers, which connects farmers at different distances for constructivist training [18].

Modern information technologies allow solving problems of soil fertility management [27], creation of intelligent irrigation systems [12], etc. The world practice indicates that introduction and development of ICTs in agriculture has an efficient impact on the increase in productivity, income of agricultural producers, food security and employment in the sector [19].

However, lack of integrated approach, basic principles and tools for the ICT usage in agricultural services at the national level leads to inefficient use of resources [7].

As such, the agribusiness sector should start using public networks and advances in communication and information technologies to be able to develop business ponentially [8, 31].

MATERIALS AND METHODS

The primary goal of this study is to identify promising areas for improving the efficiency of agricultural production using information technologies.

The study solves a number of problems to achieve this goal:

-Evaluate the intensity of ICT usage in agricultural production in the Russian Federation;

-Identify priority areas for intensification using ICTs.

Academic publications of Russian and foreign experts on the development of the agricultural sector and the problems of introducing information technologies in agricultural production served as the theoretical basis of the study.

The study uses methods of analyzing the results of observations, dynamic and comparative analysis of statistics provided by Rosstat, the Ministry of Agriculture of the Russian Federation, the Ministry of Communications and Mass Media of the Russian Federation, etc.

RESULTS AND DICUSSIONS

Informatization of agricultural industry as a priority of the Russian National Policy

Agriculture is the most important sector of the Russian economy, since food security is among the key national priorities. The state supports agricultural producers with subsidies, grants and concessional lending. This situation has led to an increase in investment in the development of large-scale projects in the agricultural industry [3].

At the same time, sanctions against Russia helped accelerate import substitution, while retaliatory measures aimed at restricting the import of certain types of food from the European Union, the US, Australia, Canada and Norway to Russia provided a "window of opportunities" for domestic producers and gave positive impetus to the industry.

As such, due to a set of measures in the field of import substitution, agricultural production has grown by 11% over 3 years, while imports of food have almost halved over 3 years: from $43 bln to $25 bln in 2016. Positive results were noted in most agribusiness branches. For example, gross harvest of grain has increased by 14.2% over 2014-2016, production of livestock meat and poultry has increased by 9.1%, catch of aquatic biological resources has increased by 5%. Sugar beet and oil crops are leading in the production of vegetables, demonstrating an increase of 53.3% and 26.4% respectively at the year-end.

Fundamental indicators of the Russian agricultural industry for 2014-2016 are presented in Table 1.

Table 1. Fundamental indicators of the Russian agricultural industry for 2014-2016

Indicator	2014	2015	2016	Change, 2016/2014	
				+/-	%
Agricultural production, bln. rub.	4,319.1	5,165.7	5,626.0	1,306.9	130.3%
including crop farming	2,222.5	2,791.4	3,170.5	948.0	142.7%
including livestock breeding	2,096.6	2,374.3	2,455.5	358.9	117.1%
Crop acreage, thous. ha	78,525	79,319	79,993	1,468.0	101.9%
Gross yield of grain, thous. tons	105,315	104,786	120,672	15,356.7	114.6%
Gross yield of sugar beet, thous. tons	33,513	39,031	51,367	17,853.5	153.3%
Gross yield of oil crops	12,859	13,837	16,258	3,399.1	126.4%
Production of meat and poultry, thous. tons	9,070.3	9,565.2	9,899.2	828.9	109.1%
Field vegetables and vegetables under glass	15,458	16,111	16,283	825.5	105.3%

Source: Federal State Statistic Service of Russian Federation http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/efficiency/#)

Imports/exports balance for individual products has also improved. Russia approached the positive balance of exports/imports of food in some months of 2016. This situation is observed for the first time in recent history.

Informatization of the industry is among priority areas for the development of modern agriculture. The key provisions of information support for agriculture are reflected in Federal Law No. 264-FZ "On the development of agriculture" [24].

The procedure for creating and maintaining the system of state information support in agriculture is established in the Regulation approved by the Government of the Russian Federation in 2008 [28].

Establishment of state information resources is among key dimensions of the State program for the development of agriculture and regulation of markets for agricultural products, raw materials and food for 2013-2020 [28]. Under Russian law, the Ministry of Agriculture of Russia is granted the functions of the state information system operator.

At the moment, the Ministry of Agriculture has introduced and improved information systems that automate technological processes in the established area of activities for such government agencies as FGIS USMT, AIS NSI, PK "Elektronnye gosuslugi", SM PB, IS PK GP, AIS "Subsidii APK". Following the results of 2016, state information resources in the field of ensuring food security are used by 98.4% of regional and 62.6% of administrative bodies of agribusiness.

The Foundation of Agriculture Promotion carries out consistent work on informatization of Russian agricultural producers. "Farmer's Workstation "ZARYA" became the first hardware and software package successfully tested by farmers in four pilot regions.

The Foundation launched the all-Russia information and maintenance service "AgroContactCenter" in early March 2017, which solves many problems of agricultural producers with the sale of agricultural products, with the development of agricultural cooperatives, with a lack of information, with a deficit of literate specialists in the countryside, etc.

Evaluating the intensity of ICT usage in agricultural production in the Russian Federation

Statistical indicators of the ICT industry advancement and the results of monitoring the economic situation and public health [11] reveal that the information infrastructure of rural areas is not sufficiently developed.

The telephone density per 100 people of the rural population amounted to 10.97, which is significantly lower than in urban areas (27.92). The volumes of commissioning of rural PBXs decreased by one third compared to 2010 and amounted to 389.3 thous. numbers by late 2015. The number of public telephones, including payphones, fell by 17% over five years [21].

The telephone network in rural areas is compressed more rapidly than in urban areas, but due to the decrease in the number of rural population, the gap in the provision of townspeople and villagers (per 100 people) with public telephones remains wide: 2.6 times by general provision; 2.1 times by home devices (2.3 in 2010).

Percentage of settlements with a telephone line in rural areas decreased from 89.1% in 2014 to 88.2% of the total number of rural settlements over three years. 11.8% of villages do not have access to landline telephone network.

Reduction in the landline telephone network in rural areas is largely due to the development of mobile telephony and the Internet.

Information technologies are increasingly being introduced in rural areas. Following the results of 2016, 61.4% of rural households have PCs, 63.5% have access to the Internet, 56.2% of rural families have broadband Internet access (Figure 1).

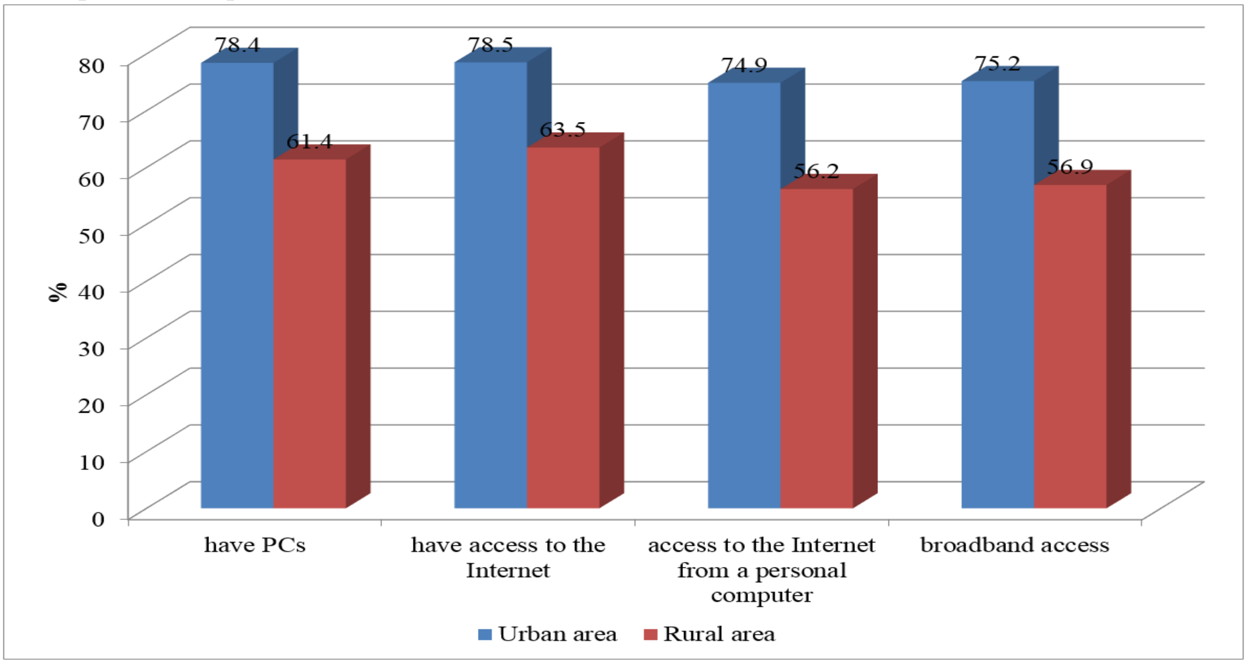


Fig. 1. Availability of PCs and access to the Internet following the results of 2016. Sources: compiled by authors on the base of statistical data [11, 21]

Rural households still lag far behind urban ones by computerization and access to the Internet, but these differences rapidly fade.

The ratio of rural and urban areas by the availability of PCs was 78.2% in 2014, while this figure was 75.2% in 2015.

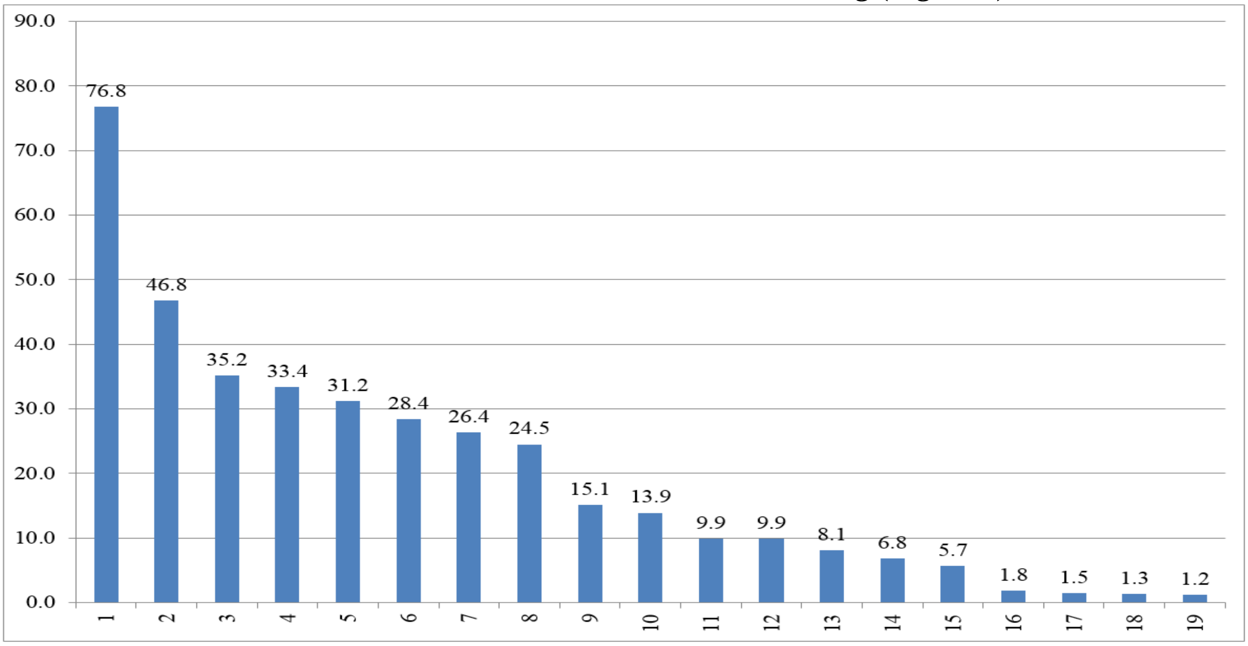
At the same time, the availability of mobile phones is 1.2 times higher than the urban level (Table 2).

Table 2. Availability of ICT equipment in rural and urban households in 2015, pcs per 100 households

Name	Village	City	Village to City, %
Personal computer	49	65	75.4
Portable computer (laptop, tablet, iPad)	41	71	57.7
Mobile phone	214	182	117.6
Smartphone, iPhone	36	75	48.0
TV (all kinds)	157	186	84.4
Radio (wired and wireless)	14	16	87.5

Source: Federal State Statistic Service of Russian Federation (http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/efficiency/#)

It must be noted that only 26.4% of rural residents use the Internet to send emails, 8.1% use it to look for a job and only 1.8% for distance learning (Figure 2).



Legend:
1 - participating in social networks (for example, Vkontakte, Odnoklassniki, Facebook, etc.)
2 - downloading movies, images, music; watching videos; listening to music or radio
3 - voice calls or video calls over the Internet (using, for example, Skype or other apps)
4 - searching for information about goods and services
5 - gaining knowledge and information on any topic using Wikipedia, online encyclopedias, etc.
6 - playing video or computer games/games for mobile phones or downloading them
7 - sending or receiving emails
8 - uploading personal files (books/articles/magazines, photos, music, videos, programs, etc.) to websites, social networks, cloud storage for public access
9 - conducting financial transactions
10 - reading or downloading online newspapers or magazines, e-books
11 - communicating via instant messaging systems (chats, ICQ, QIP, etc.)
12 - selling/buying goods and services (including via online auction sites)
13 - looking for a job
14 - searching for information about education, training courses, workshops, etc.
15 - downloading software (other than computer games)
16 - distance learning
17 - participating in online voting or consultations on public and political issues (urban planning issues, signing petitions and appeals)
18 - participating in professional networks (for example, Linkedin, Xing, E-xecutive.ru, etc.)
19 - posting opinions on public and political issues via websites, participating in forums

Fig. 2. Purposes of Internet usage by rural population, % of respondents. Sources: compiled by authors on the base of statistical data [11, 21]

According to the results of statistical observation on the ICT usage by the population, about 36.5% of rural residents do not have access to the Internet from their home computer. As a result, villagers (including farmers) can check email about once a month, when they go to the district center.

The main reason for this is lack of the need or desire to use this information source. Another reason constraining the Internet usage in rural areas is the high cost of its connection (Figure 3).

26.7% of rural residents cite the lack of web browsing skills. 8.6% cited the lack of a technical ability to connect to the Internet.

The advanced growth of agriculture is of critical importance for the economy and food security of Russia. However, agriculture will have to deal with two major challenges.

The first is the loss of arable land for non-agricultural uses due to industrialization and urbanization. The second is soil erosion due to intensive farming and environmental degradation.

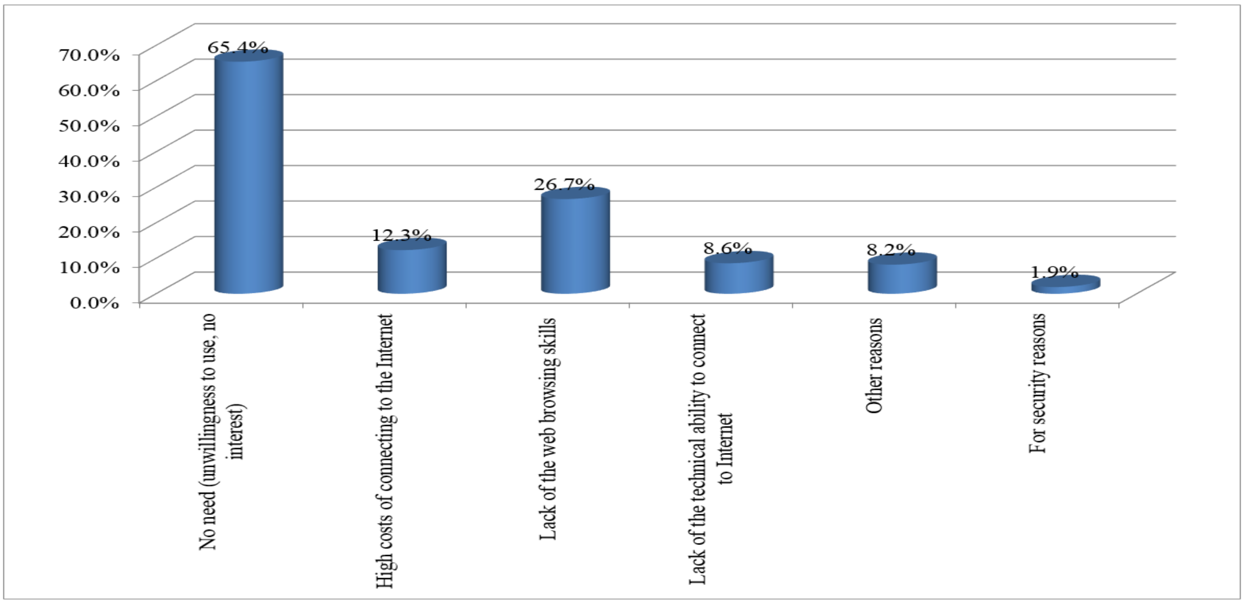


Fig. 3. Reasons for non-use of the Internet by rural residents. Sources: compiled by authors on the base of statistical data [11, 21]

The experts widely recognize that increasing agricultural productivity is critical to maintaining high growth of the national economy and reducing poverty.

The study of expert opinions allowed to determine the perspective areas for development of information technologies in Russian agriculture:

(i)Creating a unified information base on resources for agricultural producers

(ii)Introducing the Internet of things (IoT) and digitalization of agricultural production

Creating a unified information base on resources for agricultural producers

At present, the information resources required by agricultural producers are quite scattered and poorly systematized.

It is required to integrate the resources needed by agrarians into a unified information base that will accumulate all the information required by rural entrepreneurs about machinery, goods and services in one place. The Foundation of Agriculture Promotion proceeded to the implementation of this project in 2017. Undoubted advantage of the information base is that the information collected in it will be available in both "online" and "offline" modes. This will allow to cover most of the interested audience.

According to experts, the creation of such a database is a necessary step to agriculture intensification and optimization of the costs of agricultural production.

Introducing the IoT and digitalization of agricultural production

Productivity of agriculture is an indicator reflecting the volume of output per employee and describing the level of living labor costs in production, labor intensity of production and, ultimately, its competitiveness.

The resulting indicator of productivity is the yield of crop farming (or livestock breeding productivity), as well as the maximum utilization of resources (each ha of area, each unit of equipment, kg of fertilizer, agrochemistry, ruble invested, etc.).

Russia has at least a three-fold reserve of increase in the yield of grain crops in comparison with the US and Germany.

The lag by labor productivity in agriculture in general is 3 times compared to Germany and more than 20 times compared to the US. For example, following the results of 2015, the gross value of agricultural products in Russia per employee was $8 thous. dollars, while in the USA it was $195 thous. [10].

One of the relevant tasks of Russian agriculture is the accelerated narrowing of the technological gap with developed countries, increase in agricultural productivity due to the use of precision farming technologies, improvement of instruments for collecting and analyzing data and automation of agricultural processes.

The analog period in agriculture is over; the industry has entered the digital age. Investment bank Goldman Sachs predicts that the application of next generation technologies is able to increase the productivity of global agriculture by 70% by 2050 [9].

Experts estimate that due to precision farming technologies based on the IoT, there can be such a surge in yields which humanity has not seen even at the time of emergence of tractors, invention of herbicides and genetically modified seeds.

Realization of the IoT projects in agriculture shapes the partner ecosystem. There is interaction between the members within this system, where cooperation is much more beneficial than competition with each other.

Members of this ecosystem can use the common infrastructure and the IT platform interface to introduce innovations and create new products that they could never create on their own and that will be made available to general consumers. Within such cooperation, each ecosystem member promotes a common solution, achieving positive result for all members. Required members of IoT projects are device suppliers, telecom operators, IoT platforms, system integrators, app developers and customers.

Experts estimate that such a model of creating added value, based on the IoT technology and integrated automation of production business processes in agricultural production will allow to:

-Approximately halve the price level for basic food products in Russia, while improving their quality. This can be achieved through a 3-5-fold increase in labor productivity in agriculture, resulting from a reduction in the mark-up in the wholesale and retail chain. The volume of the food and agricultural products market is expected to increase by 1.5 times, and the annual increase in net profit may reach 200 bln rubles.

-Significantly improve the level of automation of the key production and business processes of rural households.

According to preliminary estimates, this will increase the consumption of information technologies by agricultural producers by 156 bln rubles (+22% to the current volume of the IT market in Russia) and data transmission services by 11 bln rubles annually (+19% to the current volume of data transmission by the corporate sector in Russia).

-Increase availability of borrowed resources for agricultural producers. Switch to integrated automated supply chains for agricultural products will ensure transparency of this process for banks and reduce lending risks, which in turn will increase the volume of lending to agricultural producers by 500 bln rubles.

-Create skilled jobs in the village with a higher level of wages.

According to experts from J’son & Partners Consulting, the total economic impact of the introduction of the rural production business model based on the IoT and digitalization can reach more than 4.8 trln rubles per year, or 5.6% of Russian GDP growth (relative to 2016 figures), while the possible increase in the volume of consumption of information technologies in Russia can amount to +22% due to the digitization of only one industry – agriculture.

CONCLUSIONS

Results of the conducted study lead to the following conclusions:

-Information systems are currently introduced in Russia that allow to automate the processes to ensure the national food security in state authorities. State information resources are used by 98.4% of regional and 62.6% of municipal administrative bodies of agribusiness.

-The information infrastructure in rural areas is not sufficiently developed compared with the urban area. However, the results of the conducted study indicate that information technologies are becoming more widespread in rural areas. More than 60% of rural households have PCs and Internet access.

-According to many experts, modernization of production systems and application of modern information and digital technologies are drivers for increasing agricultural productivity and intensifying the agricultural sector.

Having reviewed the expert opinions, the author outlined two key areas of agricultural production intensification using information technologies: creating a unified information base on resources for agricultural producers and introducing the IoT, and digitalization of agricultural production in the Russian Federation.

REFERENCES

[1]16th International Conference on Advances in ICT for Emerging Regions, ICTer 2016 - Conference Proceedings. September 6, 2017 – September 9, 2017, Colombo, Sri Lanka

[2]Adil, A, Badarla, V, Plappally, A.K., Bhandari, R., Sankhla, P.C., 2015, Development of affordable ICT solutions for water conservation in agriculture. 7th International Conference on Communication Systems and Networks, COMSNETS 2015 – Proceedings 7098716

[3]Brichka SYu., 2016, Selskoye khozyaystvo v Rossii v usloviyakh sanktsiy [Agriculture in Russia amid sanctions]. Science without borders, 5 (5): 13-16

[4]Cáceres, R., Pol, E., Narváez, L., Puerta, A., Marfà, O., 2017, Web app for real-time monitoring of the performance of constructed wetlands treating horticultural leachates. Agricultural Water Management, 183: 177-185

[5]Chalemba, L., 2016, Application of telecommunications technologies to agricultural market information systems: A comparative analysis of Malawi and Ghana. International Journal of Agricultural and Environmental Information Systems, 7(3): 60-70

[6]De Silva, L.N.C., Goonetillake, J.., Wikramanayake, G.N., Ginige, A., 2017, Harnessing mobile pervasive computing to enhance livelihood processes: Farmer response to a mobile agriculture information system. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics).10232 LNCS, pp. 641-655

[7]Deichmann, U., Goyal, A., Mishra, D., 2016, Will digital technologies transform agriculture in developing countries? Agricultural Economics (United Kingdom), 47: 21-33

[8]Dudin, M.N., Frolova, E. E., 2015, The Balanced Scorecard as a basis for strategic company management in the context of the world economy transformation. Asian Social Science, 1(3): 282-288.

[9]European Commission. Prospects of the farming sector and rural development in view of food security. The case of the Russian Federation. (n. d.). http://publications.jrc.ec.europa.eu/repository/bitstream/JRC85162/final%20online%20jrc85162%20russia.pdf Accessed on November 1ST, 2017.

[10]FAOSTAT. (n. d.). http://www.fao.org/home/en/, Accessed on November 1st, 2017.

[11]Federal State Statistics Service. Vyborochnoye federalnoye statisticheskoye nablyudeniye po voprosam ispolzovaniya naseleniyem informatsionnykh tekhnologiy i informatsionno-telekommunikatsionnykh setey [Sampling federal statistical observation on the use of information technologies and information and telecommunications networks by the population]. http://www.gks.ru/free_doc/new_site/business/it/fed_nabl-croc/index.html, Accessed on November 1st, 2017.

[12]Ghosh, S., Sayyed, S., Wani, K., Mhatre, M., Hingoliwala, H.A., 2016, Smart irrigation: A smart drip irrigation system using cloud, android and data mining. 2016 IEEE International Conference on Advances in Electronics, Communication and Computer Technology, ICAECCT, 7942589, pp. 236-239

[13]Harivallabha, V.M., Anithamahalakshmi, I., Senthamizh Selvi, M.S., 2016, A model to improve the reliability of ICT in agriculture. Proceedings - 2016 IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development, TIAR, pp. 124-132

[14]International Independent Institute of Agrarian Policy. Stsenarii Razvitiya Mirovogo Rynka Prodovolstviya Do 2050 Goda [Scenarios Of The Global Food Market Development Through To 2050]. https://docviewer.yandex.ru/view/273699294/?*=dKpPIhtG3QRjek0rzS9Yl74zD5F7InVybCI6Imh0dHA6Ly94bi0tODBhcGxlbS54bi0tcDFhaS9yZXBvc2l0b3J5L2FuYWx5dGljcy8zMjkvZG9jdW1lbnQucGRmIiwidGl0bGUiOiJkb2N1bWVudC5wZGYiLCJ1aWQiOiIyNzM2OTkyOTQiLCJ5dSI6IjkxMjAyMjIwMTE1MDIzNTM4MTkiLCJub2lmcmFtZSI6dHJ1ZSwidHMiOjE1MDQ4MDk2MjAwMjN9&lang=ru, Accessed on November 1st, 2017.

[15]Jaffan, R. H., 2015, ICT enable of agricultural innovation systems: Implications environment, population and food production. CEUR Workshop Proceedings, 1498: 247-254

[16]Jain, L., Kumar, H., Singla, R.K., 2015, Assessing Mobile Technology Usage for Knowledge Dissemination among Farmers in Punjab. Information Technology for Development, 21(4): 668-676

[17]Jukan, A., Masip-Bruin, X., Amla, N., 2017, Smart computing and sensing technologies for animal welfare: A systematic review. ACM Computing Surveys, 50(1): 10

[18]Kelly, N., Bennett, J.M., Starasts, A., 2017, Networked learning for agricultural extension: a framework for analysis and two cases. Journal of Agricultural Education and Extension, 2017: 1-16

[19]Krone, M., Dannenberg, P., Nduru, G., 2016, The use of modern information and communication technologies in smallholder agriculture: Examples from Kenya and Tanzania. Information Development, 32(5): 1503-1512

[20]Lindblom, J., Lundström, C., Ljung, M., Jonsson, A., 2017, Promoting sustainable intensification in precision agriculture: review of decision support systems development and strategies. Precision Agriculture. 18(3): 309-331

[21]Ministry of Agriculture of the Russian Federation. O sostoyanii selskikh territoriy v Rossiyskoy Federatsii

v 2015 godu [On the state of rural areas in the Russian Federation in 2015]. Annual report following the results of monitoring: academic publication. FSBSI "Rosinformagrotech", Moscow, pp. 348.

[22]Nelson, R., Coe, R., Haussmann, B.I.G., 2016, Farmer Research Networks As A Strategy For Matching Diverse Options And Contexts In Smallholder Agriculture. Experimental Agriculture, 2016: 1-20

[23]Ngowi, E., Mwakalobo, A., Mwamfupe, D., 2015, Making ICTs work for agro-pastoral livelihood: Using the telecentre as learning tool for agro-pastoralists communities in Tanzania. Journal of Sustainable Development, 8(2): 89-98

[24]O razvitii selskogo khozyaystva [On the development of agriculture]: Federal Law No. 264-FZ dated 29.12.2006

[25]Olojede, J.C., Ifenkwe, G.E., Oparaojiaku, J.O., 2017, Factors influencing information and communication technology use by women research scientists in universities of agriculture in Nigeria. Journal of Agricultural Extension, 21(1): 122-134

[26]Pound, B., Conroy, C., 2017, The Innovation Systems Approach to Agricultural Research and Development. Agricultural Systems: Agroecology and Rural Innovation for Development: Second Edition. Academic Press, 371-405

[27]Premasudha, B.G., Leena, H.U., 2017, ICT enabled proposed solutions for soil fertility management in Indian agriculture. Advances in Intelligent Systems and Computing, 469: 749-757

[28]Regulation of the Government of the Russian Federation dated March 7, 2008 No. 157 O sozdanii sistemy gosudarstvennogo informatsionnogo obespecheniya v sfere selskogo khozyaystva [On the establishment of a system of state information support for agriculture]. Moscow

[29]Rizvi, S.M.H., Dearden, A.,2016, KHETI: ICT solution for agriculture extension and its replication in open and distance learning. Open and Distance Learning Initiatives for Sustainable Development, 2016: 163-174

[30]Sopegno, A., Calvo, A., Berruto, R., Busato, P., Bocthis, D., 2016, A web mobile application for agricultural machinery cost analysis. Computers and Electronics in Agriculture, 130: 158-168

[31]Tarnanidis, T., Vlachopoulou, M., Papathanasiou, J., 2017, Driving agribusiness with technology innovations. Driving Agribusiness With Technology Innovations. 2017: 1-384

[32]Tijjani, A.R., Anaeto, F.C., Emerhirhi, E., 2017a, Analysis of the roles of information and communications technologies in rural women farmers' empowerment in Rivers State, Nigeria. Library Philosophy and Practice, 2017(1): 1498

[33]Tijjani, A.R., Anaeto, F.C., Emerhirhi, E.E., 2017b, Perceived effects of use of Information and Communication Technologies (ICTs) on rural farmers' knowledge in Orlu Agricultural Zone, Imo state. Library Philosophy and Practice, 1: 1497

[34]Vangala, R.N.K., Banerjee, A., 2016, Effect of ICT on knowledge management process in Indian milk co-operatives: A structural equation modeling approach. IEEE Region 10 Humanitarian Technology Conference 2016, R10-HTC 2016 – Proceedings.

[35]Xiaojiang, W., Yanhui, L., Jing, W., 2017, Research on modern agricultural information computer acquisition system. Agro Food Industry Hi-Tech, 28(1): 1738-1743

[36]Zhang, W.-Z., Bao, X.-J., Qiu, Z.-J., Wu, X., He, Y., 2015, Farmland information collection system based on AGWTracker and automatic position reporting system. Zhejiang Daxue Xuebao (Gongxue Ban). Journal of Zhejiang University (Engineering Science), 49(3): 415-420

[37]Zheleva, M., et.al., 2017, Smallholder agriculture in the information age: Limits and opportunities. 2017. LIMITS 2017 - Proceedings of the 2017 Workshop on Computing Within Limits, pp. 59-70.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

STUDIES REGARDING MINIMUM SOIL TILLAGE

Anișoara DUMA COPCEA, Casiana MIHUT, Daniel POPA

University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania" from Timisoara, 300645, 119 CaleaAradului, Romania, Phone: +40256277001, Fax:+40256200296, Emails:duma_anisoara@yahoo.com, casianamihut@yahoo.com

Corresponding author: duma_anisoara@yahoo.com

Abstract

Research goal was to gather data regarding soil tillage, operations with agricultural implements and machines to alter soil features and to guide vegetation factors (water, air, heat, nutrients and biological activity) thus developing optimum conditions for crop development. Research objective was unconventional soil tillage on vertisol. Soil tillage has been integrant part of agriculture since times immemorial and it has helped preparing the germination bed, reducing soil compaction (to increase soil aeration and improve root system development), reducing weeding, incorporating fertilisers and amendments, and managing plant debris.

Key words*: *soil, fertilisers and amendments, vertisol

INTRODUCTION

Soil conservation covers a set of activities, measures and technologies competing to maintain soil fertility without sensibly reducing crops or cropping costs. [13]

This concept developed from the fact that soil is the most important asset of human existence ensuring food production, raw matter for the various industries, energy etc. [5]

Therefore, maintaining soil biological capacity is a must for social life.

For a long period of time, agriculture and soil tillage have been seen as synonyms. [4]

Soil tillage have been an integrant part of agriculture since the very beginning and it has helped preparing the germination bed, reducing soil compaction (to increase soil aeration and improve root system development), reducing weeding, incorporating fertilisers and amendments, and managing plant debris. [2]

Maybe the most deeply negative effect of soil tillage in the world has been soil degradation because of wind and water action.

About 80% of agricultural area at world level suffer because of moderate erosion with soil losses of 30-40 t/ha/year. [7]

Incorporating plant debris and leaving the soil uncovered allow wind and water to move soil particles as dust or sediments.

Increasing apparent density and reducing porosity in degraded soils makes difficult soil penetration by the plant root system and its access to nutrients. [1]

Applying soil tillage widely in Romania aims at conserving soil fertility; it is extremely important particularly because arable areas are increasingly cultivated without a specialist's opinion and without a system that takes into account short-, medium- or long-term consequences. [9]

MATERIALS AND METHODS

Research was conducted on a vertisol. The soil work system consisted in minimum or low soil tillage.

It involved basic soil tillage without furrow turning, keeping 15-30% of plant debris as mulch on soil surface or superficially incorporated.

Mouldboard ploughing is accepted once in 3-5 years.

Depending on the implements used in the basic tillage, this system can have several variants:

-disc harrowing;
-chiselling;
-paraploughing;
-rototilling;

-milling;
-shanking;
-combined aggregates.

a. Disc harrowing

One can say that disc harrowing has been the most researched tillage due to the relatively good machine park.

Heavy disc harrows are sued.

Their active parts have concave discs set sidelong the advancing direction and inclined vertically.

They penetrate the soil up to 10-12 cm, cutting and mincing the soil and then partially turning it over.[3]

It is known that the disc contributes the most to deteriorating soil structure, which recommends avoiding excessive use; when use, it need optimum soil moisture time.

Disc harrowing alone is followed by rhizome weeding (rhizomes are fragmented).[15]

Photo 1.Harrowing equipment.

b. Chiselling

Chisel is an implement that aerates the soil up to 16-20 cm deep (maximum 40 cm for deep aeration). The working organ (rake) is an arch sheet with a claw-like cutter.

Chiselling aerates the soil without mixing, turning over or reversing soil layers.

High clay-content soil recovers its initial state quickly.

Photo 2. Chiselling equipment.

Tillage is high quality when the soil is relatively dry.

It is recommended particularly in cereal crops.[17]

c. Paraploughing

Paraploughing is a plough in which mouldboards are replaced by active parts that aerate the soil without turning it over.

When used on a soil with plant debris, they also use a corrugated disc to mince them.

Tillage depth is 22-25 cm (maximum 30 cm).

Using paraploughing is adequate on slope lands for anti-erosional protection, on soils with a short arable horizon, on sandy soils subjected to wind erosion, on salty soils etc. [6]

Photo 3.Paraploughing equipment.

d. Rototilling

Rototillers are meant to prepare the germination bed at depths between 8 and 18 cm.

They are attached to the power take-off shaft of the tractor.

There are several variants of rototillers with different tillage widths and tillage organs.

It allows simultaneous sowing and germination bed preparing.

Photo 4. Rototilling equipment.

Soil tillage is done without bringing up moist soil layers, thus preserving soil moisture for better seed germination.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The Packer roller ensures supplementary mincing and slight settling and levelling of the soil.[10]

g. Milling

Agricultural mills are meant to mince and aerate the soil to prepare the germination bed 6-25 cm deep in field crops, orchards, truck farming, vineyards, grasslands and haymaking fields, on marshy and peaty lands.

The main uses of the mills are preparing the germination bed by mincing, aerating and mixing soil layers with organic debris on soil surface.

Their inconvenient consists in a high energy consumption compared to other tillage machines.[11]

Photo 5.Milling equipment.

f.Shanking

Cultivators are used to till soil superficial layers aiming at aerating them and killing weeds.

Soil aeration cultivators can be equipped with shanks that are fixed on a 2-3-row frame flexibly or rigidly.

In general, these cultivators also have support wheels to regulate tillage depth.

They operate like chisel-cultivators but only 10-15 cm deep, mainly on light soils. [12]

Photo 6.Shanking equipment.

g.Combined aggregates

Combined aggregates used in minimum tillage allow a single passage in the following soil works[8]:

-aerating the soil without furrow turning up to 40 cm deep;

-preparing the germination bed;

-sowing and rolling.

Usually, these combined aggregates operate on non-aerated soils.

Optionally, one can use them only to aerate the soil and prepare the germination bed on non-aerated soils (without a sowing equipment) or only to prepare the germination bed and sow on ploughed lands (with no aerating organs).

During the tillage process, aeration organs split and dislocate the soil at the depth and the cutter rotor tills the soil by crushing and mincing dislocated soil fragments.

The cutter rotor minces and aerates by breaking down soil fragments, not by cutting, which maintains soil natural structure.[1]

Photo 7. A combined aggregate.

RESULTS AND DISCUSSIONS

Conservative soil tillage differs from the conventional low-tillage in the area covered by plant debris after sowing, which should be over 30%, and by the less frequent and intense aerating tillage.

Among conservative low-aerating soil tillage there is also *minimum till*.

This name generated significant confusion in the definition and delimiting of conservative and conventional tillage systems.

It has been considered synonym of low-tillage, without differentiating between conventional and conservative.

Minimum tillage is defined as minimum soil tillage to ensure normal growth and development of crops.

However, the name *minimum soil tillage* meant to meet the normal plant requirements depending on soil features through different mechanical soil works – from direct sowing to ploughing by completely turning the furrow – is terminologically rather evasive since it covers a rather wide range of technological possibilities. [14]
Minimum tillage could also mean stripe tillage or just reducing ploughing depth or giving up secondary works in the preparation of the germination bed.

CONCLUSIONS

The main conclusions of Romanian research generally meet references in world literature and they concern:
-a sensitive growth of indicators of compactness (apparent density, resistance to penetration) in the superficial soil layer without reaching values that could damage soil quality or crop growth and development;
-often important reduction of compactness in the layer beneath the superficial one, i.e. a tendency to remove the plough sole and its negative effects;
-an increase of water seepage speed into the soil with positive consequences for soil water regime and avoidance of water excess;
-on sloppy lands, it sometimes reduces significantly the amount of eroded soil, hence soil protection and prevention of degradation through erosion;
-higher accumulation of organic matter in the superficial soil layer with direct effects on physical degradation processes through de-structuring and crust formation;
-improvement of biological activity by increasing nutrient resources as a result of larger amounts of plant debris and of less soil tillage;
-lower energy consumption and costs despite the sensitive increase of costs to control weeds, diseases and pests.

REFERENCES

[1]Duma Copcea, A., Ilea, R., Crîsta, I., 2017, Studies regarding grain loss in straw cereals, Research Journal of Agricultural Science, 49 (1). https://www.rjas.ro/paper_details/2440, Accessed January 10, 2018.
[2]Bucată, I.V., Diaconescu, Ş., Gieraths, J, Weiller, W, 2003, Agricultura ecologică, Alma Mater Press, Bucharest p. 28.
[3]Domil, G., Okros, A., Lato, A., 2014, The agricultural system from the Luncavița locality, Caraș Severin county, Research Journal of Agricultural Science, 46 (4):39-45.
[4]Duma Copcea, A,, 2012, Pedologie, Editura Agroprint, Timișoara, p.25.
[5]Guș, P., Stănilă, S., Rusu, T., 2003,Sisteme convenţionale şi neconvenţionale de lucrare a solului. EdituraRisoprint, Cluj – Napoca, p.89.
[6]Ilea, R.,2003, Motoare şi utilaje pentru amenajări peisagistice, EdituraAgroprint, Timişoara, p.73
[7]Ilea, R., 2013 Exploatareaagregateloragricole, Timişoara, p.67
[8]Koller, K., 1995, Erfolgreicher Ackerbau ohne Pflug. Frankfurt, DLG Verlag.
[9] Koller, K., 1997, Optimizarea constructivă a maşinilor pentru semănatul direct al cerealelor, Alternative de lucrare a solului, 9 –10 oct., Cluj-Napoca, vol.II, pag.225-229.
[10] Mihuț Casiana, Radulov Isidora, 2012, Științele Solului. Ed. Eurobit, Timișoara, p.50.
[11]Niţă Lucian-Dumitru, 2007, Pedologie, EdituraEurobit, Timişoara, p. 88.
[12]Okros Adalbert, 2015, Fertility status of soils in western part of Romania, Journal of Biotechnology, Volume 208, Supplement, 20 August 2015, - 09.05.2015 Bucuresti Romania 3,14
[13]Toma, D., 1981, Tractoare și mașini Agricole, E.D.P.București, p.45.
[14]Tonea Cornelia, 1996, Tractoare,Editura Marineasa, Timişoara,p.44.
[15]Cataloage ale firmelor: Bosch, Claas, Fiat, Fendt, Caterpillar, Honda, John Deere, Mercedes, Renault, MEFIN – Sinaia, TRACTORUL - Braşov.
[16]Reviste de "Mecanizarea agriculturii" colecţia 2000 - 2012.
[17]www.no-till.com, Accessed January 10, 2018
[18]www.agroecology.org; Accessed January 10, 2018
[19]www.newfarm.org;Accessed January 10, 2018
[20]www.agriculture.com; Accessed January 10, 2018

STUDIES REGARDING THE NO-TILLAGE OR DIRECT DRILL SYSTEM

Anișoara DUMA COPCEA, Radu ILEA, Daniel POPA

University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania" from Timisoara, 300645, Calea Aradului nr. 119, Romania, Phone: +40256277001, Fax:+40256200296, Emails:duma_anisoara@yahoo.com, ileaupc@yahoo.com,

Corresponding author: duma_anisoara@yahoo.com

Abstract

Sustainable development is managing and conserving basic natural resources and choosing to make technological and institutional changes to meet human needs for current and future generations. Assessing the negative effects of ploughing such as practiced in intensive agriculture generated the idea of reducing the number of works – ***minimum tillage*** *– and even of totally removing it –* ***no tillage.***

Key words**:** *minimum tillage, no tillage, sustainable*

INTRODUCTION

Direct drill in the stubble is seen as the most conservative soil tillage system since it is the closest to the natural soil settlement state in perennial plants.

This is the system that combines in the most suggestive way the oldest ploughing practice and sowing seeds in the most natural way. [3].

This technological practice is the result of permanent changes in agricultural production systems, in soil tillage methods, in modernising and improving the machine system and, at the same time, a consequence of intensifying soil degradation specific to conventional technologies. [6].

Preventing soil degradation and the degradation of other natural resources and improving degraded soils through conventional technologies, reducing energy consumption, increasing soil productive potential and increasing the efficacy of water use have triggered the implementation and extension of direct drill in modern agriculture.

Direct drill is the most performing technology developed in agriculture nowadays [4].

This system involves sowing on no-tillage soil that is not maintained mechanically or treated for weed control [1].

MATERIALS AND METHODS

Direct drill can only be applied in a modern, performing agricultural system based on high-quality management inputs with strict requirements for good results to be observed.

One needs to mention that direct drill is a technology in which mulch is a must since this is the only way to prevent evaporation and preserve soil moisture.

This requires precision machines to sow, integrated pest control measures, and the proper fertilisation system.

The “no-tillage” system developed by Phillips and Young (U.S.A.), in 1960 in maize is not another way of preparing the soil, but a system in which all interventions (fertilisation, herbicide application, etc.) are done according to directions.

In the U.S.A. and Canada, they direct drill on 52% of the arable area; in Latin America, 44%, in Australia, 2%, and in Europe, Asia and Africa, about 2%.

Direct drill can be used in a wide range of crops except for potato, intensive vegetable crops and some special crops.

In passing from classical technology to direct drill we need a transition period of about 3-4 years.

During this time, production decreases but it adapt to the new tillage system.

From a cultivation point of view, soil structure improves, humus content increases due to increased mineralisation, soil porosity increases, and so does water availability [2].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Passing to direct drill supposes the following steps:
-*Choosing the land*: the soil needs to be clayey, silt-loamy, be well-structured, properly aerated, biologically active, and with a high content of humus.
Among soils meeting these requirements are faeziom, chernozem, gleisol, etc.
Depending on the soil type, they apply solid, liquid mineral fertilisers or organic fertilisers;
-*Basic soil tillage in summer* (ploughing, aeration works) together with fertilisation;
-*Preparing the germination bed* and sowing winter cereal;
-*Harvesting the next year* maintaining plant debris (straw, stubble) on the soil;
-*Killing perennial weeds* on the stubble and direct drilling without any other soil work.
Since the soil is covered with plant debris from the previous crops and direct drill is done only on the stripes to be sowed, we need to ensure proper control of water and wind erosion and save labour force and fuel [7].

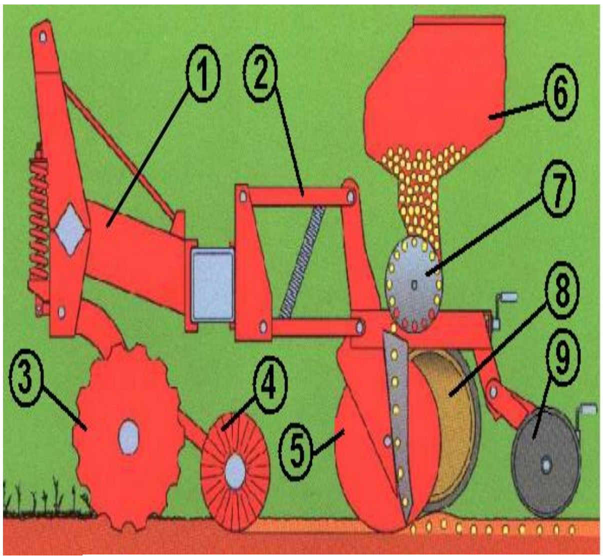


Fig. 1. The technological scheme of a sowing machine for sowing plants
Legend: 1-frame machine; 2-frame section; 3- disc for shredding vegetal remains; 4-disk cleaning line; 5-coulter double disc; 6-seed box; 7- distribution apparatus; 8-stroke depth adjustment; 9-row row compression.

A direct drill machine needs to aerate and mix the soil as little as possible and put the seed into the soil so that it enjoys optimum germination and growth conditions.
Working organs are devised to allow working on both dry and moist soils with large amounts of plant debris. [8].

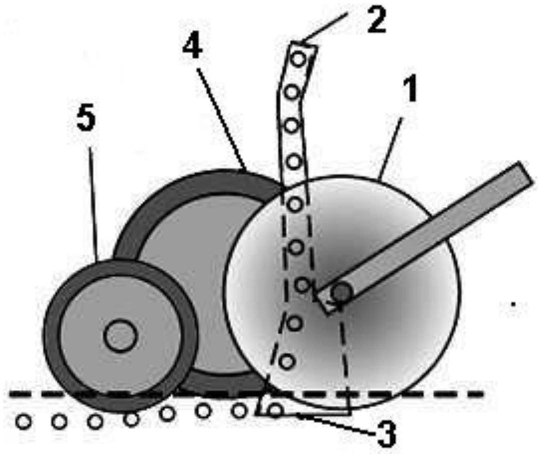


Fig. 2. Placement of seed in the soil at direct sowing machines
Legend: 1-disc for opening the soil strip; 2-tube signage control; 3-seed placement in the soil; 4-wheel for sowing depth adjustment; 5-stroke wheel.

Machine active organs operate narrow openings to introduce the seeds (disc furrow) and also, sometimes, fertilisers.


Fig. 3. Aggregate consisting of tractor and direct sowing machine

Direct drill machines differ from the ones used in classical technology mainly by using other types of coulters and some supplementary auxiliary organs to remove plant debris, to cover the soil with seeds, etc.
They use, in general, disc coulters and chisel coulters, but also combined coulters.
They have noted the efficacy of the corrugated coulters that ensure better mincing

of plant debris along the rows.
The direct drill machine needs to be able to operate with large amounts of plant debris.
For the disc coulters to penetrate the soil at the desired soil depth, we need a pressing force per coulter of about 270 daN.
This means, for a machine sowing straw cereals with a width of 3 m, a weight of at least 3 t.
Therefore, direct drill machines need high power tractors.
To reduce the general weight of direct drill machines and maintain coulter pressing force, they have designed precision machines that transfer the force from the hydraulic lift to the coulter with lever and arch mechanisms [5].
Chisel coulter direct drill machines need lower load and can be lighter.
These machines mix soil more along the rows and make better aeration favouring better heating and seepage of water around the seed; however, when the amount of straw is high, the machine cannot operate at its best.
Direct drill is another working system, not another sowing system, which is also obvious because of the acceptable weeding rate.
The failure to use direct drill is caused by improper weed control.

RESULTS AND DISCUSSIONS

Research show that effective weed control methods in direct drill need to rely on a complex of herbicides and mechanical and cultivation methods specific to each crop depending on the weed structure and biology.
These weed control methods can be grouped into preventive methods, that prevent seeds from being brought in from other sources, and curative methods, that act directly on the weeds.
The no-tillage system differs from classical sowing technologies: in order to be successful, we need to observe all the steps involved in the sowing technology.

CONCLUSIONS

Agricultural research and practice show that disc direct drills remove the danger of clogging even with large amounts of plant debris.
There are deficiencies in functioning on moist soils where the disc does not cut plant debris but rolls them over pushing them at the bottom of the furrow and placing the seeds on them. With larger amounts of plant debris and under drought conditions, germination is hindered until plant roots penetrate the vegetal layer and ease the action of disc coulters of opening the ditch; direct drill machines have organs for the cleaning of the operated area.

REFERENCES

[1]Crista, F., Boldea, M., Radulov, I., Lato, A., Crista, L., Dragomir, C., Berbecea, A., Nita, L., Okros, A., 2014, The impact of chemical fertilization on maize yield, Research Journal of Agricultural Science, Vol. 46(1):172-177.
[2]Duma Copcea, A., Mihut, C., Nita, L., Okros, A., Mateoc, T., 2014, Physical and chemical properties of psamosolului, preluvosoil and chernozem in the Mehedinti county, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 14(1):107-110.
[3]Fausey, N.R., 1984, Drainage – tillage interaction on Clermont soil. In American Society of Agricultural Engineers, no.27 pp. 403-406.
[4]Guş, P., Roș, V., Stănilă, S., 2003, Lucrările neconvenţionale ale solului şi sistema de mașini. Editura Risoprint, Cluj Napoca, pp.33
[5]Mihut Casiana, 2014, Fizica solurilor agricole, Editura Agroprint, Timișoara, pp.45
[6]Nita, Simona, Tabara, V., David, G., Nita, L.D., Simion Alda, Dragos, Marcela; Borcean, Adrian - Results obtained for soybean, pea and lentils crops on a cambic chernozem in the Banat's plain during 2008-2010, Romanian agricultural research, Volume: 29: 155-162,http://www.incda-fundulea.ro/rar/nr29/rar29.20.pdf. F.I., Accessed Januaty 10, 2018.
[7]Neagu, T., Popescu, T., și colab., 1982 Tractoare şi mașini horticole, E.D.P., Bucureşti, pp.78
[8]Stănilă, S., Ros, V., Mihaiu, I, Ranta, O., 2003 Tehnici şi tehnologii de mecanizare a lucrărilor în sistem de conservare a solului. Ed. Alma Mater Cluj Napoca, pp.91

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

TRADE-OFF IN CONSUMPTION OF IMPORTED AND TRADITIONAL OWN FOODS AMONGST IGBO FARM HOUSEHOLDS IN NIGERIA

Christopher Ogbonna EMEROLE, Chima Innocent EZEH, Obioha OKORIE

Abia State University, Uturu Nigeria, Faculty of Agriculture, Umuahia Campus, Mobile phones: +2348053289183, +2348064217385, +2348037461765, Emails: emerolechriso@yahoo.co.uk, chimaezeh@yahoo.com, obiohaokorie2000@yahoo.com

Corresponding author: emerolechriso@yahoo.co.uk

Abstract

Changing demand against locally produced foods amongst Igbo farm households in South-eastern Nigeria is in the increase. Food items such as rice, fish, and poultry products are among imported foods that presently challenge consumer preferences. It is pertinent across farm household ages and income groups to determine factors that inform trade-off in consumption of imported foods which types are locally produced. A survey of the core Igbo states was carried out following a multi-stage cluster sampling method that selected five of the seven States that are traditional home of the Igbos. A total of 480 farm households were chosen as panel of respondents from whom socio-economic and food consumption information was gathered using a mixture of methods. Data on protein and carbohydrate intakes were gathered by interviewing each household member except infants on the food consumed on a 48–hour-recall approach. The analysed data revealed that foods produced included roots, tubers, cereals, legumes, fats and oil, fish, meat, eggs, fruits, vegetables, and spices. There were significant differences between value of annual per capita nutrition gaps in intake of energy foods and protein (respectively) by Children, Adolescents and Adults in the farm households. The age of the household head was a factor that positively favoured consumption of own foods against their imported brands. The study recommended that households should patronize own products and call for change of tastes, preferences and value as well as adjust their production plans to produce more legumes in their product mix.

Key words: *consumption attitude, own products, imported foods, Igbos, Nigeria*

INTRODUCTION

With increasing globalization, spread in education and travels by human population, the lifestyles are seriously changing especially in feeding within and across geographical areas with limited diversity in food products. In south-eastern Nigeria with dominance of starchy roots and tuber crops (21 species), vegetables (116 species), legumes (20 species), nuts/seeds (21 species), fruits (36 species) and 12 species of mushroom [20], spending on foods by rural households has joined this trend especially with exposure to risk of consuming imported foods. This is either in preference or complement to farmers' own products. This changing demand for locally produced foods in South-eastern Nigeria seem likely to be shaped by same factors that have affected developed country's demand for their own locally produced products. These factors amongst others include food availability, seasonality, affordability, convenience, tastes and health concerns. [4] have recognized that there is a trade-off in food choices of wealthy educated households between tastes and health concerns.

Full community participation is needed to understand reasons, plans to alter quality of local products and positively influence their consumption by households especially those involved in producing them. This requires good understanding of customary values of indigenous foods and changing of the attitudes of people who least prefer them to the more or less instant foods imported into the country (especially inmates of the farm households). Most imported foods come into global markets in their processed forms which obviously have elements of value addition. In Nigeria and other less developed economies, low-income and relatively less educated households dominate settlements in the rural areas and inhabitants feed mainly on less healthy diets. This might be as attributed to relatively high cost of the healthy foods [7,12], while consumption of the better diets by educated consumers often domicile in urban areas are attributed to having superior health knowledge [8, 25].

Amongst the Igbos, it is glowing penchant to brag of feeding and clothing on foreign made items. [5] observed that Nigerian consumers rated made-in-Nigeria products lower than products made in more economically developed nations on basis of superior reliability and technological advancements. Certain food items such as rice, fish, and poultry products are among imported foods that are presently challenging consumer preference for their local production. This has adversely affected the foreign exchange reserve and contribution of Agriculture to the Gross Domestic Product (GDP), and worsened the per capita income of the farmers. Malnutrition cases especially in the rural areas have also been recorded [10].

There is the problem of rural-urban interactions [19] influencing consumption of locally produced foods. What happens to consumption in urban areas gradually has a way of being transmitted to people producing foods in the rural areas and vice versa. Problems faced by producers in developing economies have much to draw from their household socio-economic, cultural, and ecological factors as well as the behaviour of consumers [16] especially when considered in the contemporary shifts of macro-economic transformations and value-chain reforms [8]. Unavoidable increases in population within the core Igbo states with fragile soils, declining land-man ratios, changing patterns in traditional occupation, and exposure of the people to foods from other areas of the country and abroad are encouraging trade-off in consumption of local species and varieties of foods as well with other foods purchased and brought into the area by traders.

This study was to analyze the consumption attitudes of farm households in Igbo rural communities to their own produced foods and to such brand of foods imported into Nigeria. Specifically the study:

(i)identified traditional foods produced locally and their nutritional content;

(ii)estimated the annual per capita nutrition gaps in protein and energy food intakes of children, adolescents and adults of the Igbo rural households;

(iii)determined factors that inform trade-off in consumption of imported foods which types are produced traditionally by Igbo rural households.

MATERIALS AND METHODS

Study Area

This study was carried out in core Igbo inhabited south eastern states of Nigeria. A region located between Latitudes 4^0 $10^/$ N and 7^0 $05^/$ N of the Equator and Longitudes 7^0 $08^/$ E and 9^0 $15^/$ E of the Greenwich Meridian. The Igbos, is a race that number over 23 million with population densities ranging from 300 to over 1,000 persons per square kilometre, and the highest in West Africa dominate the South-eastern Nigeria [18]. Permanent Igbo settlements are widely distributed in six ecological areas within the Igbo culture area. These comprise: the southern half of the scarp lands of South Eastern Nigeria, the southern half of the lower Niger basin, the Midwest lowland, the Niger Delta, the Palm Belt of South-eastern Nigeria and the Cross River Basin [20]. In the present structure of Nigeria into states, these permanent Igbo settlements are in Abia, Anambra, Ebonyi, Enugu, Imo and parts of Delta, and Rivers States of Nigeria.

Sampling Technique

This study adopted a cluster sampling method that selected five of the seven States that are traditional home of the Igbos. The chosen States were Abia, Anambra, Ebonyi, Enugu and Imo. From each of the chosen States, two agrarian local Government Areas (LGAs)-one from the North and the other from the southern part of the state were randomly selected to ensure adequate coverage of the states. The chosen LGAs are: Bende and Ukwa West from Abia State; Ohaji and Obowu from Imo State; Onitsha North and Awka South from Anambra State; Ezza North and Ivo from Ebonyi State; Enugu North and Udi from Enugu State. Two (2) agrarian communities were selected from each chosen

LGA. The communities involved following the above sequence were Akoli Imenyi, Itumbuzo, Omuma Uzo, Umuekechi; Obosima, Avu, Avutu, Otoko; Atani, Odekpe, Umuatu Nibo, Ekwulobia; Ezza, Ngwo, Ishiagu, Mile 2; Obolo, Obolo Afor, Obinagu, and Eke; This gave a total of twenty (20) communities involved in this study. With the assistance of Agricultural Block Extension Supervisors (BES) in the chosen LGAs, twenty eight (28) farm households were randomly selected from each community for Panel formation and primary data gathering. A total of 480 farm households constituted the panel of respondents from whom socio-economic and food consumption as well as behavioural information was gathered at the first visit. Subsequently a form with questions requesting for information on the same food consumption behaviour was administered on members of the panel fortnightly for three months.

Data Gathering

Primary data were gathered from members of the panel of respondents using questionnaire. Data collected included household demographics of age, household size, level of formal education; traditional foods produced by farm households; hectare of land in present and previous cultivation of cultivated traditional foods; annual farm income; preference for foreign type of the locally cultivated foods; number of times product is eaten weekly; price of imported and price of locally produced product; value of foreign type of a locally produced product consumed; value of foreign type of a locally produced product received as gift; and farmer perception of local product quality compared to foreign type consumed.

Data on the protein and carbohydrate intakes was gathered by interviewing each household member except infants (persons who are breast fed) on the food consumed within the last 48 hours. Fifteen infants were encountered in these households. A total of 3,600 individuals as members of 480 households were thus interviewed using the approach of 48–hour-recall of meal(s) eaten. The members were asked the type and quantity of food they ate during each meal in the previous meal and in the day after. The protein and carbohydrate content in each food item (in percentage) was used to estimate the protein and carbohydrate proportion in all the meals consumed per person per day and projected for a year.

Data Analytical Technique

Objective i had its result displayed and discussed with frequency distribution table. Objective iii was addressed with Probit regression analysis of commodity trade-off of consumption function. This model as emphasized by [14] is appropriate when the decision takes one of only two possible values (eg. Yes or No).

$[F_{zi}]$ .... (1)

Given

$Z_i = \beta_0 + \beta_1 X_i$

$Y_i = \beta_i + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} + \mu$ .....(2)

Y^* is unobserved but $Y_i = 0$ if $y_i^* = 1$ then $Y^* \geq 0$

$P(Y_i = 1) = P(Y_i^* \geq 0)$

$P(\mu_i \geq -\beta_1 - \beta_2 X_{2i} \ldots\ldots\ldots - \beta_k X_{kL}$ ....(3)

where i = 1, 2……………………480 consuming farm households;

β_i= A Vector of unknown coefficients.

X_i = independent variables-characteristic/variable observed on ith individual.

Implicitly, the model was specified as follows:

$C_t = f(Y, T, L_d, G_f, D_p, P_g, K_c, A_g, E_d, \mu_i)$

where:

C_t= Consumption trade-off (Preference for Foreign product-yes=1; Otherwise =0);

Y = Annual Farm income (₦'000);

T = Number of times product was eaten weekly (Proxy for consumer taste);

L_d= Declined hectare of land from previous cultivation (ha);

G_f = Value of foreign type of locally produced product received as gift (₦'000);

D_p= Declined average yield of produced crops (tonne/ha);

P_g= Unit Price gap of imported and locally produced product (₦/tonne);

K_c= Farmer perception of local product quality (lower=1; otherwise= 0);

A_g = Age of head of household (Years);

E_d = Level of formal Education of head of

household (Years);
μ_i = Stochastic error term randomly influencing individual consumption trade-off.

Per Capita Food Quantities

The quantity of different food items consumed weekly were collected in different units of measurement and converted to grain equivalent value. The weekly values so obtained were extrapolated for the month and for the year. The annual per capita values were generated by dividing the annual grain equivalent values by the appropriate total number of household members.

Estimation of protein intake followed procedures of previous works [3,15]. The protein content in each food item consumed was determined and used in estimating the proportion in the total food intake of each member of the household. The per capita daily protein intake was estimated following the model they used, thus:

$$C_i = \sum_{i=1}^{m} a_{ij}\beta j$$

where:

Ci= Per capita daily protein (g) intake level of the ith individual in the study area;

aij = the weight in grams of the average daily intake of the food commodity j by the ith individual;

βj = the standardized food protein content of the j food commodity.

The household protein and carbohydrate intake was estimated as the weighted average of per capita intakes in the households using the male adult equivalent. The male adult equivalent refers to the total food (protein or carbohydrate) requirements of a household divided by the food nutrient requirements of an adult male. The amount of energy provided by carbohydrates is almost constant for all forms as one gramme of it provides 4.0 kilo calorie of energy regardless of the source. The [29] stipulated that an adult male is a male aged 20-45 years. The generated daily per capita food nutrient intakes was weighted to male adult equivalent daily intakes and projected to the annual per capita nutrient intake in the households by multiplying each estimate by 365 days.

Test of hypotheses

To test hypothesis H_0:1 involving interaction between the three mean values of annual per capita quantities of traditional foods produced and consumed and those of their imported types consumed by high, medium, and low income groups:

H_0: $\mu_1 = \mu_2 = \mu_3$

H_1: $\mu_1 \neq \mu_2 \neq \mu_3$

A two-way Analysis of Variance (ANOVA) of the means was carried out. The test of hypothesis H_0:2, about differences among the own-produced foods (A) was obtained by comparing F_A with $F_{t-1, (r-1)(t-1)}$ at 0.05 alpha level of probability and similarly, differences among the imported food types (B) was tested by comparing F_B with $F_{r-1, (r-1)(t-1)}$.

The test of hypothesis H_0:3 involving three means of consumption (by age classes) via nutrition gaps of protein and energy foods intake respectively was carried out with one-way ANOVA as follows:

H_0: $\mu_1 = \mu_2 = \mu_3$

H_1: $\mu_1 \neq \mu_2 \neq \mu_3$

A one-way Analysis of Variance of the means (ANOVA) was done.

The test of hypothesis was actually done by comparing computed F-ratio with tabulated $F_{t-1, n-t}$ at 0.05 alpha level of probability.

RESULTS AND DISCUSSIONS

Household Demographics

The age, gender, level of education and work earning ability of household members, help in defining their roles and statuses in the functional social setting. These are shown in Tables 1…4.

Table 1 revealed that a good proportion (16.04%) of household of respondents was within the age range of 0 – 5 years and a dominant (40.63%) of the members were aged between 18 and 60 years. The school age cohort of 6 – 17 years constituted 27.92% of the households. The retiree's age cohort of above 60 years constituted 15.41% of the number of persons in the household. This population structure has worrisome implication on both production and consumption behaviour. The structure revealed a young population with high

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

dependency ratio that could engender low local production, high commodity demand with inherent difficult in meeting household food demands and informs reliance on imported foods in the area.

Table 1. Distribution of farm households in Igbo Communities by age

Age (Years)	Number (n=480)	Percent (%)
0 - 5	77	16.04
6- 17	134	27.92
18 - 60	195	40.63
61 and above	74	15.41
Total	**480**	**100.00**

Source: Own Calculation.

Revealing the gender composition of the household population by age, Table 2 showed relatively more females (263) than males (229) across the age cohorts in the area. This slight dominance of females, conveys a potential source of more women labour for farm activities and consumption of own foods. Previous studies [1, 21] have recognized participation of more women in food crop production and other economic activities in households. Findings of a study funded by the United Nations Development Programme (UNDP) also revealed that depending on region in Nigeria, that women produce about two-third of food crops [27].

Table 2. Distribution of farm households in Igbo Communities by gender

Age Cohort	Gender	
	Male	Female
0 - 5	33	54
6- 17	66	68
18 - 60	94	101
61 and above	36	40
Total	**229**	**263**

Source : Own Calculation

In terms of acquisition of formal education by heads of the farm households, Table 3 showed that cumulatively, more than 92.00% of heads of farm households or household consumption decision makers in the area had formal education. This revealed increased literacy levels amongst heads of farm households in the Igbo states of Nigeria. Illness-based reports on what influence educational level of head of households and foods consumed had been documented [22]. According to the report, high level of educational attainment of heads of households was associated with more reports of illness based on what was consumed.

This shows that education rightly creates awareness of what constitute good foods to be consumed.

Table 3 revealed that many of the heads of the farm households were people that had at least primary education. Among them, 33.96% had completed their primary education, 17.08% of them had attempted primary education.

Table 3. Distribution of heads of households by level of education attainment

Formal Education of Household Heads	Number of Farmers	Percent (%)
No formal Educ	37	7.71
Pry Sch. Attempted	82	17.08
Pry Sch Completed	163	33.96
Sec Sch. Attempted	77	16.04
Sec Sch Completed	66	13.75
Voc/Teacher Training	38	7.92
Tertiary Educ Attempted	6	1.25
Tertiary Educ Completed	11	2.29
Total	**480**	**100.00**

Source: Own Calculation.

Persons that had secondary education contributed to production and participated in consumption as 16.04% had attempted secondary education and 13.75% had completed secondary education. The heads of households that had tertiary education were the least in proportion as 2.29% and 1.25% had completed and attempted tertiary education respectively in the farm households.

Table 4 showed that the highest mean annual farm income of ₦727,000.00 was from livestock and earned by 101 households in the area, followed by ₦103,000.00 earned from cash crops and earned by 130 households and the least of ₦40,000.00 was earned from food crops by 249 households.

Table 4. Distribution of households by main enterprise and annual farm income in Igbo Communities

Enterprise	Number of Households	Annual income (₦'000)	Mean Annual income (₦'000)
Food crops	249	9,958	39.99
Cash crops	130	13,400	103.08
Livestock	101	73,418	726.91
Total	**480**	**96,776**	**201.62**

Source: Own Calculation

Traditional Foods Produced and their Bundle Types.

Table 5 showed traditional foods produced in farm households by their classes in Igbo farm households. The Table revealed food classes of roots, tubers, cereals, legumes, fats and oil, fish, meat, eggs, fruits, vegetables, and spices.

Table 5. Traditional foods produced by their classes in Igbo farm households

Food Class	Food items/food Bundle
	Energy Foods
Roots	Cassava (foo foo, tapioca/*Nsisa*, Gari, *Eba*); Cocoyam
Tubers	Yam (boiled, roasted, fried, porridge)
Cereals	Rice (boiled, Jellof, fried), Maize (roasted, boiled) , *Akamu*, *Agidi*,
Legumes	Beans (*Akidi*,) breadfruit, Moi moi, *Akara*, Melon/*Egusi* (caked or boiled),
Fats and Oils	Palm oil, Coconut, Pears, Cashew nuts, Ground nuts, Bambara ground nuts(*Okpa)*
	Protein Foods
Fish	Cray fish, Cart fish (fresh, dried), Tilapia (fresh, dried),
Meat	Chicken, Goat meat, Pork, Snail
Eggs	Chicken egg
	Vitamins, Minerals and Antioxidant Foods
Fruits	Banana, Pineapple, pepper, garden eggs, cashew fruit, oranges, *Chrystophylum albicum*, Plantain, Paw paw
Vegetables	(leafy and fruit vegetables) Fluted pumpkins, Bitter leaf, broad leaf pumpkin, *Uha*, Okra,
Spices	*Ogiri*, Curry leaf, Scent leaf

Source: Own Calculation.

The roots, tubers, cereals, legumes, fats and oil are basically energy foods; fish, meat, and eggs, supply mainly proteins while fruits, vegetables, and spices amongst others supply mainly vitamins and antioxidants. The bundle of energy foods included Cassava (foo foo, tapioca/*nsisa*, gari), Yam, Plantain, Maize (*akamu*, *agidi*), rice and cocoyam. Other energy supplying foods are the palm oil, and dried coconuts, local pears and cashew nuts that supply needed oil and fats. Protein sources included Legumes (beans, *akidi*, bambara groundnut (*okpa),* breadfruit (*ukwa*)), chicken eggs, pork, goat meat, snails and fish.

The fruits and vegetables among others included banana, pineapple, pepper, garden eggs, cashew, fluted pumpkins, *uha*, udara (*Chrystophylum albicum)*, okra, and oranges widely eaten in the area supply people with the needed vitamins, antioxidants and [23, 24].

All the foods are primarily eaten to stop hunger and improve livelihood and are the entitlements of the households [6].

Annual per capita quantities of the traditional foods produced and consumed with their imported types consumed

Table 6 showed estimated mean annual quantities of some selected foods produced and consumed. These are staple crops and meat including the quantities of their imported types equally consumed by types of households. The selected food are rice, cooking oil (red palm oil and/or bottled vegetable oil), fish (fresh, frozen and dried), chicken (frozen and live) and spices. The farm households produced these traditional foods and consumed part or all of them. Some others for purposes of satisfying their tastes or preferences went ahead and purchased the imported form of the same foods they produced to meet their household needs. The per capita estimates of traditional foods produced and consumed compared with their imported types consumed gave clue to the dynamics and structure of food trade off behaviour.

Table 6 showed that households in high and medium income groups preferred the imported rice to the rice they produced locally.

The households in the low income group had zero differentials in quantities of the locally produced rice they consumed compared with the quantities of the imported rice they consumed.

This suggests practice of subsistence farming

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

amongst the low income category of food producers and awakened the need to encourage them to go into commercial farming that guarantee sustainable household food provision.

Comparing own products with their imported brands, the Table revealed a positive own-produced product differential in respect of cooking oil, chicken and spices.

The households consumed more of their produced red palm oil, chicken and locally grown spices while consuming less of imported types of these products.

For fish (a protein source consumed), the consumption mean differential favoured the imported fish (mostly frozen type) and equally signalled household insecurity in respect of fish as food in the region.

Table 6. Mean annual per capita foods (Own produced versus imported types) consumed by income groups in Igbo farm households

Monthly Income Group *	Agricultural Product/Food item	Mean Annual per Capita of locally produced Product consumed	Mean Annual per Capita of Imported Product type consumed	Mean differential From produced Product perspective	Mean differential from Imported Product perspective
High income (n=92) Greater than ₦100,000.00	Rice (kg)	50.0	75.0	-25.0	+25.0
	Cooking oil (l)	12.5	10.0	+ 2.5	- 2.5
	Fish (kg)	9.4	14.7	- 5.3	+ 5.3
	Spices (kg)	7.9	5.4	+ 2.5	-2.5
	Chicken (kg)	16.1	6.7	+ 9.4	- 9.4
Medium income (n=160) ₦75,000.00--₦100,000.00	Rice (kg)	30.0	50.0	-20.0	+20.0
	Cooking oil (l)	10.5	6.0	+3.5	-3.5
	Fish (kg)	4.4	6.3	-2.1	+2.1
	Spices (kg)	5.9	5.4	+0.5	-0.5
	Chicken (kg)	7.1	4.7	+2.4	-2.4
Low income (n=228) Less than ₦75,000.00	Rice (kg)	15.0	15.0	0.0	0.0
	Cooking oil (l)	7.5	4.0	+3.5	-3.5
	Fish (kg)	3.1	3.5	-0.4	+0.4
	Spices (kgs)	3.4	3.2	+0.2	-0.2
	Chicken (kgs)	4.1	3.3	+0.8	-0.8

*Based on [2] Classification in "Renaissance Capital Survey on booming Nigerian Middle Class" ₦75,000.00--₦100,000.00 monthly (US$480-US$645 monthly). n varied according to number of respondents that fall to each income category.
Source: Own Calculations

Test of hypothesis 1

Ho:1 There is no significant interaction between the value of annual per capita quantities of traditional foods produced and consumed and their imported types consumed by high, medium, and low income rural farm households.

H_0: $\mu_1 = \mu_2 = \mu_3$

H_1: $\mu_1 \neq \mu_2 \neq \mu_3$

The result of two-way Analysis of Variance (ANOVA) of the means is shown as Table 7 (a) *.

Table 7 (a). Analysis of variance (ANOVA) of traditional foods produced and their types imported and consumed

Source	d.f	SSD	MSD	F-ratio
Own-produced food (A)	2	25090.56	12545.28	1.357
Imported food type (B)	1	36557.44	36547.44	3.954
Error	**2**	**18484.4**	**9242.2**	

Source: Own Computations.

*This hypothesis test could not include quantities of cooking oil consumed as there was conflicting reports of quantities of red palm oil mixed with some imported vegetable oils.

The test of hypothesis about differences among the own-produced foods (A) was obtained by comparing F_A with $F_{t-1, (r-1)(t-1)}$ at 0.05 alpha level of probability and similarly, differences among the imported food types (B) was tested by comparing F_B with $F_{r-1, (r-1)(t-1)}$.

At 0.05 alpha level of probability, $F_{t-1, (r-1)(t-1)} = F_{1,(2)(1)} = 18.5$

Table 7 (a) showed own produced foods (A) and imported foods (B) with F-ratios of 1.3574, and 3.9544 computed. The ratios were less than 18.5 tabulated at 0.05 alpha levels of probability and appropriate degrees of freedom. The decision was that the interaction between the value of annual per capita quantities of traditional foods produced and consumed and their imported types consumed by high, medium, and low income rural farm households was not significant. The null hypothesis was thus accepted. The decision to combine consumption of traditional foods produced and consumed and their imported types consumed by high, medium, and low income rural farm households was purely the personal choice of the consuming units (households) and their earnings had not much interfering with it.

Per capita food energy distribution and gaps

Traditional energy foods in south-eastern Nigeria are mainly roots and tubers. These were widely grown by the farm households, who also eat much of their produce. The carbohydrates were the least expensive . The amount of energy provided by carbohydrates is almost constant for all forms as one gramme of carbohydrate provides 4.0 kilo calorie of energy regardless of the source.

Table 7 (b). Estimated per capita energy foods (Carbohydrates) consumed by age cohorts in Igbo farm households (Percent)

Food Group	Age Cohort (Male and Female)				
	Pre-school (< 6 years)	Children (6-10 Years)	Adolescents (11-17years)	Adults (18-60yrs)	Aged (> 60 Yrs)
Roots	38.41	39.10	50.22	54.57	55.51
Tubers	38.55	39.11	36.31	34.70	34,30
Cereals	38.52	39.10	35.29	34.69	34,31
Legumes	33.27	37.51	51.32	52.65	40,12
Fats and Oils	1.86	1.89	2.51	2.53	2.11
Fish	30.27	32.51	50.22	51.65	50,11
Meat	31.27	32.51	50.32	52.65	51,12
Eggs	30.27	37.49	50.12	50.65	49,11
Fruits	32.27	37.51	41.32	42.65	42,12
Vegetables	30.27	31.51	40.22	40.45	40,12
Spices	30.27	31.51	40.12	40.65	40,12
Others	2.66	2.41	3.14	2.33	3.33
Carbohydrate daily per capita (Total)(g)	**59.56**	**62.87**	**72.67**	**73.84**	**70.71**
Carbohydrate daily energy per capita (Kcal)	**238.2**	**251.48**	**290.7**	**295.4**	**282.8**
Carbohydrate Annual per capita (Total) (g)	**21,741.54**	**22,946.93**	**29,105.63**	**26,950.35**	**25,810.84**

Total Carbohydrate = The percentage of total energy available after taking into account that consumed as protein and fat (WHO, 2003) .
Source: Own Estimation.

Table 7 (b) showed energy food intakes by the farm households in the study panel distributed by their relevant age cohorts. The Table showed that the trend in the gap of daily per capita intake of total carbohydrate increased steadily from pre-school through children, adolescents, to the adults but fall slightly with the aged. Across the age cohorts, the daily per capita total carbohydrate intakes and (energy) ranged from 59.56g and (238.24 Kcal) amongst the pre-school infants to 73.84g and (295.36 Kcal) amongst the adults. These values are within anticipated mean (55.75%-75.0% energy goal) per person per day recommended by the [52]. The Table further showed that other food groups such as legumes, fruits, vegetables, spices, fats and oils and protein sources supplied carbohydrates in the daily diets consumed in the households.

<u>Test of hypothesis H_0:3 (a)</u>

H_0:3 There is no significant difference in the annual per capita nutrition gaps in Energy food intakes of Children, Adolescents and Adults in rural farm households.

H_0: $\mu_1 = \mu_2 = \mu_3$

H_1: $\mu_1 \neq \mu_2 \neq \mu_3$

To carry out this test, one way analysis of variance (ANOVA) of the means of energy foods consumed by groups gave the results presented in Table 7 (c).

Since 794.99 (Table 7(c)) computed was greater than the theoretical 3.00 at alpha probability level of 0.05, we concluded that there was a significant difference between the value of annual per capita nutrition gaps in Energy food intakes by Children, Adolescents and Adults in rural farm households of the Igbo communities of South-Eastern Nigeria.

Table 7 (c). Estimated analysis of variance of consumed energy foods by respondents

Source	d.f	SSD	MSD	F-Ratio
Total	479	28178846		
Treatment	2	21676035	10838017.5	794.99
Residual (error or within samples)	477	6502811	13632.727	

Source: Own Calculation.
At 0.05 level $F_{t-1, n-t}$ = 0.05 at $F_{2, 477}$ = 3.0

This meant a rejection of null hypothesis (Ho1) and acceptance of the alternative (H_1). Adolescents and adults who do more laborious duties consumed more of the energy foods to sustain their lives. This observed difference in consumed energy foods might suggest that each age group had access (mainly from roots, tubers and cereals) to the required quantities of carbohydrate food nutrient needed. Any deficit in food production may have been supplemented with foreign brands.

Per capita protein distribution and gaps

The protein intake by age cohorts of members of the farm households in Igbo communities are shown as Table 7 (d). The Table revealed variation in percentage contribution of each food group to their daily and annual per capita intake of protein amongst relevant social age cohorts of the households. It as well revealed a trend in that the households sourced protein in descending order of the following food groups: Legumes, Cereals, Fish, Roots, Tubers, Meat, Eggs, Fruits and Vegetables. Legumes and cereals took the lead in supplying protein in meals of Igbo farm households an evidence of dominance of crops as key sources of protein supplies to the households. This revelation also agreed with the findings of [3, 15] in Edo State, Nigeria.

Further, the Table showed that the adults (18-60 years) and the adolescents (11-17 years) consumed the highest daily (21.15g; 21.09g**)** and annual (7,720.79g; 7,699.65g**)** per capita protein respectively compared with the aged that consumed the least daily (17.76g**)** and annual (6,481.18g**)** per capita protein in the households.

Table 7 (d). Estimated per capita foods protein consumed by age cohorts in Igbo farm households (percent *)

Food Group	**Age Cohort (Male and Female)**				
	Pre School (<6years)	Children (6-10 years)	Adolescents (11-17 years)	Adults (18-60 years)	Aged (> 60 years)
Roots	10.247	11.689	10.213	9.837	6.332
Tubers	5.782	6.577	5.427	5.631	4.933
Cereals	22.946	10.617	20.873	23.451	20.551
Legumes	31.712	33.642	35.213	33.141	29.162
Fats and Oils	0.000	0.000	0.000	0.000	0.000
Fish	14.894	14.681	13.327	14.806	12.507
Meat (Beef, Chicken, goat meat)	6.049	3.526	6.173	6.665	5.567
Eggs	1.983	13.511	9.411	7.634	5.631
Fruits	0.115	0.126	0.311	0.543	0.441
Vegetables	0.673	0.112	0.132	0.642	0.712
Spices	0.135	0.113	0.116	0.117	0.139
Other animal products	0.112	1.114	1.111	0.121	0.142
Total Protein daily per capita intake (g)	**19.52**	**19.73**	**21.09**	**21.15**	**17.76**
Total Protein Annual per capita intake (g)	**7,123.23**	**7,203.01**	**7,699.65**	**7,720.79**	**6,481.18**

(*estimate based on %/100g of dry matter consumed)
Source: Own Calculations

The children and infants consumed relatively lower daily (19.73g; 19.52g**)** and annual (7,203.01g; 7,123.23g) per capita protein respectively in the area. These protein gaps are against the nutritional recommended requirements for the age groups and the entire households [26]. The protein consumption across the age cohorts in the households was below the recommended 44.4g per person per day which goes to suggest unhealthy gap and critical need of protein in the diets of these households. These gaps might therefore be bridged by the farm households intensively embracing technology of animal husbandry and aquaculture, (especially those that are yet to adopt such).

Test of hypothesis H_0:3 (b)

H_0:3 There is no significant difference in the annual per capita nutrition gaps in Protein food intakes of Children, Adolescents and Adults in rural farm households.

H_0: $\mu_1 = \mu_2 = \mu_3$

H_1: $\mu_1 \neq \mu_2 \neq \mu_3$

To carry out this test, an analysis of variance (ANOVA) of the means of protein intakes by groups gave the results presented in Table 7(e).

Table 7 (e). Analysis of variance (ANOVA) of per capita protein of different age groups

Total	479	9492958.67		
Treatment	2	5419218	2709609	317.27
Residual (error or within samples)	477	4073740.67	8540.337	

Source: Own Calculations

At 0.05 level $F_{t-1, n-t}$ = 0.05 at $F_{2, 477}$ = 3.00

Since 317.27 (Table 7 (e)) computed was greater than the theoretical 3.00 at alpha probability level of 0.05, we concluded that there was a significant difference between the annual per capita nutrition gaps in Protein food intakes by Children, Adolescents and Adults in the rural farm households of south-eastern Nigeria. This meant rejection of null hypothesis (Ho1) and acceptance of the alternative (H_1). The computed 317.27 was about half the computed 794.99 for carbohydrates (Table 7(c)) and goes to suggest that the households consumed far less proteins than they consumed carbohydrates in the area.

Determinants of trade-off in Food Consumption in Farm Households

Estimates of factors that influenced decision to trade-off food consumption in Igbo farm households are shown in Table 8.

The Table showed that education level, declined average yield of produced crops, and annual farm income were factors that negatively but very highly influenced decision to trade-off consumption of foods (decision to prefer own produced foods to the imported alternatives) within the Igbo farm households. Other factors that had significant, negative but moderate influence on household's decision to trade-off locally produced foods with their imported types were: number of times product was eaten weekly, decline area of land from previous cultivation, and unit price gap between imported and locally produced products. Another significant factor that had a slight negative influence on this decision was value of foreign type of locally produced product received as gift. These revelations suggest that, the more educated the food purchasing decision maker is, the more the declined average yield of produced crops, the more the fall in annual farm income, reduced number of times product was eaten weekly, decline in area of land from previous cultivation and increase in the naira value of foreign type of locally produced product received as gift the less the Igbo farm households preferred own products to imported ones.

By these revelations, hypothesis Ho:2 on factors influencing food trade off in respect of level of education, declined average yield of produced crops, annual farm income, number of times product was eaten weekly, decline area of land from previous cultivation, and unit price gap between imported and locally produced products was rejected.

The negative influence of the unit price gap between the locally produced farm products and their imported alternatives strictly showed that the lower the unit price of the product, the more the households consumed it. The importance of prices of food items on household demands and consumption expenditures had long been emphasized [23, 24, 10].

Further, Table 8 showed that most of the significant household-based variables except age of the decision maker (head of households) were negatively signed. In terms of age (with implications of cultural inertia and/or patriotism), the Table revealed that the more aged the household heads are, the more they preferred feeding on own-produced foods to swapping their products with the imported types. By this revelation also, hypothesis Ho:2 in respect of age of household head (decider of foods eaten) was equally rejected.

Table 8. Maximum Likelihood Estimates of First-Stage Probit function of factors influencing rural farm households consumption attitudes to own produced against imported foods in Igbo States, Nigeria.

Variable	Coefficient	Std. Error	t-ratio
Number of times product was eaten weekly	-0.358**	0.18	-1.99
Education Level	0.162***	0.026	-6.12
Value of foreign type of locally produced product received as gift	-0.930*	2.71	-1.45
Declined average yield of produced crops	2.375***	0.775	-3.064
Annual Farm income	3.779***	1.105	-3.42
Decline area of land from previous cultivation	-3.448**	1.227	-2.81
Unit Price gap of imported and locally produced product	-0.633**	0.213	-2.97
Farmer perception of local product quality	1.084	0.912	1.19
Age of head of household	0.334***	0.044	7.59
Constant	4.869***	0.74	6.58
-2lnLikelihood	71.32***		
Sample size (n)	480		

*Significant at 10.0%; ** Significant at 5.0%; ***significant at 1.0% alpha level.
Source: Own Estimations

This however was the only significant factor that favoured consumption of own foods. The decisions of households to feed on own produced food against the available imported ones therefore was hinged on their experience and taste both of which are akin to age and the cultural value they placed on their own produced foods. This cultural value placed on own produced foods might be one reason why farmers in these communities celebrate some of their indigenous crops (yam, *Discorea spp.;* cocoyam, *Colocasia esculanta*) with remarkable annual festivals (new yam festival) and Coco yam ceremonies, with special recognition on farmers who relatively produced much of them.

CONCLUSIONS

The following conclusions were drawn from the findings of this study:
(i)The farm households in the south eastern Nigeria produced many traditional foods as carbohydrates, protein, fats, oil, and vitamin sources;
(ii)There was a positive own-produced product differential in respect of cooking oil, chicken and spices.
(iii)Adolescents and adults who do more labourious duties consumed more of the energy foods than did the infants to sustain their lives.
(iv)There was also significant differences ($P<0.05$) between the annual per capita nutrition gaps in Carbohydrates and Protein food intakes (respectively) by Children, Adolescents and Adults in the rural farm households of south-eastern Nigeria;
(v)The households also consumed far less proteins than they consumed carbohydrates in the area;
(vi)The interaction between the value of annual per capita quantities of traditional foods produced and consumed and their imported types consumed by high, medium, and low income rural farm households was not significant;
(vii)The decisions of households to feed on own produced food against the available imported ones was hinged on their experience and taste both of which are akin to age and the cultural value they placed on their own produced foods.
The findings led us to the following recommendations:
(i)Household heads who relatively are young and who carry out household purchases should follow the footstep of the aged household heads in feeding more on own products than on their imported brands. This indeed is a call for change of tastes, preferences and value system;
(ii)The unhealthy gap across age cohorts and critical need of protein in the diets of the households demand that as farmers, the production plans should be adjusted such that more legumes and livestock form the hub of their enterprise and product mix;

ACKNOWLEDGEMENTS

We are grateful to Nigeria Tertiary Education Trust Fund (TETFUND) for financing this project.

REFERENCES

[1]Abubakar, R. Z., Voh, J.P., Umah, B. F., Khalid, S., Aigbe, J., Aliyu, A. B., 2012, Women Participation in Agriculture and Rural Development Activities, in Bengaje community in Sokoto State, Nigeria; Scientific Journal of Agriculture 1(6):150-158.
[2]Adewunmi, O., 2011, Nigeria's Middle Class: How we live, and what we want from Life. How We made it in Africa. Insight into Business in Africa, DHL.
[3]Aromolaran, A.B., 2000, Food Consumption pattern and Women Income: Implications for Household Food Security in Nigeria. A revised Work-in-Progress presented at the AERC Mid-Year Workshop in Nairobi, Kenya May 27th – June 1st.
[4]Binkley, J.K., Golub, A., 2011, Consumer demand for nutrition versus taste in four major food categories. Agricultural Economics 42: 65-74
[5]Chike, O., Vincent, O., 1999, Nigerian Consumer Attitudes Towards Foreign and Domestic Products. Journal of International Business Studies, (Third Quarter) 30: 3 p.611
[6]Dreze, J., Sen, A., 1989, Hunger and Public Action. WIDER Oxford. P9.
[7]Drewnowski, A., Darmon, N., 2005, The economics of obesity: Dietary energy density and energy cost. Am. J. Clin. Nutr. 82(1), 265S–273S.
[8]Drichoutis, A.C., Lazaridis, P., Nayga, R.M., 2005, Nutrition knowledge and consumer use of nutritional food labels. Eur. Rev. Agric. Econ. 32(1), 93–118.
[9]Eaton, C., Shepherd, A.W., 2001, Productivity, Market Access and Income for Small farming Businesses Through Contracts in Tanzania. Tanzania-Denmark Pilot Research Programme 2011- 2013. Danish Fellowship Centre.
[10]Emerole, C.O, Nwosu, A.C, Onyenweaku, C. E, Ukoha, O.O, Nwachukwu, A.N., 2007, Determinants of consumption expenditure and its share to total income in small farm households in Ikwuano, Abia state Nigeria. Global Approaches to Extension Practice. 3(1):1-11.
[11]Ene-Obong, H. N, Enugu, G.I., Uwaegbute, A.C., 2001, Determinants of Health and nutritional Status of Rural Nigerian Women. J. Health Popul. Nutr. 19(4): 320-330.
[12]FAO/WHO, 1985, Energy and Protein Requirements. World Health Organization Technical Report Series. World Health Organization Geneva p. 206.
[13]Golan, E., Stewart, H., Kuchler, F., Dong, D., 2008, Can low-income Americans afford a healthy diet? Amber Waves 6(5): 26–33
[14]Gujarati, D.N., Porter, D.C., 2003, Basic Econometrics 5th Edition The McGraw-Hill Series.
[15]Iyangbe, C.O., Orewa, S.I., 2009, Determinants of Daily Protein intake among Rural and Low income Urban Households in Nigeria. American-Eurasian Journal of Scientific Research 4 (4): 290-301
[16]Javor, A., Czekledi, L., Madai, H., Vass, N., 2008, New Trends in Functional Foods of Animal origin. analele universitatii din oradeafascicula: ecotoxicologie, zootehnie si tehnologii de industrie alimentara, 7(7): 264-271.
[17]Kormawa, P., Akoroda, M.O., 2003, Cassava Supply Chain Arrangement for Industrial Utilization in Nigeria. IITA, Ibadan.
[18]Ndiokwere, N.I., 1998, Search for Greener Pastures: Igbo and Africa Experience, U.S.A: Morris Publishing.
[19]Okali, D., Okpara, E., Olawoye, J., 2001, Rural-Urban Interactions and Livelihood Strategies The Case of Aba and its Region, South-eastern Nigeria. Working Paper Series on Rural-Urban Interactions and Livelihood Strategies, Working Paper 4. International Institute for Environment and Development (IIED)
[20]Okeke, E.C., Eneobong, H.N., Uzuegbunam A.O., Ozioko, A.O., Kuhnlein, H., 2008, Igbo Traditional food System: Documentation, Uses and Research Needs. Pakistan Journal of Nutrition 7 (2): 365-376, 200
[21]Oladejo, J. A.. Olawuyi, S.O., Anjorin, T.D., 2011, Analysis of Women Participation in Agricultural Production in Egbidore LGA Osun State, Nigeria. International Journal of Agricultural Economics and Rural Development 4(1): 1-11.
[22]Pitt, M. M., Rosenzwieg, M. R., 1984, Agricultural Prices, Food Consumption and the health and productivity of farmers. Economic Development Center Department of Economics, Minneapolis Department of agricultural and applied economics, St. Paul
University of Minnesota. Bulletin No. 84-1
[23]Pitt, M. M., 1983, Food Preferences and Nutrition in Rural Bangladesh, Review of Economics and Statistics (65):105-114.
[24]Strauss, J., 1983, Determinants of Food Consumption in Rural Sierra Leone: Application of the Quadratic Expenditure System to the Consumption-Leisure Component of a Household-Firm Model," Journal of Development Economics 11(3):327-354.
[25]Variyam, J., Blaylock, J., Smallwood, D., 1996, A probit latent variable model of nutrition information and dietary fiber intake. Am. J. Agric. Econ. 78(August), 628–639.
[26]WHO, 2003, Diet, nutrition and the prevention of chronic disease. Report of the FAO/WHO Expert Consultation: WHO Technical Report Series, No.919. Geneva
[27]World Bank, 2008, World Development Report. Agriculture for Development. Washington D.C.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

MAXIMIZE HYDROGEN GAS PRODUCTION FROM A SMALL UNIT USING ACIDIC AND SALINE WATER

Tarek FOUDA, Samy BADR, Asaad DERBALA, Adel ELMETWALLI, Abouelmagd SALAMAH

Tanta University, Faculty of Agriculture, Tanta, Egypt, Phone No: Work +20403455584, Fax: +20403455570, Emails:tfouda@yahoo.com, asaadderbala@yahoo.com, adelra99@yahoo.com, abouelmagd.salamah@yahoo.com

Corresponding author: tfouda@yahoo.com

Abstract

The Main objectives for this work design a small hydrogen gas production unit and maximize hydrogen gas from water. A small unit was designed from stainless steel with a number of cells (9, 11, 13, 15 cells), cell distance (1.5, 1.0, 0.5 mm), duration of unit operation (15, 30, 45, 60 min) and Type of water (Acidic water and Saline water (sea water in particular)). The experimental results of hydrogen cells production unit are presented. It is used for electrical analysis of two types of water (acidic - saline). The results obtained showed that the highest production of hydrogen energy was observed with (15 cells) number was (5.12 kWh) at working time (60 min), distance between cells (0.5 mm), cell temperature (46.7°C) and water temperature (56.1°C) in the presence of saline water. At same time the lowest hydrogen energy observed with number of cells (15 cells) number was (2.606 kWh), working time (15 min), distance between cells (1.5 mm), cell temperature was (35.5°C) and water temperature was (31.2°C) in the presence of acidic water. Total energy was increased by 96.47%, increasing number of cells and lack of distance between cells.

Key words: *hydrogen gas, fuel cells, consumed energy, produced energy, cell temperature, evaluate*

INTRODUCTION

Hydrogen is one of the most promising renewable fuels because it can generate from resources like biomass and water. Hydrogen gas energy carrier is growing fast with the development of fuel cells and its application such as the fuel cell, and hydrogen usage as transportation fuel in the form of a compressed gas.

Used Electrolysis of saline water (sea water in particular) is examined as feedstock for the production of hydrogen by electrolysis. Hydrogen could be produced from abundant sources of sea water along with solar energy, for countries where fresh water is scarce. However, due consideration is not given to the availability and quality of raw materials used in the production of hydrogen; this is water. In normal operating conditions, the electrolysis cell behaves to produce H_2 / Cl_2 instead of H_2 / O_2. The experimental results of the electrolysis of a wide range of saline water (0.5 - 7.0% TDS) are presented and explanations are given for two key characteristics of cell operation are the rate of hydrogen production and chlorine evaluation [5].

According to the type of used electrolyte (tap water, margin, gas, liquor, waste water from cooking, puckered olive, urine, vinegar of pink, municipal waste water and finally milk, water), there is variation of the hydrogen flow rate produced by supplying the electrolytes in electrical current by the photovoltaic module as the energetic efficiency does not change often in the same direction as the produced hydrogen flow [12].

Enabled such systems can be designed to produced additional purified hydrogen as a by product by feeding additional fuel and then purifying the hydrogen-rich “anode tail gas” from the fuel cell into purified hydrogen [5].

The hydrogen supply options include 'hydrogen production via electrolysis process using renewable and carbon dioxide-free electricity sources such as solar, wind or wave powered electrolysis, gasification of coal, petroleum coke and biomass with carbon dioxide capture and storage technology, the splitting of water by thermo chemical means such as high temperature nuclear and solar heat [10].

Hydrogen gas can be electrochemically produced in microbial reverse-electrodialysis electrolysis cells (MRECs) using current derived from organic matter and salinity-gradient energy such as river water and seawater solutions. Here, it is shown that ammonium bicarbonate salts, which can be regenerated using low-temperature waste heat, can also produce sufficient voltage for hydrogen gas generation in an MREC. The maximum hydrogen production rate was 1.6 m^3 $H_2/m^3 \cdot d$, with a hydrogen yield of 3.4 mol H_2/mol acetate at a salinity ratio of infinite. Energy recovery was 10% based on total energy applied with an energy efficiency of 22% based on the consumed energy in the reactor. The cathode over potential was dependent on the catholyte (sodium bicarbonate) concentration, but not the salinity ratio, indicating high catholyte conductivity was essential for maximizing hydrogen production rates [8].

Studied was proposed to develop a new method for hydrogen production in significant amounts. Furthermore, it was an innovative method for hydrogen production. In fact, SO_2 was fed into a PEM electrolyzed stack. The dissolved SO_2 was oxidized at the anode which led to the production of sulphuric acid; whereas, hydrogen (H_2) was produced at the cathode. This new method was able to treat 3.7 t/day of SO_2 in order to produce 0.116 t/day of hydrogen and recover 5.6 t/day of 35 wt.% H_2SO_4. Results showed that the studied procedure was more economical in terms of energy consumption than the Westinghouse hybrid process. Hence, 67% of the energy needed for the decomposition step. After the presentation of the principles of the new process design, each part of the process was sized. The calculations showed that the number of electrolyzes could be calculated using the same formula used for the number of electrolyzes for water [6].

Hydrogen was produced by electrolysis of formalic acid solutions. The effect of Formic acid and NaOH concentrations on the voltage was studied. The voltage was found to be related to the actual formic acid concentration. When the actual formic acid concentration is higher than 0.8×10^{-9} m, the initial electrical voltage can be low to 0.30 volts, which is much lower than the open circuit voltage in the proton exchange membrane fuel cell. Specifically in 1.0 M Sodium Hydroxide and 4.0 HCO, the constant voltage value increases from 0.62 to 0.70 V with a current density increase of 1.0 to 6.0 mA / cm^2. In 3.0 m HCO and 2.5 M Sodium Hydroxide, the hydrogen production rate is 53 μm / h under 8.0 mA / cm^2 [2].

Found that, electrodes were added with carbon loads in order to control the grain size and with this, the current density for hydrogen evolution in alkaline media. A carbon 1.59 % weight present produced a 3.4 nm grain size and the lowest over potential for the HER at polarization current density 0.12 A/cm^2. In a layer by layer preparation of Ni-Fe-C electrodes on Cu. [13].

Measured slope it was found that nickel Raney added with PTFE increased its electro active area in 102 - 103 times compared to the geometric area. Using Ti, Cr and Fe as additives stable electrochemical performance was seen at 60°C. Changing growth conditions during electro deposition process showed an effect on catalytic properties of nickel alloys, in particular Ni-W, which grown under super gravity conditions [7].

Reported that, electrolysis of both synthetic sea water and Arabian Gulf water were carried out using a simple Hoffman electrolysis apparatus simulated composition of sea water was chosen to cover the range all the way from brackish (say 4,000 ppm) to MSF desalination rejects (say 60,000 ppm). Electrolysis took place under the conditions of: 6 - 20 V, 25 - 126 mA/cm^2 and up to 1000 coulombs of electricity. For the solutions investigated, it was found that the hydrogen production rate was dependent upon the applied current density alone. The quantity of hydrogen produced on a platinum electrode of area l.5835 cm^2 is 85 ml h-1 for 120 mA cm^{-2} current density. Similarly, the rate of hydrogen production increases chemically (follows Ohm's law) with the increase in voltage for natural and synthetic seawater.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

However, the rate of increase at low values of voltage, say 6 - 8 V, is rather slow, since the production rate is dependent on the current density. At higher voltages (l0 V and above), the initial conductivity is no longer affecting the current density and the solution behaves like a resistance, with lower resistance at high TDS; hence, the increase in salinity level gives a proportional increase in the hydrogen productivity [4].

Produced hydrogen can be used either directly as a fuel or as a reducing agent in chemical processes. Water splitting can be realized both at low temperatures (typically below 100 $^{\circ}$C) and at high temperatures (steam water electrolysis at 500, 1000 $^{\circ}$C), while different ionic agents can be electrochemically transferred during the electrolysis process (OH, H^+, O_2). Singular requirements apply in each of the electrolysis technologies (alkaline, polymer electrolyte membrane and solid oxide electrolysis) for ensuring high electro catalytic activity and long-term stability. The aim of the present article is to provide a brief overview on the effect of the nature and structure of the catalyst electrode materials on the electrolyser's performance. Past findings in the development of efficient anode and cathode materials appropriate for large-scale water electrolysis are presented [11.]

There are five major types of fuel cells being known or used in the market. They all have the same basic design as mentioned above, but with different chemicals used as the electrolyte. These fuel cells are: Alkaline Fuel Cell (AFC), Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC), Solid Oxide Fuel Cell (SOFC) and Proton Exchange Membrane Fuel Cell (PEMFC). All the above fuel cells require fairly pure hydrogen fuel to run. However, large amount of hydrogen gas is difficult to transport and store. Therefore, a reformer is normally equipped inside these fuel cells to generate hydrogen gas from liquid fuels such as gasoline or methanol [3, 9].

From these options, hydrogen production via electrolysis of water seems to be the most viable method. The Main objectives for this work design a small hydrogen gas production unit and maximize hydrogen gas from water.

MATERIALS AND METHODS

This research work was carried out at Gemmeiza Agricultural Research Station, Department of Agricultural Engineering and Agricultural Research Center in Giza, to investigate the possibility of manufacture a small unit to producing hydrogen gas from water during summer (2016). Four different study parameters were investigated including water type, space between cells, working time and number of cells.

-Water type (Tap - Acidic - Saline)
-Distance between cells (0.5- 1.0 - 1.5 mm).
-Numbers of cells were used (9-11-13-15 cells)
-Working time (15 - 30 - 45 - 60 min).

The water temperature and temperature cell were measured also produced gas (l/h) and the quantity of energy produced and consumed (kWh).

The hydrogen production unit

The production unit of hydrogen gas consisted of a group stainless sheets of negative and positive poles.

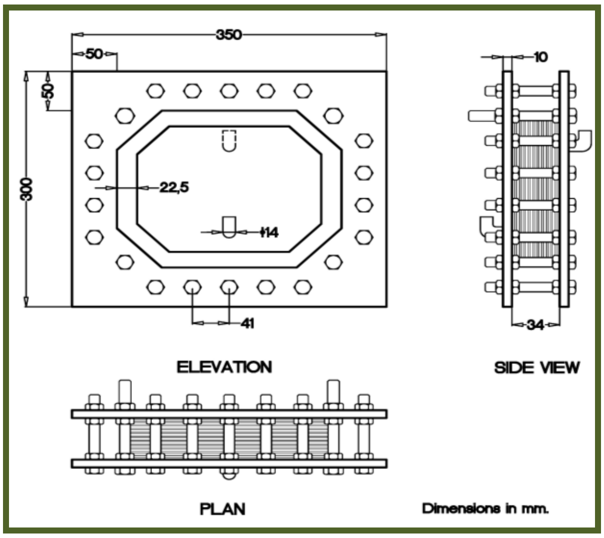


Fig.1.The assembly of fuel cells, plan, elevation and side view of the hydrogen gas production unit.
Source: Own design.

Between each two successive stainless steel sheets, Gasket **"Aspects"** was uses to avoid leakage of both water and hydrogen gas. Gaskets were also used to control the distance between cells. Acrylic covers of 25 cm * 35 cm were used to cover and link the whole unit.

Measurement of current intensity

MY-61Digital Multimeter/Volt/Amp/Diode/Ohm/Capacitance tester Transistor VEJ56 T18 0.5 was used for measuring current intensity and voltage and this device.

1. Principles of electrolysis

The principle chemical equations are shown in reaction 1, where the electrochemical flow is shown for acidic and alkaline environments. This work involves the alkaline reaction pathway.

Net Reaction: $H_2O \rightarrow H_2 + ½ O_2$ .... (1)

Acidic Reaction

Anode: $H_2O \rightarrow ½O_2 + 2H^+ + 2e^-$

Cathode: $2H^+ + 2e^- \rightarrow H_2$

Alkaline Electrolysis

$2OH^- \rightarrow ½O_2 + H_2O + 2e^-$

$2H_2O + 2e^- \rightarrow H_2 + 2OH$

2. Fuel Cell Efficiency

Fuel cell efficiency is commonly taken to mean the actual efficiency of the electrochemical reaction. This efficiency can be derived as follows.

The amount of energy released when hydrogen and oxygen combine to form water according to the reaction $H_2 + ½O \rightarrow H_2O$ is quantified as the "enthalpy of reaction" (ΔH°). This value is measured experimentally and depends on whether the water is formed as a gas or a liquid. For fuel cells, the water forms as a gas and the enthalpy of reaction is known to be:

$$\Delta H^o = -230 \frac{BTU}{mole_{water}} = -242 \frac{KJ}{mole_{water}}$$

....(2)

$mole_{water} = 6.023*10^{23}$ *molecules of water* ....(3)

This value of the enthalpy of reaction is only strictly correct at 25°C and 1 atmosphere.

Gibbs free energy" (ΔG°) for gaseous water at 25°C and 1 atmosphere this is known to be: The negative sign denotes that the energy is released during the reaction, and not absorbed. Gibbs free energy can be determined from the following equation.

$$\Delta G_{gas} = -217 \frac{BTU}{mole_{water}} = -229 \frac{KJ}{mole_{water}}$$

....(4)

The voltage of each cell (ε_{cell}) is related to the Gibbs free energy according to the equation:

$$\mathcal{E}_{cell} = -\frac{\Delta G^o}{n\,\mathcal{F}}$$ ....(5)

where:

n = Number of electrons involved in the reaction. This is most conveniently Expressed as "mole of electrons" (or mole e^-) where each mole e^- is equal to $6.023x10^{23}$ electrons. From the anode and cathode reactions ($H_2 \rightarrow 2H^+$ $2e^-$ and $½\ O_2 + 2e^- + 2H^+ \rightarrow H_2O$) two electrons are involved in the formation of each water molecule. Thus n = 2 mole e^- for every $1 mole_{water}$ formed.

$\mathcal{F}$ = Faraday's constant. Equal to 96.500 coulombs/mole e^- Coulombs are Aunt of electric charge. Substituting values into the equation (using imperial units):

$$\mathcal{E}_{cell} = -\frac{-217\,BTU}{mole_{water}} x \frac{1055.7\,J}{BTU} x \frac{mole_{water}}{2\,mole\,e^-} x \frac{mole\,e^-}{96.500\,coul} = \frac{1.187\,J}{coul} = 1.187\,V$$

....(6)

Similarly, using metric units:

$$\mathcal{E}_{cell} = -\frac{-229\,BTU}{mole_{water}} x \frac{1000\,J}{KJ} x \frac{mole_{water}}{2\,mole\,e^-} x \frac{mole\,e^-}{96.500\,coul} = \frac{1.187\,J}{coul} = 1.187\,V$$

....(7)

Thus each cell can generate a maximum theoretical voltage of 1.187V (at 25ºC and 1 atmosphere). The fuel cell efficiency is therefore simply the proportion of the actual voltage the cell produces with respect to this theoretical maximum:

$$Efficiency_{cell} = \frac{V_{Acuall}}{\mathcal{E}_{cell}} \cong \frac{V_{Acuall}}{1.2\,V}$$ ....(8)

For a real fuel cell, typical voltages are between 0.5 and 0.6V at normal operating loads and can reach 1.1V at open circuit conditions.

3.Efficiency of the unit for producing hydrogen gas

It was calculated according **Mario et al. (2007)** Equation:-

$$\left(p + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$ ....(9)

Where:

V = Size (m^3)
n = Number of moles.
T = Temperature (°C)
p = Pressure (P_a)
R = Constant.

a = Coefficient approximation to the impact of reform pressure.

b = Coefficient approximation to reform the effect size.

RESULTS AND DISCUSSIONS

Experiments and laboratory tests to evaluate the performance of the proposed design unit and its ability to produce hydrogen gas in varying amounts in different periods of time were conducted. The unit production of hydrogen gas test, data has been collected to get the best set of operating standards under study analysis. However, Can the results of this current work discussed under the following headings:

1.Influence of water type on produced hydrogen.

Indicated in Figure (2) the impact of water used in the different types of study in hydrogen produces.

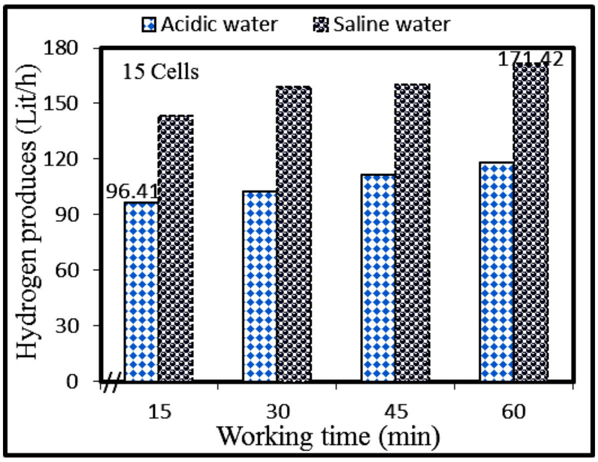


Fig.2. Effect of water types and working time on produce hydrogen.
Source: Own design based on the obtained results.

Thus, the previous measurements show that the lowest output hydrogen was 96.41 L/h for acidic water and 143.41 L/h for saline water with 15 cell counts, 0.5 mm cell distance, 15 min working time, the hydrogen produced with saline water was 48.75% higher than acidic water. The highest output capacity was 118.37 L/h of acidic water and 171.42 L/h of saline water with 15 cell counts, distance between cells 0.5 mm, running time of 60 min, thus the hydrogen produced with water saline increased by 44.81% for acidic water.

2.Effect of water used on the difference consumed and produced energy.

Effect of different types of water used on consumed and produced energy as shown in Figure (3).

Power gen, for the case of two types of water when distance between cells (0.5 mm), number of cells (15 cells) and working time (15, 30, 45, 60 min) were changed. The results slow that: **Acidic water,** The lowest value of the power gen was obtained. The difference was 2.8649 kWh with distance between 0.5 mm cells, number of 15 cells and working time 15 min. While the highest value of power gen was 3.4638 kWh with number of 15 cells, working time 60 min. and distance between cells was 0.5 mm.

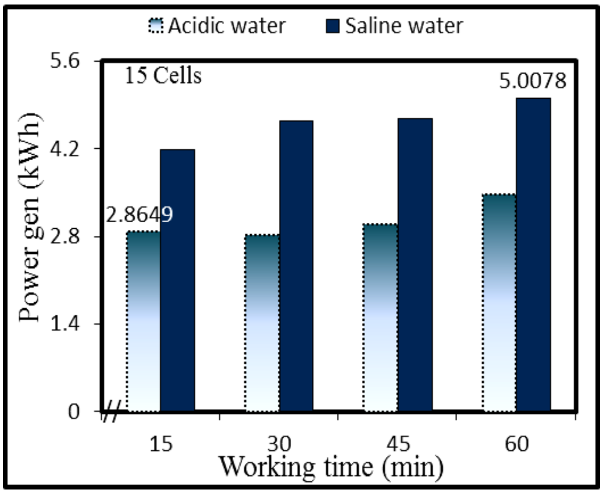


Fig. 3. Effect of water types and working time on power gen.
Source: Own design based on the obtained results.

Saline water. The lowest value of the power gen was obtained. The difference was 4.1883 kWh with distance between 0.5 mm cells, number of 15 cells and working time 15 min. While the highest value of power gen was 5.0078 kWh with number of 15 cells, working time 60 min. and distance between cells was 0.5 mm. As shown above, the net energy between produced and consumed energy increases with saline water in acidic water by 44.57%. This is due to the increase in cations in saline water that accelerate the separation of hydrogen from them in acidic water.

3. Effect of number of cells and water types on produce hydrogen.

Figure (4) shown the effect of number of cells

(9, 11, 13, 15 cells) and different types of water used on produced hydrogen. The results obtained from the average hydrogen produced with number of cells (9, 11, 13, 15 cells) in the presence of two types of water, distance between cells (0.5 mm) and working time (60 min).

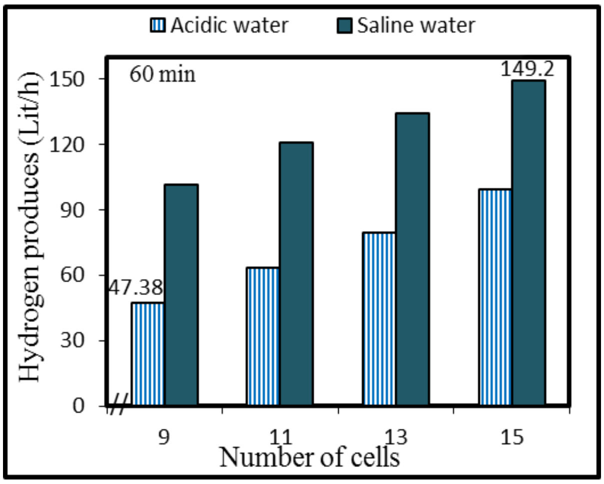


Fig. 4. Effect of water types and number of cells on produces hydrogen.
Source: Own design based on the obtained results.

Results with acidic water, the lowest average obtained value of produced hydrogen 47.38 L/h with distance between cells 0.5 mm, number of 9 cell and working time 60 min. While the average highest value of produced hydrogen 99.49 L/h with number of 15 cells, working time 60 min. and distance between cells 0.5 mm. Results with saline water, the lowest average obtained value of produced hydrogen 101.87 L/h with distance between cells 0.5 mm, number of 9 cell and working time 60 min. While the average highest value of produced hydrogen 149.2 L/h with number of 15 cells, working time 60 min. and distance between cells 0.5 mm. From the above, the increase in number of cells increases produced hydrogen as a result of increasing the exposed surface and separation of hydrogen from water. It increases with 15 cells and saline water by 214.90% from 9 cells and acidic water.

4.Effect of distance between cells and number of cells on producing hydrogen.

Indicated in Figure (5) shown the effect of distance between cells (1.5, 1.0, 0.5 mm) and different types of water used on produced hydrogen. The results obtained from the average hydrogen produced with distance between cells (1.5, 1.0, 0.5 mm) in the presence of tow types of water, number of cell (15 cells) and working time (60 min). Results with acidic water, the lowest average obtained value of produced hydrogen 91.86 L/h with distance between cells 1.5 mm, number of 15 cells and working time 60 min. While the average highest value of produced hydrogen 107.15 L/h with number of 15 cells, working time 60 min. and distance between cells 0.5 mm.

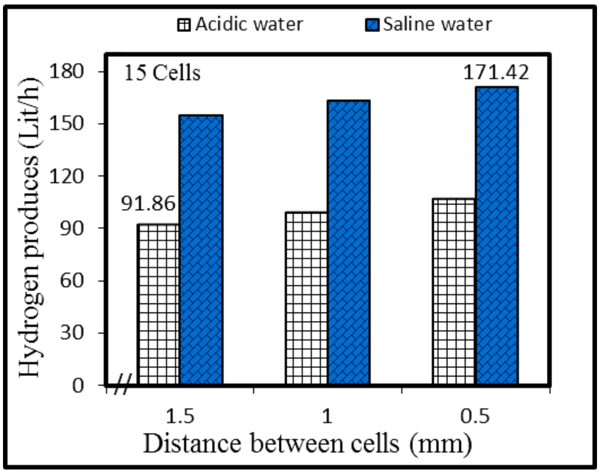


Fig. 5. Effect of distance between cells and number of cells on producing hydrogen.
Source: Own design based on the obtained results.

Results with saline water, the lowest average obtained value of produced hydrogen 154.72 L/h with distance between cells 1.5 mm, number of 15 cell and working time 60 min.
While the average highest value of produced hydrogen 171.42 L/h with number of 15 cells, working time 60 min. and distance between cells 0.5 mm. As shown above, the lack of distance between cells increases the hydrogen produced by the lack of water between cells increases the speed of analysis separation of hydrogen from water. The analysis increases with 0.5 mm in the presence of saline water by 86.61% than 1.5 mm in the presence of acidic water.

5. Efficiency of hydrogen gas production unit and effect of distance between cells,working time (η^o)

Figure (6) Efficiency of hydrogen gas production unit the efficiency of fuel cells is usualy taken to mean actual efficiency of electrochemical reaction. This value is measured experimentally and depends on whether water is formed as gas or liquid. For fuel cells, water is formed as gas. Thus, total efficiency is ratio of produced energy (output) transferred to water and leaving hydrogen cells to consumed energy (input) hydrogen gas energy.

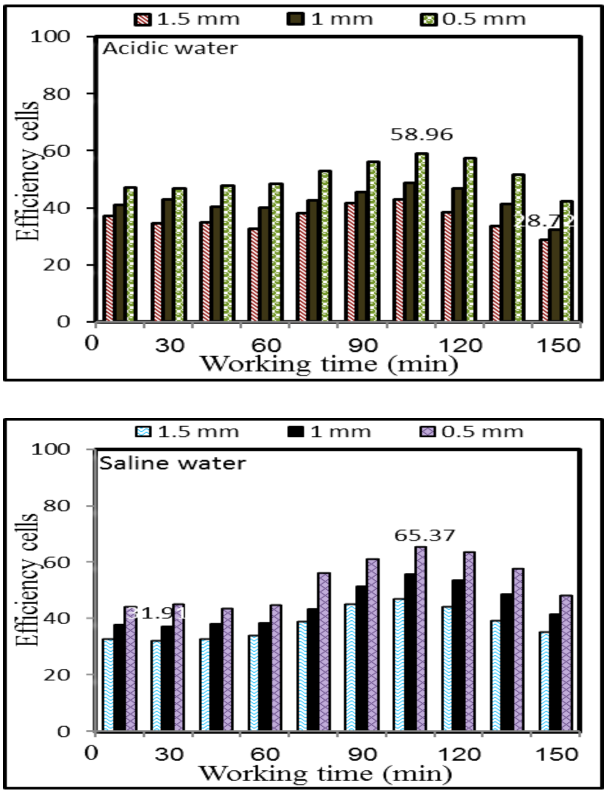


Fig. 6. Effect of water types, working time and distance between cells on efficiency cells.
Source: Own design based on the obtained results.

During test period, working time (15 to 120 min), distance between cells (1.5 to 0.5 mm) and two types of water (acidic - saline) was the efficiency of cells as follows; in the presence of lowest efficiency acidic water (28.72%), working time 150 min and distance between cells 1.5 mm.

The highest efficiency of cells (58.96%), working time 105 min and distance between cells 0.5 mm. In the presence of lowest efficiency saline water (31.91%), working time 30 min and distance between cells 1.5 mm. The highest efficiency of cells (65.37%), working time 105 min and distance between cells 0.5 mm.

In presence of lowest efficiency acidic water (28.72%), working time 150 min at distance between cells 1.5 mm. Efficiency of cells the highest (65.37%) at working time 105 min and distance between cells 0.5 mm with saline water. This is because presence of an electrochemical reaction breaks down bonds of its reactors to produce new bonds in resulting materials and to synthesize new materials that are different in their chemical and physical properties. This results in their deposition on surface of cells, reducing their efficiency by increasing working time.

CONCLUSIONS

The highest produced of hydrogen gas was observed with number of cells 15 cells in the presence of saline water, distance between cells 0.5 mm, working time 60 min, cell temperature 46.7°C water temperature increased to 56.1°C by (5.123 kWh).

While the lowest produced of hydrogen gas energy was with number of cells 15 cells in used of acidic water, distance between cells was 1.5 mm, working time 15 min, cell temperature was 35.5°C water temperature increased to 31.2°C by (2.606 kWh).

Thus the increase with saline water was by 96.58% the energy produced in the presence of acidic water.

In the presence of lowest efficiency acidic water (28.72%), working time 150 min and distance between cells 1.5 mm.

Efficiency of cells the highest (65.37%) at working time 105 min and distance between cells 0.5 mm with saline water.

REFERENCES

[1]Abdel-Aal, H.K., Zohdy, K.M., Abdel Kareem, M., 2010, Hydrogen Production Using Sea Water Electrolysis, Higher Technological Institute, Tenth of Ramadan City, Egypt. The Open Fuel Cells Journal, 3, 1-7.

[2] Guo, W. L., Li L., Li L. L., Tian, S., Liu S. L., Wu Y. P., 2011, Hydrogen production via electrolysis of aqueous formic acid solutions, Int. J. Hydrogen Energy 36:9415 – 9419.

[3]Haile, M. S., Boysen, A.D., Chisholm, R.I.C., Merle, B., R., 2001, Solid Acids as Fuel Cell Electrolytes. Materials Science, California Institute of Technology, Pasadena, CA, Nature, Vol. 410, pp.910 - 913.

[4]Harrison, K.W., Remick, R., Martin, G.D., Hoskin, A., 2010, Hydrogen Production: Fundamentals and Case Study Summaries Preprint. National Renewable Energy Laboratory A. Hoskin Natural Res. Canada To be presented at the 18th World Hydrogen Energy Conference Essen, Germany May 16-21.

[5] Jyothi1, U. S., Reddy, K. V. K., 2014, The impact on Combustion, Performance and Emissions of CI Diesel Engine using Hydrogen as Dual Fuel Operation-A Review, International Journal of Emerging Technology and Advanced Engineering, Volume 4, Issue 12.

[6]Meddeb, Z., Hajiem, H., Mabrouk, A., Jeday M. R., 2015, A New Industrial Hydrogen Production Process, Green and Sustainable Chemistry,145 – 153.

[7] Mingyong, W., Wang, Z., Guo, Z., Li, Z., 2011, The enhanced electrocatalytic activity and stability of NiW films electrodeposited under super gravity field for hydrogen evolution reaction. Inter J. of Hydrogen Energy (36) 3305-3312.

[8] Nam, J-Y., Kusick, D.R., Kim, Y., Logan, E.B., 2012, Hydrogen Generation in Microbial Reverse-Electrodialysis Electrolysis Cells Using a Heat-Regenerated Salt Solution, Environ. Sci. Technol., 46 (9), pp. 5240–5246

[9]NASA Focusing on the Future, http://www.nasa.gov/missions/science/focus_fuel_cell.html, Accessed on October 20, 2017.

[10]Ogden, J. M., Fulton, L., Sperling, D., 2014, Transition Costs in Perspective. manuscript in preparation. Cited in Ogden, J., Jang, C., Nicholas, M., Fulton, L., 2014, The Hydrogen Transition, A NextSTEPS White Paper, ITSUCTDavis, https://steps.ucdavis.edu/files/08-05-2014-NextSTEPS-White-Paper-Hydrogen-Transition-7.29.2014.pdf, Accessed on December 10, 2017.

[11] Sapountzi, M.F., Gracia, M.J., (Kees-Jan) Weststrate, C. J., Hans, Fredriksson, O.A.H., (Hans)Niemantsverdriet, J.W., 2017, Electrocatalysts for the generation of hydrogen, oxygen and synthesis gas. Progress in Energy and Combustion Science, Vol. 58, pp. 1 – 35

[12]Slama, R.B., 2013, Production of Hydrogen by Electrolysis of Water: Effects of the Electrolyte Type on the Electrolysis Performances. Computational Water, Energy, and Environmental Engineering, Vol. 23, No 2, pp. 54-58.

[13] Song, L.J., Meng, H.M., 2010, Effect of carbon content on Ni–Fe–C electrodes for hydrogen evolution reaction in seawater, Int. J. of Hydrogen Energy, (35), 10060-10066

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

N-3 PUFA-ENRICHED HEMP SEED DIET MODIFIES BENEFICIALLY SOW MILK COMPOSITION AND PIGLETS' PERFORMANCES

Mihaela HĂBEANU[1], Anca GHEORGHE[1], Ioan SURDU[2], Veronica Sanda CHEDEA[1], Nicoleta Aurelia LEFTER[1], Gheorghe STOIAN[3], Andreea-Anne–Mary-Dolores PANAIT[3], Ionuț BEIA[4]

[1]National Institute of Research and Development for Animal Biology and Nutrition, Balotesti. 1, Calea Bucuresti, Ilfov County, 077015, Romania, Emails: mihaela.habeanu@ibna.ro, ankgheorghe10@yahoo.com, chedeaveronica@yahoo.com, ciuca_nicoleta@yahoo.com,
[2]Mountain Economy Centre (Ce-Mont), Romanian Academy, "Costin C. Kiritescu" National Institute of Economic Researches, Bucharest, 050711, Romania, surdu.ioan@gmail.com
[3]University of Bucharest, Faculty of Biology, Department of Biochemistry and Molecular Biology, 91-95 Spl. Independentei, District 5, 050095, Bucharest, Romania, gigistoian2007@yahoo.com, dolores.panait93@gmail.com
[4]University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59, Marasti Boulevard, District 1, Bucharest Cod 011464, Romania, Email: beiaionut@yahoo.com

Corresponding author: mihaela.habeanu@ibna.ro

Abstract

An experiment was conducted to evaluate the dietary hemp seed (HS) influence on sow milk composition and piglets' performances. Ten sows were assigned randomly, to a control group (CL) with classical diets, and an experimental group (HSL) fed with 5% HS. Their litter (N=96) were divided in two groups: HH/CH with 1.5% HS and CC/HC without HS. The HS antioxidant activity was determined by DPPH method, phenolic compound by Folin–Ciocalteu, cannabinoid by colorimetry. Milk and colostrum samples from sow were collected manually. Gas chromatography was used to determine milk fatty acids (FA) composition. Colostrum and sow milk content of protein was determined by biuret reaction and lactose concentration was determined using phosphomolybdenic reagent. The lipid specimen was heated with concentrated sulfuric acid. Then vanillin and phosphoric acid are added to yield a pink coloured product which has been measured at 530 nm and quantified using a triolein standard. Milk yield (MY) was calculated. Average daily gain (ADG) of piglets at 0 to 7 d (days) was higher (P= 0.001) for HC/HH group and tended to be higher for HC/ HH group at 0-21 d. Milk yield calculated at peak lactation was > 2.1-fold in HSL group than in CL group. The diets tend to influence milk fat content, whereas the day had a significantly higher influence for protein and lactose. The n-3-rich diet favours milk deposition of α-linolenic FA (ALA), linoleic FA (LA) and total n-3 polyunsaturated FA (PUFA). This led to a significantly lower n-6:n-3 ratio in milk of HSL group. Docosahexaenoic FA (DHA) increased 1.87 and 2.33-fold at 0-7 d and 0-21 d in HSL group. We can conclude that HS altered beneficially milk FA associated with litter performance. Significantly positively correlated with MY, milk constituents declined in time.

Key words: *hemp seeds, milk composition, milk yield, sows, piglets performances*

INTRODUCTION

The industrial hemp (*Cannabis sativa)* is an ideal source of n-3 and n-6 FA, whose ratio is ideal for health. Although this ingredient has been used for many years, the studies on its physiological effects are limited [8]. The researches show that n-6:n-3 ratios below 2:1 are beneficial to human health [26] [16]. The dietary ingredients rich in essential fatty acids (EFA), are known to improve the survival rate of the new-born piglets and the sow milk production [3]. The milk, as main supplier of nutrients for the piglets in their early days of life [22], plays an essential role in the rate of survival and in the development of the piglets [11]. Fat, lactose, protein and minerals are the major components of the milk. Furthermore, α-linolenic FA (ALA) and linoleic FA (LA) are critical to the formation of tissues and to the regulation of the immune functions [19] [18]. Even though the current scientific information is rather advanced regarding the beneficial effects of the EFA, many gaps still exist in the knowledge about the effect of less and/or unknown dietary resources on the relation between the various production parameters in sows and piglets. This research paper addresses the hypothesis that the dietary hemp seed (HS) could modulate fatty acids (FA) of sow milk composition and the associated performances. The aim of this study was to evaluate sows milk content of protein, lactose, fat and the FA. The protein, fat and lactose value were compared with the theoretical calculated values of these parameters using the experimental evidences from our study and the equations from the literature [12] [30].

MATERIALS AND METHODS

Animal care

The research protocol has been approved by the Ethics Committee within INCDBNA Balotesti. It was developed according to Law 43/2014, Romania, regarding the protection of animals used for scientific purposes. The experiment was carried out in 2016-2017, to experimental station of INCDBNA Balotesti.

Animal and Diet

The experiment was conducted with 96 suckling piglets from 10 multiparous sows Topigs [♀ Large White × Hybrid (Large White × Pietrain) × ♂ Talent, mainly Duroc]. A total of 123 piglets were born, of which 11 stillbirths; another 16 piglets died throughout the experimental period. The lactating sows were assigned randomly for 21 d (days) to two groups: control (CL), which received the classical diets, and experimental (HSL for lactating sows), treated with 5% HS *Jubileu* variety (Table 1).

Table 1. Composition of the experimental diets for pregnant, lactation sow and nursery piglets (as- fed basis)

Items, g kg^{-1}	**Lactating sows**		**Piglets**	
			CL sow	HSL sows
	CL	HSL	CC/HC	HC/HH
Corn	562.5	553.7	648.0	641.2
Rice flour	100.0	100.0	-	-
Jubileu hemp seeds	-	50.0	-	15.0
Soybean meal	180.0	150.0	220.0	215.0
Sunflower meal	100.0	100.0	-	-
Corn gluten	-	-	30	30
Milk replacer	-	-	50	50
Onix oil	16.0	5.0	8.0	5.0
DL-methionine	-	-	0.9	0.9
L-lysine	0.4	0.9	3.1	3.1
Calcium carbonate	19.5	19.4	14.6	14.9
Monocalcium phosphate	5.6	5.0	13.4	12.9
Salt	4.0	4.0	1.0	1.0
Choline premix	2.0	2.0	1.0	1.0
Vitamin-mineral premix $^{(P1+2)}$ ‡	-	-	10.0	10.0
Vitamin-mineral premix $^{(P5+6)}$ ‡	10.0	10.0	-	-
Analysed composition (g kg^{-1})				
Dry matter	895.4	893.9	887.9	890.4
ME (MJ /kg) †	12.76	12.75	13.73	13.74
Crude protein	169.8	170.2	195.9	197.9
Lysine†	8.7	8.7	12.0	12.0
Met + Cys†	6.3	6.3	7.2	7.2
Calcium	9.5	9.6	9.7	9.5
Phosphorus	6.0	6.1	6.5	6.5
Cellulose	63.1	76.9	40.5	43.6
Fat	43.1	46.5	27.5	28.2

† ME and amino acid contents were calculated based on feed composition. Gestation diets were provided in one meal / day; lactation diets were provided in two meals /day.

‡Vitamin mineral premix added at 1% to the diet contained (/kg feed): P1+2: 10000 IU vitamin A; 2000 IU vitamin D3; 30 IU vitamin E; 3 mg vitamin K3; 2 mg vitamin B1; 6 mg vitamin B2; 20 mg vitamin B3; 13.5 mg vitamin B5; 3 mg vitamin B6; 0.06 mg vitamin B7; 0.8 mg vitamin B9; 0.05 mg vitamin B12; 10 mg vitamin C; 30 mg of Mn; 110 mg of Fe; 25 mg Cu; 100 mg Zn; 0.38 mg I; 0.36 mg Se; 0.3 mg Co; 60 mg antioxidant. Vitamin mineral premix P5+6: 9000 IU vitamin A; 1500 IU vitamin D3; 50 IU vitamin E; 2 mg vitamin K3; 1.5 mg vitamin B1; 5.2 mg vitamin B2; 15 mg vitamin B3; 8.1 mg vitamin B5; 2 mg vitamin B6; 0.10 mg vitamin B7; 0.5 mg vitamin B9; 0.03 mg vitamin B12; 39 mg of Mn; 100 mg of Fe; 15 mg Cu; 100 mg Zn; 0.3 mg I; 0.22 mg Se; 0.25 mg Co; 60 mg antioxidant

Source: compound feed formula calculated, Mihaela Habeanu, INCDBNA Balotesti

The piglets from the two groups of sows were assigned randomly to two groups, so that every sow group had two litter groups (with and without HS dietary addition, Fig 1).

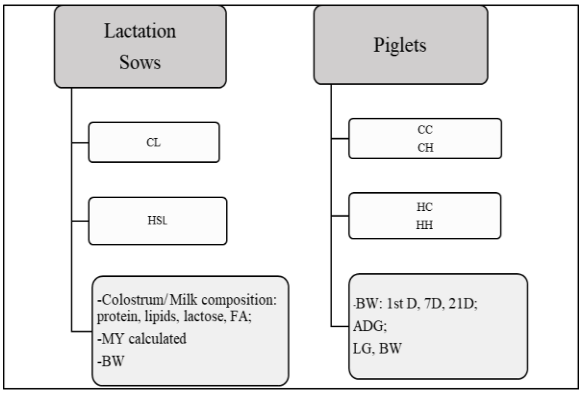


Fig. 1. Experimental design
Source: original, Habeanu protocol

The piglets were kept within the same litter after farrowing (AF). The HS was ground and screened through 8 mm mash sieves and analysed chemically. Ten day AF piglets started to receive pelleted feed *ad libitum.*

Assay Procedures and Analyses

In the first day AF (within the interval of ~ 12h), at 7 d and 21 d AF, the sows milk samples were collected. At 114 d of pregnancy, the sows received intramuscularly 1 mL D-cloprostenol (75µg active substance /mL), so as to farrow as a group. The sows had free access to the pelleted diets, and the leftovers were recorded on a daily basis. Piglets were weighed at 1^{st}, 7 d and 21 d AF.

Standardized methods, as per Commission Regulation (EC) no. 152 (2009), were used to determine the gross chemical composition. Crude protein was determined by the Kjeldal method, on the basis of the nitrogen content. The crude fat was determined by continuous extraction in organic solvents followed by fat measurement with Soxhlet, after solvent removal. The crude fibre was determined with a classical semiautomatic Fibertec-Tecator method. The metabolisable energy (ME) was calculated using the regression equations developed by the „Oskar Kellner” Institute of Animal Nutrition:

$$ME = 5.01 \times DP + 8.93\ EE + 3.44\ CF + 4.08\ DNFE.$$

The antioxidant activity of the HS was determined by the DPPH method according to Arnous et al. [2] with slight modifications. The polyphenols from HS were extracted in acetone 80%, ethanol and boiled water (1:7 w/v sample: solvent ratio) for 24 hours at 37^{o}C under continuous shaking according to the previous study [4]. The total phenolic compound of the extract was determined by the Folin–Ciocalteu method, adapted to a microscale, after method described by Arnous et al. [2]. The results were expressed as gallic acid equivalents (GAE)/L. The cannabinoid content was determined by the colorimetric method, which consists of a colour scale, with grades from 1 to 10, corresponding to 0 – 1.0% THC content.

Milk and colostrum samples from sow were collected manually, according to the method described by Noblet and Etienne [21]. The samples were stored at -80^{o}C until assayed, to inactivate different constitutive enzymes and avoid biochemical markers alteration or hydrolysis. On 7 and 21 d of lactation, piglets were separated for two hours from the sow, after the morning suckling, and milk samples were collected. After about 70 min. the sows were injected with 10 IU oxytocin (Veyx-Pharma, Germany) in the auricular vein, after which they were milked by hand. Milk was collected from all functional mammary glands.

The milk composition (protein, fat and lactose)

The lipid concentration was determined using the method described previously by Knight et al. [17], Al-Mashhedy et al. [1]. In this procedure, the lipid specimen was heated with concentrated sulfuric acid. Then vanillin and phosphoric acid are added to yield a pink coloured product which has been measured at 530 nm and quantified using a triolein standard. Colostrum and sow milk content of protein was determined by biuret reaction. Prior to the protein determination, the colostrum and milk was defatted by centrifuging samples upside down in a tightly sealed polypropylene tube at 3000 g and at 4°C for 15 minutes. Biuret reagent containing 18 mmol disodium ethylenediaminetetraacetate, 15 mmol Cu^{2+}, and 1 mol of NaOH per litre was prepared as described by Chromy and Ficher [5] and Chromy et al. [6]. A sample of 50 µL defatted milk was mixed with 1,000 µL of the biuret reagent at room temperature and the absorbance was read at 550 nm after 30 minutes taking into account the interference due by the abundant presence of lactose. Further, milk and colostrum lactose concentration was determined using phosphomolybdenic reagent essentially described by Hindin [15] using lactose 1% as standard.

The fatty acids composition of colostrum, milk, HS and diets were determined by gas chromatography using a Perkin Elmer-Clarus 500 gas chromatograph (Massachusetts, United States), fitted with Flame Ionization Detector (FID) and capillary separation column with high polar stationary phase Agilent J&WGC Columns, (United States), DB-23 dimensions 60m × 0.250 mm × 0.25 µm. The FA were identified by comparison with blank chromatograms and were subsequently determined quantitatively as percent of total FAME. SUPELCO 37 component FAME Mix was used; 10 mg/ml as standard solution of methylated FAs and also Soybean Oil and Sunflower Oil; SUPELCO, as reference material was used. We used hydrogen as carrier gas and the air oxygen as burning gas, method described by Hăbeanu et al. [13].

Statistical analyses and calculation

All experimental results obtained were submitted to variance analysis using by SPSS - general linear model (Statistics version 20, 2011). The response to the dietary treatment was variable dependent, and the diet and/or sampling day were fixed factors. The results were expressed as mean value and standard error of the mean (SEM). Pearson's correlation (r) was used to evaluate the linear dependence between different parameters. We used the Equation (Eq.) described by Hansen et al., [12], Wood [30] to calculate milk yield (MY):

MY(t) = a x tb x exp (c x t)

where:

MY(t) = milk yield , t = time AF;

a, b, c, = coefficients described by Woods, [30].

RESULTS AND DISCUSSIONS

Results

Hempseed and diet characteristics

Characterized by higher protein quality, free of trypsin inhibitors and highly digestible compared to other vegetal sources [14] hemp is a plant with valuable potential for livestock. The proximate analysis of HS *Jubileu* used in our study was*:* 89.67% dry matter: 21.26% protein, 27.70% fat; 28.82% cellulose. HS had the THC content of 0.0139%, lower than that noticed by EFSA Regulation [27]. The total polyphenols content was 10.57 ± 0.12g GAE/ 1kg seed (or 2.93 mg GAE / g oil) compared to 0.44 mg GAE/g oil noticed by Yu et al. [29] in the cold-pressed HS oil extract. The antioxidant activity expressed as antiradical activity was 83.58 ± 2.36 mM TE (trolox equivalents)/g seeds.

The FA composition of the HS, reveals the predominance of PUFA (72.58%) and n-6:n-3 PUFA ratio of 3.19. ALA, as predominant n-3 FA, had a concentration of 17.06%, LA belonging to n-6 family, had a concentration of 53.79%, the oleic FA as main monounsaturated FA (MUFA) had a level of 14.46%, and the main saturated (SAT) FA, palmitic FA was 7.18%. The favourable FA composition of the HS reflected in the diet (Table 2).

The 5% dietary HS given to HSL lactating sows increased 1.61 times ALA concentration in the diet, 1.01 times LA concentration, while reducing 1.52 times n-6:n-3 ratio compared to CL group. In piglets, 1.5% dietary HS given to groups CH/HH, increased 1.40 times ALA concentration, while decreasing 1.52 times n-6:n-3 ratio compared to CC/HC feed group.

The sows had an average body weight 213 Kg ± 38 AF. The average compound feeds intake during lactation was closed between groups: CL sows had an average daily feed intake (ADFI) of 5.16 Kg, while the sows with HS in the compound feed consumed 5.57 Kg/day. The daily intake of protein and fat was calculated from the daily feed intake and from the protein and fat feed level.

Table 2. Centesimal FA composition of diets

Fatty acids†, % of total FAME	Sow		Piglets	
	CL	HSL	CC/HC	CH/ HH
C14:0	0.24	0.21	0.54	0.51
C16:0	15.02	14.09	12.99	12.81
C16:1	0.21	0.23	0.11	0.22
C18:0	2.43	2.41	2.93	2.82
C18:1n-9	31.99	29.41	26.86	25.52
C18:2n-6 (LA)	44.96	45.53	51.63	50.76
C18:3n-3 (ALA)	3.8	6.12	3.83	5.37
C18:4n-3	0.49	0.54	-	0.35
C20:0	-	0.71	-	0.44
C20:2n-6	0.51	0.42	0.23	0.24
C20:3n-6	0.08	0.05	-	-
C20:3n-3	0.06	-	-	-
C20:4n-6	0.22	0.04	-	-
Σ PUFA	50.12	52.7	55.68	56.73
Σ n-6	45.77	46.04	51.86	51.01
Σ n-3	4.35	6.66	3.83	5.73
n-6:n:3	10.52	6.91	13.55	8.9
Σ MUFA	32.2	29.64	26.97	25.71
Σ SAT	17.69	17.57	17.35	17.53

†ALA –α-linolenic FA; LA – Linoleic FA; PUFA – polyunsaturated FA; MUFA – monounsaturated FA.
Source: analyses made in the Chemistry Lab, INCDBNA

Throughout the lactation period, the sows had the following daily intakes of protein and fat: group CL consumed 876 g protein and 222 g fat, while the group treated with HS consumed 948 g protein and 259 g fat.

Table 3 shows litter performance. The average LS was 10 in HSL sows group, and 9.25 in CL sows group. The average initial BW of the piglets was similar among the groups, but after 7 d a significant increase was noticed in group from HS sows compared to piglets from C sows (>1.18 times). After 21 d we noticed a tendency the treatment had significantly effect. Piglets ADG 7 d AF was greater in HC/HH group (1.17-fold higher than in the sows group with no HS treatment, P = 0.001), whereas to 21 d tended to be greater ($P < 0.10$) for HC/ HH group. Litter weight did not differ significantly between groups (1.18 higher in HC/HH group than in CC/CH group); however, the day's effect was very significant irrespective of the treatment.

Calculated MY and lactation curve

MY was calculated according to Eq. described by Hansen et al. [12] for 7 d up to 21 d (Table 4). MY was 1.13-fold higher in HSL group compared to CL group. In our study, the MY values were similar to those reported by Hansen et al. [12] in case of HS dietary addition, while in the group fed classically they were 15.6% lower than the data reported by Hansen et al. [12]. While the MY minimum value was similar between the two groups, the MY maximum value was higher in the group with dietary HS addition. The mean MY at peak lactation was 8.58 Kg (<7% than value of Hansen et al. [12] 11% than value reported by Daza & Centeno [7].

Table 3. Body weight and average daily gain of the nursery piglets

Items†	CL		*Mean*	HSL		*Mean*	*SEM*	*P- value*
	CC	CH		HC	HH			
BW 1th AF, Kg	1.36	1.68	*1.52*	1.61	1.45	*1.53*	*0.05*	*T*
BW 7 d, Kg	2.19	2.58	*2.39*	2.95	2.67	*2.81*	*0.07*	**
BW 21 d, Kg	4.73	5.38	*5.08*	5.53	5.45	*5.49*	*0.11*	*T*
ADG 7 d, Kg	0.119	0.129	*0.124*	0.188	0.175	*0.181*	*0.006*	**
ADG 21 d, Kg	0.161	0.177	*0.169*	0.187	0.191	*0.189*	*0.004*	*T*
Total born			*11.75*			*12.0*		
LS§	8.5	10	*9.25*	10	10	*10.0*		
LG (diet effect)			*1.46*			*1.90*	*0.10*	*NS*
LW, 7 d			*22.18*			*27.98*	*3.06*	*NS*
LW, 21 d			*47.06*			*54.92*	*4.75*	*NS*

† Diet of piglets were classical (CC and HC - piglets from sows fed with and without HS) and 1.5% HS supplementation (CH and HH – piglets from sows fed with and without HS dietary addition) ; ADG average daily gain; litter weight LW; litter gain LG; litter size LS.
**Highly significant effect; NS not significant; T = trend that the treatment has effect;
Source: Results of *in vivo* biological test, Habeanu

The results were used to plot the sow lactation curve (Figure 2). In our study, MY increased up to 19-20 d, when the peak of lactation occurred, then declined.

Milk composition

The composition of colostrum, transition milk and mature milk are different. The comparison between values calculated and determined through analyses are shown in Table 5. While protein values analysed are higher than the calculated ones, whatever the treatment or day, both for fat and lactose the evaluated values are lower. The treatment tend to influence milk fat content (P = 0.06), whereas the day had a significantly higher influence for protein and lactose milk content. By dietary addition of the HS the recorded values were higher than those of CL group.

Table 4. Milk yield calculated by theoretical Eq. The effect of the dietary treatment and day, %

Group†	MY	MY at peak lactation (Kg)	MY at 7 d	MY at 21 d
CL	7.35	7.98	7.04	7.95
HSL	8.31	9.17	7.82	9.09

† Diets of sow were classical (CL) and 5% HS supplementation (HCL).
Source: date calculated using regression Eq, Habeanu & Surdu

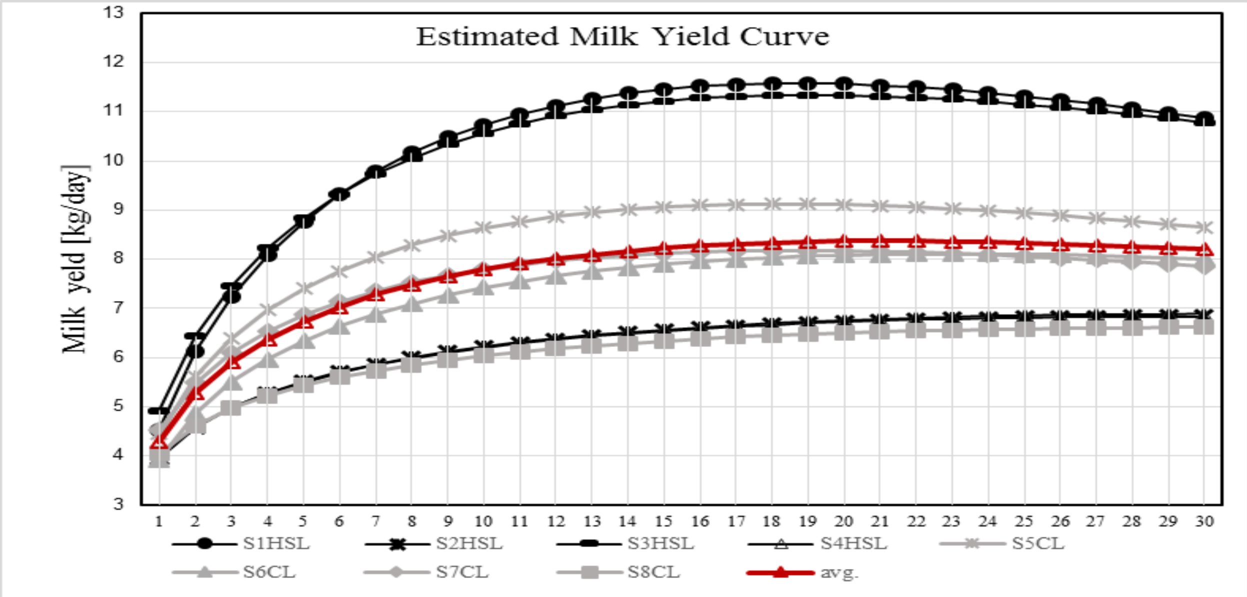


Fig. 2. Estimation milk yield curve.
Lactation curve estimated for a period of 30 days, using the Eq. of Hansen *et al*., (2012). Each line represents a sow. Milk yield reach the peak between 19-20 d.
†HSL – lactation hemp seed group; CL – lactation control group.
Source: original, MY curve calculated, Habeanu & Surdu

Table 6 shows the centesimal sow milk and colostrum FA composition. The dietary addition of HS in lactating sows diets improved milk EFA composition. In our study, the dietary EFA composition differed according to the source of dietary lipids, which was reflected in milk composition. Thus, significant differences were noticed for ALA and LA as predominant EFA. While LA content slightly increased following the HS treatment, both at 7 d and at 21 d, these n-6 FA decreased slightly compared to CL group. On the other hand, ALA increased highly significantly both in colostrum and milk, following the HS treatment (1.29-fold in the colostrum, and 1.58-fold in the milk at 7 d and 1.47-fold at 21 d).

The higher ALA concentration, like in the diet, produced a significantly higher level of n-3 FA and, implicitly, a lower n-6:n-3, at 21 d, to the same proportion as in the diet. One must also notice the much higher level of milk docosahexaenoic (DHA) in HSL group (1.87-fold at 7 d and 2.33-fold at 21 d), the differences were not, however, significantly. In line with the hypothesis that ALA is ingested by the piglets via milk [25] another long-chain FA, EPA was noticed in low proportions in the colostrum and in the milk collected at 7 d, only from group HSL which

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

supports the conclusion of Sampels et al. [25] that eicosapentaenoic (EPA) too is transferred via milk, and probably synthesized from ALA.

Table 5. Comparative milk content as effect of the dietary treatment and day, %

Items	CL		HSL		*P value*	
	Mean value				Diet	Day
	Calculated †	Evaluated	Calculated†	Evaluated		
Protein					0.94	<0.0001
12h AF		9.06		8.99		
7D	5.42	5.73	5.42	6.06		
21D	5.0	5.36	5.0	5.48		
Fat					0.06^{T}	0.68
12h AF		6.01		6.94		
7D7	7.71	6.03	7.71	6.43		
21D	6.8	5.9	6.8	6.26		
Lactose					0.97	<0.0001
12h AF		2.74		2.72		
7D7	5.47	4.75	5.47	4.70		
21D	5.33	4.52	5.33	4.35		

†Milk content of protein, lipids and lactose were calculated using Hansen *et al.*, (2012) equation

Source: analyses made at University of Bucharest, Panait, Stoian, Gheorghe, Lefter; Estimated values, Habeanu

Table 6. Fatty acids composition of the colostrum/milk (1st AF, 7 d, 21 d) due to the dietary *Jubileu* hemp seeds treatment

% FA of total FAME†	Colostrum		Milk				*SEM*	*P value*‡
	CL	HSL	CL	HSL	CL	HSL		
	1th AF		7-D AF		21-D AF			
C16:0	19.83	20.12	27.32	33.14	31.49	31.20	*1.316*	**
16-1	3.17	3.28	8.85	11.07	7.59	10.93	*0.784*	***
C17:0	0.49	0.47	0.18	0.21	0.15	0.11	*0.038*	*NS*
C17-1	0.17	0.22	0.20	0.22	0.12	0.15	*0.016*	*NS*
C18:0	4.05	3.88	4.01	4.04	3.66	2.72	*0.129*	*NS*
C18:1n-9 *cis*	29.41	28.26	31.84	22.71	23.97	21.18	*0.861*	**
C18:1n-7 *cis*	1.40	0.65	0.87	0.51	0.49	0.40	*0.161*	*NS*
C18:2n-6 (LA)	34.24	34.95	18.95	18.60	24.34	23.02	*1.689*	***
C20:0	0.23	0.39	0.21	0.23	0.02	0.23	*0.030*	**
C18:3n-3 (ALA)	1.73	2.24	1.20	1.90	1.72	2.52	*0.100*	***
CLA	0.08	0.08	0.06	0.12	0.00	0.09	*0.017*	*NS*
C18:4n-3	0.08	0.01	0.11	0.05	0.14	0.10	*0.170*	*NS*
C20:2n-6	0.09	0.09	0.39	0.11	0.16	0.16	*0.030*	*NS*
C20:3n-6	0.42	0.44	0.14	0.14	-	-	*0.048*	*NS*
C22:1n-9	0.18	0.27	0.04	0.04	-	0.05	*0.029*	*NS*
C20:3n-3	1.00	1.18	0.00	0.07	0.06	0.05	*0.127*	*NS*
C20:4n-6	0.04	0.04	0.71	0.49	0.50	0.45	*0.063*	*NS*
C22:2n-6	0.18	0.20	0.07	0.16	0.05	0.11	*0.026*	NS
C20:5n-3 (EPA)	-	0.02	-	0.01	-	-	*0.006*	NS
C22:4n-6	-	-	-	0.03	0.14	0.16	*0.014*	NS
C22:6n-3 (DHA)	-	-	0.31	0.58	0.15	0.35	*0.054*	NS
∑SFA	27.31	27.54	35.93	42.71	40.20	39.57	*1.511*	*
∑MUFA	34.47	32.89	42.00	34.90	32.51	33.24	*0.788*	*
∑PUFA	37.86	39.29	21.96	22.25	27.25	27.04	*1.781*	NS
∑n-6	35.05	35.82	20.33	19.64	25.18	24.01	*1.661*	NS
∑n-3	2.81	3.46	1.63	2.61	2.06	3.03	*0.162*	**
n-6/n-3	12.66	10.38	12.72	7.56	12.28	8.07	*0.497*	***

†FAME – fatty acids ester methyl; SFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, Polyunsaturated fatty acids;
∑ SFA : C4:0 C6:0+C8:0+ C10:0+ C12:0+ C14:0 + C15:0 + C16:0 + C17:0 + C18:0+ C20:0+ C23:0+C24:0;
∑ MUFA: C14:1+C15:1+ C16:1 + 17:1 + Total cis C18:1 + C20:1 n-9;
∑ PUFA: C18:2n-6 + 18:3n-3 + C18:4 n-3 + CLA + C20:2n-6 + C20:3n-6 +C20:3n-3 + C20:4n-6 + C22:2n-6 + C20:5n-3 +C22:3n-6 + C22:4 n-6 + C22:5 n-3 + C22:6n-3.
‡ NS (P > 0.10), T (P < 0.10), *P < 0.05, **P < 0.01, ***P < 0.001

Source: analyses in Chemistry Lab, INCDBNA, statistic calculation Habeanu

The trend was not similar regarding the time of sampling colostrum/milk for ALA assessment, n-6:n-3 ratio (P>0.05); however, the level of n-3 FA has been influenced significantly by time. The dietary HS induced a significant change of the total SAT and MUFA FA (ΣSFA and ΣMUFA). Predominant among the SFA, was the palmitic acid, whose concentration increased significantly in the colostrum and milk at 7 d and decreased at 21 d in the HS group compared to CL group. The oleic FA (C18:1n-9 *cis)* decreased significantly in HSL group, both in the colostrum and milk.

Discussions

The industrial hemp, with low content of delta-9-tetrahydrocannabinoid (THC, need not to exceed 0.2 %), was accepted to be cultivated in European Union countries [23]. Until 1990, Romania ranked third worldwide in terms of hemp production. Efforts have been made in the recent years to improve the crops and make them suitable for animal feeding. *Jubileu* cultivar, obtained by SCDA Secuieni, Romania, has been approved in 2012 for use as oil and seed crop (900 – 1,200 kg seeds /ha). The quantity and composition of the milk are factors responsible for development of the piglets. The lipid content of diets, as important source of EFA, is essential for obtaining a positive response on health and growth. Results from this study showed that n-3 FA rich diet using HS alter beneficially sow milk composition and litter's performance. The lactating sows treated with HS consumed 8.2% more protein and 16.6% more fat than the control group due to LS that higher as well. It is know that lipid supplementation increases secretion of the milk fat [24], which means a higher level of energy (>1.05 times), protein (> 1.03 times) and fat (>1.02 times) provided to piglets. Furthermore, milk intake of the litter increased gradually during the lactation period and the quantity of nutrient intake depends on MY. Previous studies revealed the relation between the amount of dietary fat and piglet gain [18]. In our study, although the dietary fat level was close, the piglets fed HS, particularly those born by HSL sows, had a stronger development than the piglets born by CL sows and treated with the conventional diet. During the first 7 d after birth, the piglets receive all the required nutrients from the colostrum / milk they suckle, thus the average BW and ADG depending on the treatment applied to the sows. It is generally acknowledged that the heavier piglets and the first to be born have a rapid access to the teats [9] [10] and might thus have a higher intake, which is reflected in their weight gain. From our previous observations, the heavier piglets switch faster to solid food than the lighter piglets.

MY is variable among sows because of multiple factors, such as genetic factors (the MY heritability was estimated at 0.32) [10], nutrition, management, environment [28]. Starting from the model developed by Noblet & Etienne [21], with its limits, and based on the literature, Hansen et al. [12] developed a hierarchical Bayesian model for MY. The data obtained in our trial were included in the regression Eq. described by Hansen et al. [12] Wood [30]. In our study, MY increased up to 19-20 d, when the peak of lactation occurred, then declined; however, a slight increase was noticed in certain sows, MY being correlated with LS and LG. MY enhanced the growth of piglets. For sows with higher MY, LS and LG this finding was close to previous studies [20] [7], were MY appeared to reach the peak between 15-21 d, compared to 19-20 d in our study. When MY was lower, the peak was few days later, which influenced the general mean of peak lactation days. A significantly positive correlation (r=0.93) was noticed between MY and LG, this parameter being included in the Eq. used, which confirms the results of Vadmand et al. [28]. Milk composition, fat particularly, depends on feeding. The rapid changes in the composition of the fluids secreted by the mammary gland influence piglet development. Our results confirm that both MY and its nutrients (protein, fat, lactose) registered a decline starting 20 d AF. In consequence, for further development of the piglets it is better to wean starting with 21 d despite the fact that the enzymatic equipment is underdevelopment. Moreover, as we showed in a previous study that weaning induces an increase of 26%

serum cortisol and 6% Se. By formulating an appropriate diet we could avoid the negative effects of the earlier weaning even more so as after about a week the cortisol value are close to those prior to weaning.

Previous researches [24] [25] showed that little attention has been paid to n-3 FA requirement in sow feeding. Fat is more than energy source, is an EFA source depending on the plants added in the diet. As far as we know, there is no data in the literature regarding the sow milk/colostrum FA composition following HS treatment. In sow colostrum / milk, the chain length is between 4 and 22 carbons. Due to some confusion and regulation, the researches on HS nutritional potential for animals, were not as attractive as another plants known by their EFA rich content and nutritional and health implications. Milk ALA and LA concentration reflected the differences of these FA transferred via sow diet. While colostrum concentration of total n-6 PUFAs of HSL fed group was 2.14% higher than in the CL fed group, the milk level of n-6 PUFAs HSL fed group was lower than in CL group both at 7 d and 21 d. The concentration of n-3 PUFAs was significantly different in colostrum/ milk from HSL sow group. The long chain FA (DHA) increased slowly in HSL group. This registered value led to o significant decrease of n-6:n-3 ratio in the colostrum and milk. This aspect is essential for health. This ratio must be improved to reach the ideal of 5:1 recommended. Higher than 10:1 ratio has adverse health effects. Since similar data on the composition of human milk have been published previously, the results of our study can be the support for further studies on humans and for understanding the correlation with other parameters of reference for the health state.

CONCLUSIONS

The dietary addition of HS influenced in a positive way the milk protein and fat content, due to a higher intake of these nutrients. The sampling day had a significantly higher influence for protein and lactose milk content. The evaluated protein values were slightly higher than the calculated theoretical, whatever the treatment or day, both for fat and lactose the evaluated values were lower. The dietary HS as rich n-3 PUFA vegetable source changed beneficially the FA composition of the sow milk. The quality of the dietary fat had positive effects on animal performance, improving LG and LW. The lactation curve, MY implicitly, changes depending on LG and LS. Significantly positively correlated with MY, milk constituents also changed in time. The results suggested that the HS could be considered a valuable vegetable source due to its beneficial effect on lactating multiparous sows and their litter.

ACKNOWLEDGEMENTS

This work was supported by funds from the National Research Project ADER 6.1.1 granted by the Ministry of Agricultural and Rural Development, Romania. Partial support for this study (reagents) was provided by Romanian Ministry of Research and Innovation, Grant PN16410101.

REFERENCES

[1]Al-Mashhedy L.A.M., Jubran, A.S., Sadaam, N., 2015, The comparasion between human, cows, and sheep milk. WJPR 2015, 4 (11): 130-134.
[2]Arnous, A., Makris, D., Kefalas, P., 2001, Effect of principal polyphenolic components in relation to antioxidant characteristics of aged red wines. J. Agric. Food Chem. 2001, 49: 5736–5742.
[3]Bontempo, V., Jiang, X.R., 2015, The gestating and lactating sow. Editor Chantal Farmer, 2015 p. 452. https://doi: http://dx.doi.org/10.3920/9.
[4]Chedea, V.S., Pelmus, R.S., Cismileanu, A.E., Pistol, G.C., Palade, L.M., Taranu, I., 2016, Total Polyphenols Content, Antioxidant Activity and Stability of a Grape Pomace Incorporated in Animal Feed. Scientific Paper Animal Sciences and Biotechnoloigy 2016; 49 (1): 1-5.
[5]Chromy, V, Fischer, J., 1977, Photometric determination of total protein in lipemic sera. Clin Chem 1977, 23: 754-756.
[6]Chromy, V., Fischer, J., Kulhanek, V., 1974, Re-evaluation of EDTA-chelated biuret reagent. Clin Chem 1974, 20: 1362-1363.
[7]Daza, A.J., Centeno, C. R., 2004, Changes in the composition of sows' milk between days 5 to 26 of lactation. Span J Agric Res 2004, 2 (3): 333-336.
[8]Delfin, R.L., Pierce, N.G., 2010, The cardiac and haemostatic effects of dietary hempseed. Nutr

Metabolism 2010, 7:32.
[9]Dividich, J., Rooke, J.A., Herpin, P., 2005, Nutritional and immunological importance of colostrum for the new-born pig. J Agric Sci 2005; 143: 469-485.
[10]Eliasson, C., Isberg, S., 2011, Production and composition of sow milk. Available from: http://stud.epsilon.slu.se, Accessed De cember 10, 2017.
[11] Farmer, C., 2013, Review: Mammary development in swine: effects of hormonal status, nutrition and management. Can J. Anim Sci 2013, 93: 1-7.
[12] Hansen, A.V., Strathe, A.B., Kebreab, E., France, J., Theil, P.K., 2012, Predicting milk yield and composition in lactating sows: A Bayesian approach. J Anim Sci 2012, 90: 2285–2298.
[13] Hăbeanu, M,, Tabuc, C., Gheorghe, A., Ropota, M., Dumitru, M., Călin, L., Mihalcea, T., Palade, M., 2016, Preliminary study on the interrelation between sow milk quality and litter performance in relation to their health. Animal Science Series: Lucrări Ştiinţifice - Seria Zootehnie 2016, 66: 35-40.
[14]Hemp Oil Canada Inc. Nutritional composition, 2001, http://www.hempoilcan.com. Accessed December 2, 2017.
[15]Hindin, E., 1953, Determination of Lactose in Dairy Wastes. Sewage Ind Wastes 1953, 25:188-190.
[16]Husted, K.S., Bouzinova, E.V., 2016, The importance of n-6/n-3 fatty acids ratio in the major depressive disorder. Medicine 2016, 52:139-147.
[17]Knight, J.A., Anderson, S., Rawle, J.M., 1972, Chemical Basis of the Sulfo-phospho-vanillin reaction for estimating total serum lipids. Clin Chem 1972, 18 (3): 199-202.
[18]Mateo, R.D., Carroll, J.A., Hyun, Y., Smith, S., Kim, S.W., 2009, Effect of dietary supplementation of n-3 fatty acids and elevated concentrations of dietary protein on the performance of sows. J Anim Sci 2009, 87: 948-959.
[19] Muskiet, F.A.J., Fokkema, M.R., Schaafsma, A., Boersma, E.R., Crawford, M.A., 2004, Is decahexaenoic acid (DHA) essential? Lessons from DHA status regulation, our ancient diet, epidemiology and randomized controlled trials. J Nutr 2004, 134:183–186.
[20] Nielsen, T.T., Trottier, N.L., Stein, H.H., Bellaver, C., Easter, R,A., 2002, The effect of litter size and day of lactation on amino acid uptake by the porcine mammary glands. J Anim Sci 2002, 80: 402-2411.
[21] Noblet, J., Etienne, M., 1989, Estimation of Sow Milk Nutrient Output. J Anim Sci 1989, 67 (12): 3352-3359.
[22]Novotni-Dankó, G., Balogh, P., Huzsvai, L., Györi, Z., 2015, Effect of feeding liquid milk supplement on litter performances and on sow back-fat thickness change during the suckling period. Arch Anim Breed 2015, 58: 229–235.
[23]Official Journal of the European Union. Council Regulation (Ec) No. 1782/2003/2008.
[24] Rosero, D.S., Odle, J., Mendoza, S.M., Boyd, R.D., Fellner, V., Van Heugten, E., 2015, Impact of dietary lipids on sow milk composition and balance of essential fatty acids during lactation in prolific sows1. J Anim Sci 2015, 93: 2935–2947.
[25] Sampels, S., Pickova, J., Högberg, A., Neil, M., 2011, Fatty acids transfer from sow to piglets for different polyunsaturated fatty acids (PUFA). Physiol Res 2011, 60: 113-124.
[26]Simopoulos, A.P., 2002, The importance of the ratio of omega-6/omega-3 essential fatty acids. Biomed & Pharmacother 2002, 56:365-379.
[27]The European Food Safety Authority (EFSA), 2015, Scientific Opinion on the risks for human health related to the presence of tetrahydrocannabinol (THC) in milk and other food of animal origin. EFSA Panel on Contaminants in the Food Chain (CONTAM). 2015; 13(6): 4141.
[28]Vadmand, C.N., Krogh, U., Hansen, C.F., Theil, P.K., 2015, Impact of sow and litter characteristics on colostrum yield, time for onset of lactation, and milk yield of sows. J Anim Sci 2015, 93: 2488–2500.
[29]Yu, P., McKinnon, J.J., Christensen, D.A., 2005, Improving the nutritional value of oat hulls for ruminant animals with pretreatment of a multienzyme cocktail: in vitro studies. J Anim Sci 2005, 83(5): 1133-1141.
[30]Wood, P.D.P., 1967, Algebric model of the lactation curve in cattle. Nature 1967. 216: 164–165.

THE USE OF CERAMIC BLOCKS OF BRICK AS A COMPLEX MATERIAL IN THE EXECUTION OF A BUILDING

Adelaida Cristina HONȚUȘ

University of Agronomical Sciences and Veterinary Medicine - Bucharest, Faculty of Management, Economical Engineering in Agriculture and Rural Developments, 59, Mărăşti Boulevard, no.1 Sector, Bucharest, cod 011464, Romania, E-mail: adelaidahontus@yahoo.com

Corresponding author: adelaidahontus@yahoo.com

Abstract

The purpose of this paper is to present and maintain that the use of bricks, by brick ceramic blocks as a building material, is still the best option to have a durable and durable house. I have presented both the advantages and drawbacks of using ceramic blocks in the execution of buildings. As a method of research, we presented the technological method of execution of masonry blocks in ceramic blocks and the method of realization of ceramic blocks. The building material, its quality, how it is used, and the cost of each construction material are very important in the execution of a home. We can say that a brick house can last for over 150 years. The lifetime of a brick house is high and the maintenance costs are very low. Even if we see that most old homes have used full brick, it is not as resistant as the Porotherm ceramic blocks. The technology through which they are made is far more advanced than what was available in the past. Ceramic brick blocks are baked at particularly high temperatures and robotic formats with a high degree of precision. Thus, although they have air inlets for better thermal insulation, they are particularly resistant to compression. The field of brick production is constantly evolving. Increasing demands on structural properties and economic issues lead to product differentiation and specialization. For these reasons, we conducted this study on all aspects, both technical, technological, and economic, regarding ceramic brick blocks.

Key words: *ceramic brick blocks, maintenance, thermal insulation, strength, stability, elasticity*

INTRODUCTION

Contemporary architecture requires timeless construction materials that have proven their properties for thousands of years. Ceramic brick and tile have kept pace with the times and trends, while being innovative and modern.

Brick ceramic blocks, like ceramic roof tiles, are designed for durable houses in harmony with the surrounding environment. They have clay in their composition and are then burned in furnaces between (800-1,000) ° C. Ceramic materials can be recycled, taking care of the environment.

Whether we relate to a home that we already have, or we want to build a dream house step by step, there are finally a few important things to keep in mind: the quality of construction materials that ensure a healthy indoor climate and the optimal thermal comfort for you and your family. [2] Buildings built with ceramic blocks and having a ceramic roof represent and have always represented a high quality of living and living space. [4] Brick remains the most beloved building material by both Romanians and Europeans. Every year, according to statistics, over two million new homes in Europe are built of brick. This represents 60% of all new houses and apartments. There are peoples who still use almost all the brick constructions, such as the Italians, the French and the Spanish, who rarely make a home from another material. Even if a brick house is built with more weight. [2]

Brick is undoubtedly the most complete building material - in terms of aesthetic value, diversity, structural properties and economic and ecological aspects. [5] People have intrigued the qualities of bricks, starting to use them from ancient times for construction and today famous.

As Daniel Stoica said in his book, "The durability of the old masonry is explained by the ductility of the lime mortar, which compensates for the churn of the elastic bricks. Due to ductility, masonry is capable of

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

self-protection in time." [5]

Besides the beautiful appearance of the building or of the house and the roof, a home is truly spectacular if it is durable, energy efficient and if each architectural innovation of the component brings a benefit to the client living inside it. Porotherm bricks are so versatile that they can meet even the most demanding requirements, eventually creating a truly spectacular home. [3]

MATERIALS AND METHODS

In this paper, it was used as a material, the brick, which is one of the most used building materials used in the execution of a building. As a research method, I have presented the technological method of execution of masonry brick blocks, the method of making ceramic blocks, as well as the advantages and disadvantages of this constructive material. Presentation of certain specific technical features, helps the beneficiary in choosing the building material for the execution of his own house. It is obvious that each beneficiary chooses the building material, depending on the material possibilities, the time he has for the execution of a home and his own aesthetic opinion regarding the building's realization. The building material, its quality, how it is used, and the cost of each construction material are very important in the execution of a home.

RESULTS AND DISCUSSIONS

Advantages of brick-built houses

The construction of a brick-built building can be left in red or gray.

The construction of a brick-built building can be left "to red" or "to gray".

Brick houses resist much better weather even when they are not finished. That's why they can be started this year and completed in the next 2-3 years, depending on the possibilities. This is one of the most important advantages of brick houses.

A brick house may remain in the "to red" or "to gray" phase, for long, compared to houses that are made of other construction materials. [6] The only mandatory condition, in order not to deteriorate, is that the building is plastered externally to prevent any infiltration of water between the wall joints. It is also advisable to build the roof.

In general, most beneficiaries prefer to raise their homes in the autumn, with labor and materials being cheaper; to let the winter "to red", which is plastered and the roof made, and in the spring to take up phase "to gray" for summer to complete phase including "turnkey".

Ideal is to build the house "to gray" in the autumn and leave it for at least 4 months, so that the concrete can be perfectly strengthened and the house "sit". Thus, the beneficiary will have the guarantee that the finishes will not degrade over time (cracks, infiltrations, molds, etc.).

Brick is a material that guarantees very good sound insulation. This leads to increased comfort.

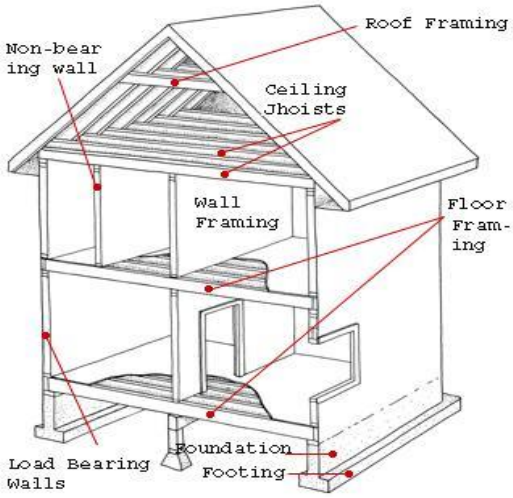


Fig. 1. Structure of a building
The legend: Roof framing, Wall framing, Floor framing, Ceiling joists, Non-bearing wall, Load bearing walls, Foundation, Footing
Source:
https://instalatiipentruconstructii.wordpress.com [10]

Earthquake safety

The masonry of ceramic blocks can be used even in areas with high seismicity. [6] As with other building materials, the type of masonry structure and building configuration must be carefully selected to support the requirements of a high seismic activity area. Ceramic masonry blocks have strong mechanical properties and make a good socket with masonry mortar, which leads to a high degree of earthquake safety. [8]

Fig. 2. Structure of Porotherm ceramic blocks
Source: www.constructii-neamt.ro [11]

The masonry of ceramic blocks can be used even in areas with high seismicity. [6] As with other building materials, the type of masonry structure and building configuration must be carefully selected to support the requirements of a high seismic activity area. Ceramic masonry blocks have strong mechanical properties and make a good socket with masonry mortar, which leads to a high degree of earthquake safety. [8]

Fire protection

Bricks are classified as "non-flammable". Non-flammable construction materials reduce the likelihood of being destroyed. That also means I'm immune to fire. The bricks have already passed through the fire in the manufacturing process. In case of fire, the brick does not fire, it is baking.

Soundproofing

Sound insulation measures are required to protect a room from outside noise or from neighbors. The spread of air, impact and noise structure should be minimized. Solid exterior walls, built of ceramic bricks, are characterized by a special value of sound insulation. Ceramic brick walls and ceilings ensure a quiet living without tiring noises inside or outside the building.

Thermal insulation

Brick and its thermal properties

The thermal insulation properties of the bricks are generated by their porosity resulting from the manufacturing technology. A mixture of clay and fine slices is formed. Bricks are formed, dried and burnt at 1,000 ° C. When the sawdust is completely burnt, the pores remain once again filled with air and have the thermal insulation properties. [8] The porosity of ceramic blocks and a good design of the entire system reduce heat loss.

Brick is a good heat-retainer: a brick wall absorbs natural energy from the sun and at the same time preserves the heat emanating from the inside. This heat is resumed inside, even after a long period of time. Brick houses do not cool quickly in the winter and also remain cool during the summer.

Strength and structural stability. Porotherm ceramic blocks are in a large variety of compressive strengths. [6] This is a measure of monitoring and quality control, which leads to the safety of owners and architects.

Brick structures have tremendous stability. Compared with other building materials for masonry, ceramic blocks are also favorable for constructions in areas with high seismicity. High mechanical strength and a strong bond between the ceramic block and mortar ensure maximum safety. [8]

There is already a special ceramic blocks system on the market for areas with high earthquake risk.

The comfort of the ceramic brick blocks

Due to the shape of the voids and the porosity, the exterior bricks reach tremendous thermal insulation values.

A brick wall can absorb the natural energy from the sun and at the same time keep the heat emanating from the house. The brick wall releases the absorbed heat later in the house. [3] This saves heat - temperature fluctuations are balanced by the absorption and release of heat - in the winter the house remains warm and the summer keeps cold.

The brick absorbs the moisture from the inside and frees it quickly outwards. This means that the wall surface remains dry in any season and thus ensures a particularly pleasant climate in the room. [7]

Of particular importance for thermal comfort is the temperature at the surface of the wall: a lower wall temperature than that in the room leads to an uncomfortable climate. The extraordinary thermal properties of the exterior brick lead to a thermal balance in the interior and thus the comfort is superior.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Long life

Brick has always been the first choice for someone who wants a home with pleasant ambience, safety and comfort, now and over many years. [2]

Brick is a material with a lifetime above average compared to other building materials: such as the bricks made of brick during the Romans and the Renaissance and Gothic churches.

A solid brick structure, combined with an appropriate quality, requires minimal maintenance.

All the properties of a brick masonry are maintained for a long time.

The economy of using ceramic blocks in brick, in the construction of houses

Choosing construction material has a small influence on the total cost of the house but is decisive for its quality. With Porotherm blocks, you choose an economical construction system from all points of view, which offers the highest quality and value. With the Porotherm block system you have a short construction time due to the low consumption of materials (mortar, for example). A solid masonry requires low maintenance costs. [1] Thermal protection also saves costs. The life and sales value of a ceramic building block leads to a secure investment for several generations. The walls of the ceramic blocks are economical and durable.

The durability of ceramic blocks in time

Environmental analyst Peter Tappler said: "Ceramic clay blocks are natural and healthy, they are able to breathe, keep the heat and optimally balance the humidity and temperature of the air in the room. In short: clay blocks ensure a climate healthy and pleasant inside the rooms."

The decision to build a house can be a brave step for each of us. There are many views on the choice of ceramic blocks versus other building materials, but the decision belongs to everyone according to their expectations and financial possibilities. To choose a good, robust construction material, you need to have the correct information that will help you better understand what is the most suitable building material for your home.

Building clay materials are able to regulate and protect you naturally from moisture. Thus, the ceramic blocks contribute to the indoor air quality. In addition, houses built with ceramic blocks do not emit any pollutant or allergen in the air you breathe in your home. [4] Studies show that all brick houses generate considerably lower emissions than other buildings with other building materials. Emissions values for Volatile Organic Compounds (VOCs), which are sometimes responsible for the growing number of allergies, are not detectable in building materials based on clay. [7]

Energy efficiency and thermal balance inside the house, due to the use of ceramic blocks in brick

Due to the combination of ceramic blocks and clay consistency, bricks have qualities that other building materials do not have, that is, they isolate the building against the cold and store the heat inside it. This prevents rapid winter cooling and protects against overheating during the summer. [5] This is done without additional thermal insulation on the facade or air conditioning and ventilation systems. Thus, they contribute to a significant reduction in energy demand for heating or cooling. In conclusion, it offers you the full thermal comfort you need, that is energy efficiency and thermal balance inside the house.

Ceramic blocks are environmentally friendly materials.

All clay building materials are durable and environmentally friendly - a ceramic blocks building can have a lifetime of more than 100 years. They are made of natural raw materials (earth, water, air, fire). Moreover, due to the very long lifetime, the initial impact of the material on the environment is very low. Ceramic products generate lower greenhouse gas emissions during the production phase than concrete products sold on the EU market. Values for ceramic products vary between 46 and 75 kg of CO_2/m^3, while values for concrete and AAC products vary between 85 and 120 kg CO_2/m^3. [9]

Clay building materials should not be treated with chemicals to obtain protection against fire or moisture. To improve the quality of products, only additives that are tested on a large scale eco-friendly are in harmony with humans and nature. [4]

The bricks can provide you with sound insulation. Brick masonry has very good sound insulation properties. The thicker the wall, the lower the noise both from the outside and from the inside.

Other advantages offered by ceramic blocks.

Ceramic blocks are robust, stable and safe even for multi-storey buildings.

Due to their mechanical strength and stability, the walls of ceramic blocks also protect against earthquakes.

They are flame-retardant, being framed at the best fire reaction class.

In addition, the construction has reduced maintenance costs over the lifetime, as ceramic blocks can withstand severe shocks and tensions.

So using state-of-the-art technology and the expertise of the best specialists in the field, Porotherm ceramic blocks are modern solutions with specifications tailored to environmental and climate conditions, according to the building regulations of our country.

We can say that investing in a ceramic masonry construction gives the beneficiary the guarantee of a home where future generations will live in a healthy and safe environment.

Disadvantages of brick houses

As in any real-life situation, there are disadvantages for brick houses, which we will expose below in an attempt to create a more objective image of this type of house.

The disadvantages of a brick house are given by the low thermal comfort, high construction costs and a longer construction period. The "red" cost of the house is given 70% of building materials and 30% of work. [1] Since the cost of materials is the main cost element, the realization of the house in its own direction cannot cause a significant decrease in the final price.

Execution time is high. Brick houses are built heavier than wooden ones, for example, roughly one year. [2]

Houses made of bricks require special foundations. Loads transmitted by the superstructure are large, and in the case of brick houses a complex calculation is required for the foundations dimensioning.

Brick houses have low thermal insulation. Unless an exterior insulation is used, the costs of energy or heating fuel during the cold period will be raised.

The construction of the masonry can be done in several ways, depending on the need of the structure to be able to take over all the forces that could damage the structural bearing system. Depending on the building gauge, there may be a mandatory requirement to place brickwork in a certain way, this method contributing to the load bearing capacity of the masonry wall. The methods of realization are varied and can be easily combined, the joints being able to be along or adjacent to the plane of the wall. [3]

In order to ensure brick masonry full of monolithic content, the bonding of joints is used, so when building the masonry it is necessary to respect the bonding of the joints in the neighboring rows. [6]

When masonry walls are used, the mortar is used as the bonding material.

Mortars used in construction are well homogenized mixtures of binder, water and small aggregate.

Some additives such as: plasticizers, pigments, waterproofing substances, sinks, hydraulic substances, etc. may also be used in the preparation of mortars.

By nature of the binder, the usual mortars are: lime, cement, plaster, clayey; after compressive strength, the mortars may have the following marks: M4, M10, M25, M50, M100 (figures indicating the minimum compressive strength at 28 days, in N/cm^2). At mortar M4, resistance is determined at 90 days and must be 49 daN/cm^2. [2]

A correct design is required to avoid breaking the masonry in any plane, especially the masonry that is part of the assembly of the structural elements that make up the resistance structure.

CONCLUSIONS

After that presented in the paper, we can draw the following conclusions:

-Clay ceramic blocks are suited to building a sustainable home
-Brick, as a building material, ensures a healthy climate within your home
-Ceramic blocks ensure energy efficiency and thermal balance inside the house
-Ceramic blocks are environmentally friendly materials and support the environment
-Bricks can provide you with very good sound insulation
-Load bearing walls in ceramic blocks, have mechanical strength and high stability, protecting the house also in case of earthquakes
-Houses built with ceramic brick blocks offer the thermal comfort required by the beneficiary, namely energy efficiency and thermal balance inside the house

The final decision, however, remains at the discretion of each beneficiary who, depending on personal priorities, aesthetic tastes and last but not least financial choices, chooses construction materials for the execution of his own home.

Pottery blocks Porotherm should be part of any green building strategy. All dwellings, no matter where we are talking about blocks of flats or houses on their own, should meet the challenges of the future. In addition to the beautiful appearance of the building, a home must be sustainable, energy-efficient, so that every architectural innovation in its composition can bring a benefit to the owner living inside it. Porotherm bricks are so versatile that they can meet even the most demanding requirements of a customer.

REFERENCES

[1] Honțuș Adelaida Cristina, 2015, Building a house - between traditional materials and patented organic materials, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 15, Issue 3, pp. 167-172
[2]Honțuș Adelaida Cristina, 2014, Comparative study on the choice of building materials for constructing a house, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 14, Issue 4, pp. 117-125
[3]Honțuș Adelaida Cristina, 2014, Agrotouristic Building - the Second edition revised and enlarged", Ceres Publishing, Bucharest. pp.172-209
[4]Stan Daniel, 2004, Constructions and Environment, Matrix Rom Publishing House, Bucharest, pp.190-201, pp. 227
[5] Stoica Daniel, 2015, Structures in masonry. Modern Issues and Solutions, Matrix Rom Publishing House, Bucharest, pp. 23-45
[6]Stoica Daniel, 2014, Civil engineering. Modern Issues and Solutions, Matrix Rom Publishing House, Bucharest, pp.78-89
[7]Suman, R., Ghibu, M., Gheorghiu, N., Oana, C., Oţel, A., 1988, Modern Technologies in Construction, Technical Publishing House, Bucharest, pp. 68-85
[8]Şerban Liliana, 1998, Building Materials, Matrix Rom Publishing House, Bucharest, pp. 58-76
[9]STAS 1963-73. Material resistance. Terminology and symbols
[10]Installations for buildings (in Romanian), https://instalatiipentruconstructii.wordpress.com, Accessed January 10, 2018
[11]Neamt Costructios, Usefulinformatio about buildings materials (Constructii Neamt, Informatii utile despre materiale de constructii), www.constructii-neamt.ro, Accessed January 10, 2018.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IMPACT OF MUNICIPAL WASTE ON THE HYDROCHEMISTRY OF EPE LAGOON, SOUTH WESTERN, NIGERIA

Toyosi Fadekemi IGEJONGBO, Eunice Oluwayemisi ADEPARUSI, Ayokanmi Adekunle DADA

Federal University of Technology Akure, Department of Fisheries and Aquaculture Technology, PMB 704, Nigeria, Phone: +2348065693483, Emails: toyosi.adeyemi@yahoo.com, eoadeparusi@futa.edu.ng, aadada@futa.edu.ng

Corresponding author: toyosi.adeyemi@yahoo.com

Abstract

This study investigates the impact of municipal waste on the physicochemical parameters of Epe Lagoon. Three stations were chosen where a lot of human activities take place. The samples were collected from surface water at 10cm depth for 12 consecutive months in duplicates between August 2014 – August 2015. pH, dissolve oxygen, conductivity, total dissolve solids, salinity, temperature, turbidity, dissolved oxygen and the biological oxygen demand were measured. The pH measurement was highest in March with mean value of 7.9±0.17, a rainning month and lowest in October, a dry month with mean value of 6.1±1.21 The mean dissolved oxygen value was 7.17±0.67 mg/l. The annual mean salinity value was 0.08 ppt. The water turbidity was highest in March with mean value of 68.3±3.15 mg/l and lowest in the month of June with mean value of 47 ±1.21 mg/l. The mean nitrate value was 1.31±0.07 ppm. The mean value of alkalinity was 58.34±0.67 mg/l and that of phosphate was 7.52±0.67 mg/l. Conductivity mean values ranged from 76.94 ±5.35 uhoms/cm^{-1}in the month of November to the highest in the month of June with a value of 94.87 ±1.39 uhoms/cm^{-}. In this study BOD mean value was 1.84±0.67 mg/l . Regulatory bodies should spring into action to control the dumping of munincipal waste along the course of the lagoon so as to prevent the extinction of aquatic life in the water boody.

Key words: *Epe Lagoon, municipal, physicochemical parameters, pollution*

INTRODUCTION

The society produces garbage and solid waste every day, the disposal of these wastes into the water pollutes it. Pollution in a water body is a global problem. Diverse use of water are limited and impaired due to pollution. Pollution affects migratory patterns, natural reproductive processes and fish behaviour [12]. [16] attributed water quality problems in Africa to urbanization processes, high birth rate, and industrial development like mining, petroleum extraction, refining, transportation, agricultural practices and the chief source of water pollution as sewage. Nigerian waters are highly polluted by human activities in and around the water thus affecting its chemical and physical properties and systematically destroying the community by disrupting the delicate food web [14]. [2] reported that knowledge of the physicochemical regime of a water body is of great value as it helps to determine biological productivity and it is useful to the entire state or nation. Water quality deterioration usually comes from excessive nutrient input, eutrophication, acidification and organic pollution. The disposal of waste and domestic sewage leads to contamination of the river, lakes or lagoon chronologically affecting its flora and fauna and this is detrimental to human and animal health and safety [13]. Hence, there is a challenge of providing water in adequate quantity and of required quality to reduce hazards to human health and to conserve the water bodies and their environment. Since the physical and chemical parts of aquatic environment are very important factors affecting the biological life in the aquatic system, adequate knowledge of this in relation to aquatic life is necessary [10]. Epe lagoon supports a major fishery in Lagos State, Nigeria. It is also used as a transportation route for people, goods and timber logs from

Epe to other places in South-Western Nigeria. Over the years the population of Epe and other villages along the bank of the lagoon has increased through expanding commercial activities due to its closeness to metropolitan cities of Lagos State. This has led to the abuse of the environment especially as there are no modern sanitary and waste treatment facilities in most of the settlements. Human faeces and other domestic waste are deposited in the lagoon indiscriminately. This study will access the water quality of the lagoon using selected physicochemical parameters for monitoring and to track changes resulting from the impacts of human activities.

MATERIALS AND METHODS

Study Area

Epe lagoon ($2^0$50'- $4^0$10'N, $5^0$30'-$5^0$40'E) has a surface area of 243 km^2. The lagoon has an average depth of about 1.80 m and is sandwiched between Lekki lagoon (freshwater) to the east and Lagos lagoon (brackish) to the west (Figure 1).

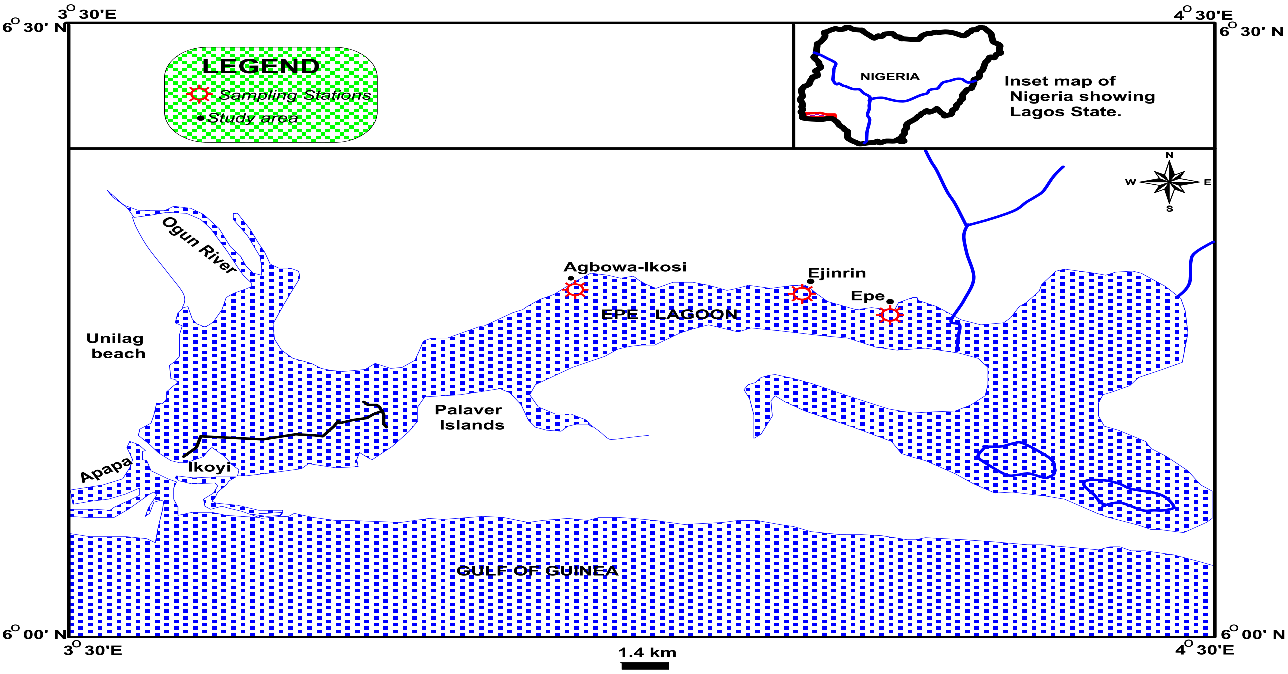


Fig.1:Map of Epe Lagoon showing the study areas.

Fig.1. Epe Lagoon map showing the study area.
Source: Field Survey (August, 2014 – July, 2015

Sample Collection and Analysis

Duplicate water samples were collected from the randomly selected sampling stations of Epe, Ejirin and Ikosi. The sites chosen were at the main market axis of the stations where a lot of human activities such as washing, bathing and fish landing takes place, they were chosen to reflect the municipal activities around the lagoon that will affect its water quality. The samples were collected from surface water of 10cm depth for 12 consecutive months between August 2014 – August 2015. pH, conductivity, total dissolve solids, salinity and temperature were determined using the Ezodo combined meter (Model PCT- 407). Turbidity was determined according to EPA method 180.1 using Portable Turbidimeter, Model 2100P (Cat.No, 46500-88). The dissolved oxygen was measured *in-situ* by a portable digital dissolve oxygen meter (Jenway model 9071). The Biological Oxygen Demand was an empirical determination of O_2 required to oxidize the organic matter in water sample during an incubation period of 5 days at 20^0C. The DO was measured at the beginning and end of the incubation period. BOD = (Initial DO –Final DO) mgl^{-1}. Spectrophotometer (Jenway 6405 uv/vis) was used to determine the Nitrate level while Nitrite was determined *in-situ* using a portable battery operated Spectrophotometer (HACH model). Spectrophotometer (Jenway 6405 uv/vis) was used to determine the phosphate level. *Ex-situ* analysis of carbonate and hydroxide was used to determine alkalinity by titration with standard acid to pH about 8.3, the end point was detected using phenophthalin indicator. Data collected from the study were subjected to descriptive statistical analysis. Analysis of Variance (One-Way), Means, standard deviation and standard error.

RESULTS AND DISCUSSIONS

The mean dissolved oxygen value was 7.17±0.67 mg/l. Of all the three sampling sites Ejirin had the highest disolved oxygen mean value of 7.35±0.15 mg/l and Agbowa-Ikosi had the lowest mean value of 7.07±0.87 mg/l (Fig.2).

The annual mean salinity value was 0.08 ppt. Ejirin had the highest disolved oxygen mean value of 7.03±1.04 next to Epe which had a mean value of 6.97 ±0.65 and Agbowa-Ikosi had the lowest 6.95±0.98.

The pH measurement was highest in March with mean value of 7.9±0.17 which is a rainning month and lowest in October which is a dry month with mean value of 6.1±1.21 (Fig. 4).

The water turbidity was highest in March with mean value of 68.3±3.15 mg/l and lowest in the month of June with mean value of 47 ±1.21 mg/l. The mean turbidity value was 68.04±0.67 mg/l (Fig. 5).

Table 1. Mean Values of the Physicochemical Parameters of the Epe Lagoon. (August, 2014 – July 2016)

	DO	Temp	pH	Salinity	Turbidity	Nitrate	Alkalinity	Phosphate	Conductivity	BOD
Epe	7.09	27.07	6.97	0.04	57.31	1.33	56.21	7.72	77.69	1.60
Ejirin	7.35	27.36	7.03	0.08	57.94	1.30	59.00	7.38	75.85	2.09
Agbowa	7.07	26.95	6.95	0.10	58.86	1.31	59.80	7.45	86.08	1.76
Mean	7.17	27.13	6.98	0.13	58.04	1.31	58.34	7.52	79.87	1.82
SEM	0.129	0.107	0.071	0.00	0.95733	0.029	0.797	0.122	1.592	0.120
Unit	ppm	^oC		Ppt	uhoms/cm	ppm	ppm	Ppm	ppm	ppm

Source: Field Survey (August, 2014 – July, 2015).

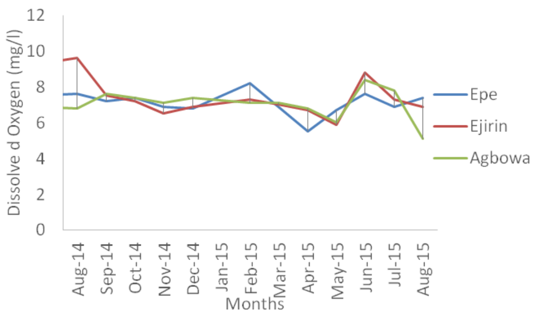


Fig. 2. Monthly Variations of Dissolved oxygen (ppm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015

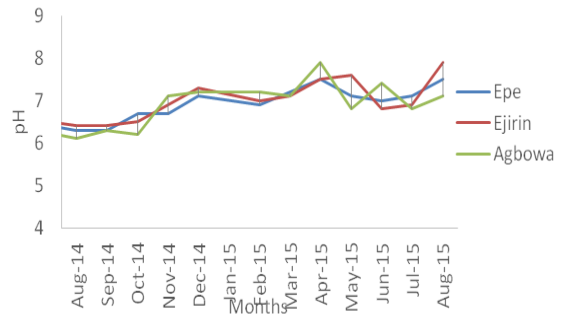


Fig. 4. Monthly Variations of pH level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015

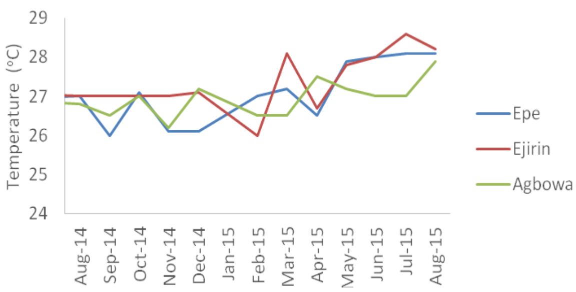


Fig. 3. Monthly Variations of Temperature (^oC) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015

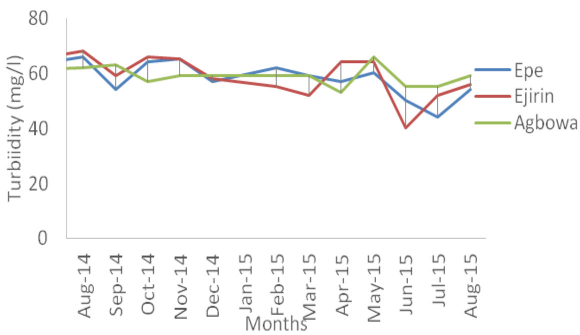


Fig. 5. Monthly Variations of Turbidity (ppm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015

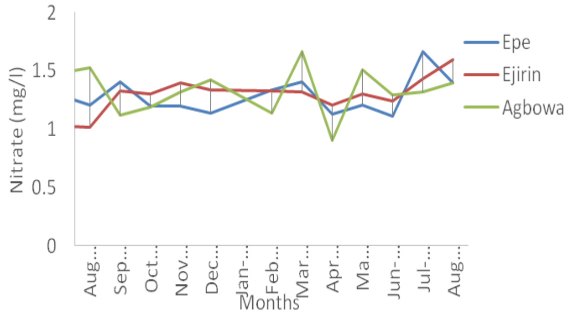


Fig. 6. Monthly Variations of Nitrate (mg/l) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

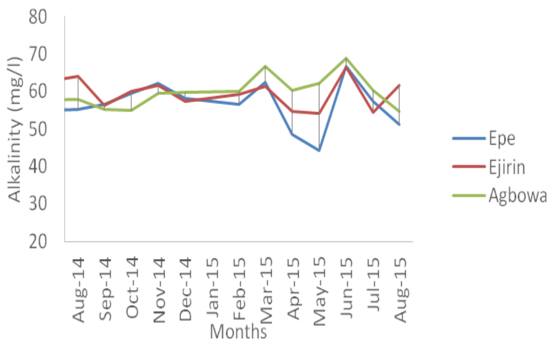


Fig.7.Monthly Variations of Alkalinity (ppm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

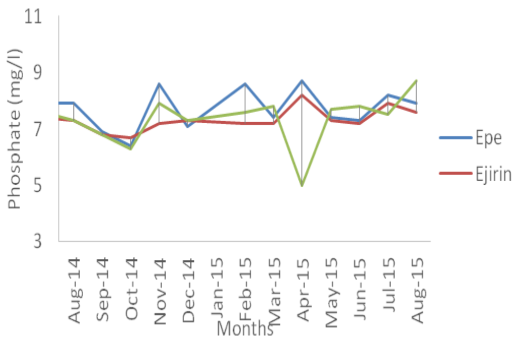


Fig. 8.Monthly Variations of Phosphate (ppm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

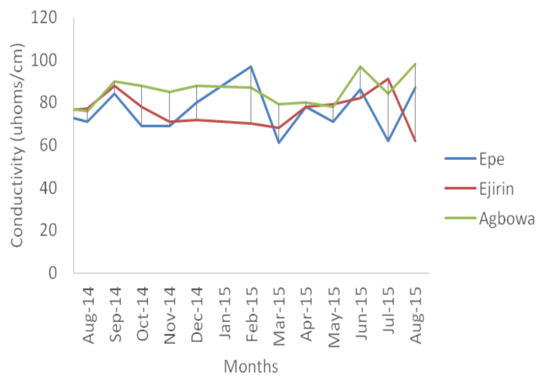


Fig. 9. Variations of Conductivity (uhoms/cm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

Fig. 10.Monthly Variations of BOD (mg/l) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

The nitrate value was highest in the dry month of Feburary with mean value of 1.79 ±0.06 ppm and lowest in April with mean value of 0.9±0.11 ppm. The mean nitrate value was 1.31±0.07 ppm (Fig. 6).

The mean value of alkalinity was 58.34±0.67 mg/l and that of phosphate was 7.52±0.67 mg/l. Conductivity mean values ranged from 76.94 ±5.35 uhoms/cm^{-1}in the month of November to the highest value of 94.87 ±1.39 uhoms/cm^{-1} in the month of June (Fig.9).

In this study mean values of BOD ranged from the least of 0.55 ±0.03 mg/l in the month of December to the highest in the month of June with a value of 3.5 ±0.39 mg/l. The mean value was 1.84±0.67 mg/l (Fig.10).

The mean dissolved oxygen value was 7.17±0.67 mg/l which is just slightly below [7] recommendation of 8-10 mg/. Of all the three sampling sites Ejirin had the highest disolved oxygen mean value of 7.35±0.15 mg/l. Agbowa Ikosi had the lowest mean value of 7.07±0.87 mg/l (Fig. 2). These values are good pointers to the productivity of these water bodies and to the fact that they can accommodate diverse organisms. [9] reported that dissolve oxygen for optimum performance in fish is >4. Dissolve oxygen is defined as the measure of the amount of gaseous oxygen dissoled in an aqueous solution [5]. It is an important indicator of the productivity and ecological status of a water. Although the concentration of dissolved oxygen generally decrease as temperature of water increases [6] from this study dissolve oxygen and temperature increased simultaneously during the months of June and July.

pH is the negative logarithm of hydrogen ion concentration. This value is an indication of the acidity or alkalinity of a solution [3]. Ejirin had the highest pH mean value of 7.03±1.04 which could be as a result of high solubility of ammonia from waste which is often caused by phytoplankton bloom. Epe had a mean pH value of 6.97 ±0.65 while Agbowa-Ikosi had the lowest 6.95±0.98. This is within the recommended range of 6.0-9.0 by the Federal Ministry of Environment*. The pH measurement was highest in March with mean value of 7.9±0.17 which is a rainning month and lowest in October which is a dry month with mean value of 6.1±1.21.

Salinity is seen as a strong normalizing factor in the aquatic ecosystems. Salinity values are influenced by evaporation, precipitation and river inflow [11]. The annual mean salinity value was 0.08 ppt. This is similar to the result reported by Jimoh *et al.,* (2011). This confirmed that the lagoon is relatively fresh and stable from season to season. This freshness could be due to the its being sandwiched between two water bodies: Lekki Lagoon and River Oshun which might override the possible salinity effect of the Lagos Lagoon. The freshness could also be due to heavy rainfall during the period of the study. The water turbidity was highest in March with mean value of 68.3±3.15 mg/l and lowest in the month of June with mean value of 47 ±1.21 mg/l. These values were slightly higher than the WHO limit. This might be as a result of decomposition of organic matter from domestic waste input. Turbidity is the measure of the ability of water to transmit the light that restricts light penetration and limit photosynthesis [12].

The nitrate value was highest in the dry month of Feburary with mean value of 1.79 ±0.06 ppm and lowest in April with mean value of 0.9±0.11 ppm. The mean nitrate value was 1.31±0.07 ppm. Of all the three sampling sites Epe had the highest nitrate mean value of 1.33 ±0.15 ppm and Ejirin had the lowest mean value of 1.30±0.02 ppm. [10] in the study of Agboyi creek in Lagos State recorded nitrate value of 3.62 ± 0.45 ppm which exceeded the recommended limit by World Health Organisation for drinking and bathing hence the need for FEPA intervention. Effect of human activities are seen in the nitrite, nitrate and sulphate concentrations. Nitrate is thought to be produced by autotrophic nitrobacter combining oxygen with nitrite in the bioconveter [6]. Sulphate is the main nutrient for algae and higher values could lead to eutrophication. Phosphate mean values ranged from 6.94 ±0.15 mg/l in the month of December to the highest in the month of April with a value of 8.87 ±1.37 mg/l. The mean value was 7.52±0.67 mg/l. Of all the three sampling sites Epe had the highest phosphate mean value of 7.72 ±1.16 mg/l and Ejirin had the lowest mean value of 6.38 ±1.24 mg/l. There was no significant difference ($P > 0.05$) among the three sampling sites in Epe lagoon. Higher phosphate was observed during the raining season, this is the peak of agricultural activities. Washing of cow dung and washing with phosphate based detergent could also be responsible for the high values in phosphate. Sulphate is a major culprit in eutrophication and this could pose threat to fish production, destroy food web and decrease biodiversity [8]

Conductivity mean values ranged from 76.94 ±5.35 uhoms/cm^{-1}in the month of November to the highest in the month of June with a value of 94.87 ±1.39 uhoms/cm^{-1}. The mean value was 79.84±2.67 uhoms/cm^{-1}. Of all the three sampling sites Agbowa Ikosi had the highest alkalinity mean value of 86.08 ±1.16 uhoms/cm^{-1} and Ejirin had the lowest mean value of 75.85 ±1.84 uhoms/cm^{-1} . Conductivity recorded in the wet season might be due to increase in the concentration of cations such as calcium, magnesium and sulphate during the rains. Conductivity is based on the capcity of water to conduct current. The more the ions in the water the more the conductivity [1]. [15] reported that conductivity can be used as an indication of primary productivity and thus fish production. The values for Conductivity reported in Epe lagoon compares favorably well with results of [2] for Ikere gorge, Ibadan, Nigeria. Biochemical Oxygen Demand is the measure of total dissolve oxygen consumed by microorganisms for biodegradation of organic matter. [4] reported that a BOD level above 5 mg/l is an indication of water pollution. In this study BOD mean values ranged from 0.55 ±0.03 mg/l in the month of December to the highest in the month of June with a value of 3.5 ±0.39 mg/l. The mean value was 1.84±0.67 mg/l. Of all the three sampling sites Ejirin had the highest BOD mean value of 2.69 ±1.16 mg/l and Epe had the lowest mean value of 1.60 ± 0.04 mg/l. These values are within FEPA values.

CONCLUSIONS

Most of the measured parameters, except turbidity, were within FEPA permissible range and WHO standards. However, it is interesting to note that most of the values were at the brink of the permissible limits and almost exceeding it. Presently the water supports aquatic life but if the input of munincipal waste is not curbed, it will make the lagoon highly polluted and render the water unfit for aquatic life. However, to sustain the ecological status of the lagoon, waste management through recycling and reuse should be encouraged. Regulatory bodies should spring into action to control the dumping of munincipal wastes along the course of the lagoon so as to prevent the extinction of aquatic life.

REFERENCES

[1]Ademoroti, C.M.A., 1996, Standard Methods for Water and Effluent Analysis, Foludex Press Limited, Ibadan, Nigeria,182 pp.
[2]Adeosun, F. I., 2007, Bioecology of fish fauna of Ikere Gorge, Ibadan Nigeria, Ph. D Thesis, University of Agriculture, Abeokuta Nigeria. 178pp
[3]Bhatnagar, A., Devi, P., 2013, Water quality guidelines for the management of pond fish culture. Int. J. Environ. Sci. 3(6): 1980-2009.
[4]Clerk, R. B., 1996, Marine Pollution, Clarandon Press, Oxford, 256 pp.
[5]Dhavran, A., Karu, S., 2002, Pig Dung as Pond Manure: Effect on Water Quality Pond Productively and Growth of Carps in Poly Culture System. The International Centre for Living Aquatic Resources Management (ICLARM) Quarterly, Manila 25 (1):1-14
[6]Eze, V. C., Ogbaran, I. O., 2010, Microbiological and Physicochemical Characteristics of Fish Pond Water in Ughelli, Delta State. Inter. J. of Current Research. 8: 082-087.
[7]FEPA., 1991, Guidelines and Standard for Environmental Pollution Control. Federal Environmental Protection – Agency, 27, 20.
[8] Hanson, M.A., Buttler, M.G., 1994, Responses to food web manipulation in shallow waterfowl lake. Hydrobiologia, 280 :457-466.
[9]Jimoh, A.A., Clarke, E.O., Whenu, O.O., Adeoye H.B., 2011, Food and feeding Habits of the African River Prawn (Macrobrachium vollenhovenii) in Epe Lagoon, South Western Nigeria. Int. J. Fish. Aquac., 3: 10 -15.
[10]Olawusi-Peters, O.O., 2008, Ecological evaluation of the effects of anthropogenic activities on sustainable fish production in Agboyi creek, Lagos State, Ph.D thesis, University of Ibadan. 167pp
[11] Oniye, J. S., Adebote, D. E., Usma, S. K., Makpo, J. K., 2002, Some aspect of the biology of Protopterus annectens in Jachi Dam near Katsina, Katsina State Nigeria. Journal of Fisheries and Aquatic Science, 1(2):136 – 141.
[12] Onuoha,G.U.C., Deekae, S.N, 2005, Effect of oil pollution on Fish Production, Proceedings of the Fisheries Society of Nigeria, p 112 (edited by Araoye, P. and Omoniyi, I.T.).
[13]Sangodoyin, A.Y. 1991, Groundwater and Surface Water Pollution by Open Refuse Dump in Ibadan, Nigeria. J. of Discovery and Innovations, 3(1) 24-31.
[14]Sideni, M.T., Fakio, A.L.T., Maria, C.R., Francises, A.E., Adaunto, F. 1992, Seasonal variation of some limnological factors of Lagoa does Guarana, a Varzea lake of the Rio Paranana State of Mato Groso do Sul, Brazil. Rev. Hydrobiologia 25(4): 269-276.
[15] Verhuest, L., 1997, Obtaining Basic Information for the Enhancement of small Water Body Fisheries. A Regional Project Viewpoint. Acquatic Resources Management Programme for Local Communities. ALCOM/FAO. Harare, Zimbabwe p 22.
[16]Yab, H.T., 2005, Marine Environmental Problems: Experiences of Developing regions, Marine Pollution Bulletin, 25(1-4): 37- 40.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ASSESSMENT OF CLIMATIC PARAMETERS DURING THE VEGETATION PERIOD IN TERMS OF EFFICIENCY OF GROWING OF ENERGY PLANTS IN SLOVAKIA REGIONS

Marián KOTRLA, Martin PRČÍK

Slovak University of Agriculture in Nitra, Faculty of European Studies and Regional Development, Tr. Andreja Hlinku 2, 949 76 Nitra, Slovak Republic, Phone: + 421 (37) 6415613, Emails: marian.kotrla@gmail.com, martin.prcik@uniag.sk

Corresponding author: marian.kotrla@gmail.com

Abstract

Reliable identification of realistic biomass at regional level is particularly important in creating a real energy strategy. It must stand for the region in particular in the long-term aspect of its sustainable development. The aim of the paper is to identify and quantify environmental impacts, especially microclimatic impacts, on the possibility of establishing and growing economically and energy-efficient plantations of fast-growing energy plants in Slovakia regions. The NUTS III methodology was used to locate the climatic conditions of the Slovakia regions. Climatic factors in Slovakia regions were expressed as average monthly air temperatures and average monthly precipitation for the vegetation period from April to October. The climatic parameters of the model plantation in the Nitra region were defined on the basis of measurements of the Physicus Meteostation, located in the field conditions of Koliňany village. Regions in the southern and south-eastern regions of Slovakia (Bratislava, Trnava, Nitra, Košice) are the most climatic friendly for the growing Mustanthus and Populus. The Northern regions (Žilina and Prešov) are less suitable for climatic reasons - the shorter length of vegetation period required for the economically efficient production of above-ground biomass. In the Nitra region, productivity in real climatic conditions is 33.66 t.ha^{-1} (Miscanthus) and 135.14 t.ha^{-1} (Populus).

Key words: *climatic parameters, region, Slovakia, production, energy plants*

INTRODUCTION

Global problems caused by climate change and energy security have significantly increased interest in renewable energy, including energy crops in different regions. In addition, economic assessments have confirmed that the cultivation of energy crops has the potential to offer farmers a cost-effective alternative to often decreasing yields from conventional land use. Environmental protection also forms part of the EU's support measures under the CAP [15,16] farmers should be rewarded for services they provide within the countryside (landscape development, biodiversity, climate stability) that are beneficial to the climate and the environment.
Energy based on renewable energy sources focuses on long-term aspects and global solutions. The long-term goal for research and development of energy use of biomass is primarily to ensure its competitiveness with fossil fuels [20].
Solution of the climate change requires global coordination and a long-term strategy. The Paris agreement of 2015 provides a framework to limit global warming to below 2 ° C above pre-industrialization levels. The EU has set binding climate and energy targets for 2020 and 2030. Member States have set up an energy union to provide affordable, safe and sustainable energy [6]. Such an energy union is prospective for the climate [7].
Renewable Energy Directive (RED) (2009/28 /EC) sets binding targets for 2020 for the share of renewable energy in gross final energy consumption, the Energy Efficiency Directive puts forward targets expressed in primary energy. As the latter is part of the EU 20-20-20 climate and energy package, understanding the interactions between different RES technologies and their statistical impacts on primary energy is useful to policymakers [19].
Among all renewable energy sources, biomass

could contribute to meeting the EU's renewable energy targets by 2020 [4,9]. In Italy, interest in biofuels has increased over the past 10 years. Cultivation of crops for biomass production was in fact included in the cultural plans of several farms, particularly in the northern regions of Italy.

Technologies of energy crops production are focused on the production of biomass for direct combustion, gasification, anaerobic digestion, the production of liquid biofuels, and other methods of energy and, eventually, industrial use. Energy crops are usually divided into herbaceous and woody plants. The potential in the subsequent use of the biomass thus obtained has regional or local character.

Potential problems that biomass, as a renewable energy source, can cause to the environment are compared to fossil-based energy more acceptable in terms of long-term corporate intentions.

Reliable identification of realistic biomass at regional level is particularly important in creating a real energy strategy. It must stand for the region especially in the long-term aspect of its sustainable development.

Phytoenergetics, as a new sector of the economy, includes a set of technologies enabling the use of biomass as an alternative source of energy and it can have a significant role in the energy development of the regions. It includes biomass technologies, biomass cultivation technology and biomass processing for energy use at local and regional level.

Targeted cultivation of energy plants has potential to be applied in economic and social practice and leads to an increase in the sustainable development of the regions. The partial goal of planting energy plants is to reduce the energy dependence of the state and its individual regions, to reduce greenhouse gas emissions, to increase the share of renewable resources in the state's energy mix. In recent years, the production of energy crops has also been affected by increasingly frequent weather extremes [14].

The aim of the paper is to identify and quantify environmental impacts, especially microclimatic impacts, on the possibility to establish and grow economically and energy-efficient plantations of fast-growing energy plants in the Slovakia regions.

MATERIALS AND METHODS

The NUTS III methodology (La Nomenclature des Unités Territoriales Statistiques) was used to locate and assess the climatic conditions of the Slovakia regions. NUTS III regions are divided into 8 regions in Slovakia (BA - Bratislava, TT - Trnava, TN - Trenčín, NR - Nitra, ZA - Žilina, BB – Banská Bystrica, PO - Prešov and KE - Košice region).

Climatic factors in the Slovakia regions are expressed as average monthly air temperatures and average monthly sums precipitation for the vegetation period from April to October. The data were processed according to the database of the Slovak Hydrometeorological Institute for the years 2010 to 2017.

The climatic parameters of the model plantation in the Nitra region were specified on the basis of Physicus Meteostation measurements, localized in the village of Kolíňany in specific field conditions. Average monthly air temperatures and average monthly precipitation sums for the vegetation period 2015-2017 were expressed.

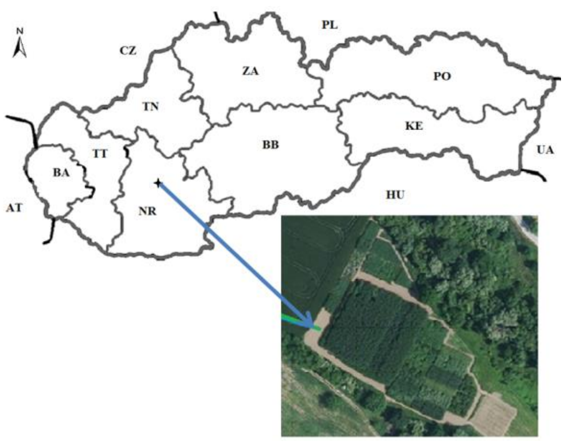


Fig. 1. Localization of model plantation of fast-growing energy plants in Kolíňany, Nitra Region
Source: pôdnemapy.sk, own processing, 2017

The model area of experimental research on growing fast-growing plants is located in the Nitra region in the cadastre village of Kolíňany. The GPS location of the model

plantations is 48 ° 21'21 "N 18 ° 12'25" E (Figure 1) with an altitude of 80 m above the sea. A more detailed description of the abiotic conditions of the model area is given in the article [10].
The plantation of the energy woody plant green poplar and the energy grass *Miscanthus* were evaluated in the model area of the Nitra region. A more detailed description of the plant material is given in the works [3] and [12]. Biomass harvesting of energy grass is done annually. The plantation of energy woody plant *Populus* is set on a three-year harvest cycle.

RESULTS AND DISCUSSIONS

The significant biomass production and limiting element for localization of plantations of fast growing plants in the regions are climatic parameters. *Populus* and *Miscanthus* for their growth and biomass production need appropriate temperature and humidity conditions during the vegetation period and stable climatic conditions at the beginning of the vegetation period. Based on the databases of average monthly air temperatures and average monthly sums of precipitation were processed the regional differences of selected climatic parameters (Table 1) in Slovakia regions.

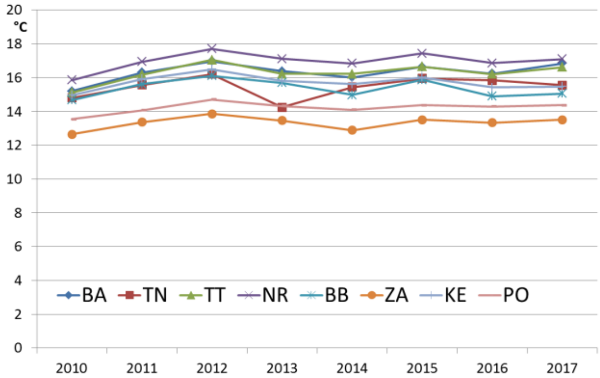
Table 1. Differentiation of selected abiotic conditions in Slovakia regions - climatic parameters

region / parameter	Ø air temperature (°C) during the vegetation period	Ø total precipitation (mm) in the vegetation period
BA	16.32	504.85
TT	16.28	419.76
TN	15.45	486.03
NR	16.98	423.39
ZA	13.32	622.53
BB	15.36	525.34
PO	14.22	549.61
KE	15.71	496.10

Source: own processing, 2018

For the cultivation of the energy grass *Miscanthus* and the energy woody plant *Populus*, the climatically most tolerant regions are situated in the southern and south-eastern regions of Slovakia. On the contrary, the northern regions (Žilina and Prešov) are less suitable for climatic factors - the shorter length of vegetation period required for economically efficient production of above-ground biomass. Even here, however, are local exceptions, in relation to the altitude of a particular habitat.

a)



b)

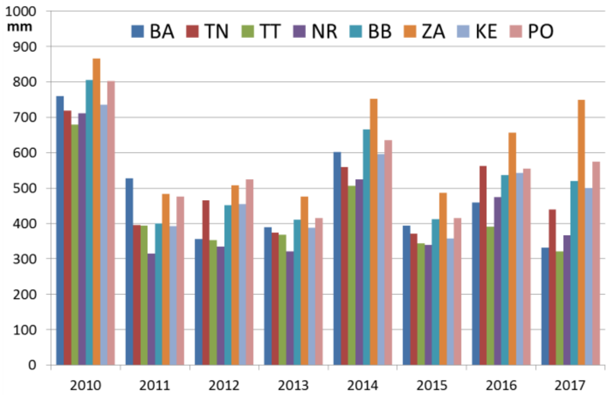


Fig. 2 Comparison of climatic parameters in the Slovakia regions during the vegetation period 2010 - 2017 (a) average temperature during the vegetation period b) average precipitation during the vegetation period)
Source: own processing, 2018

The trend of average temperatures and average precipitation during the vegetation period from 2010 to 2017 in Slovakia regions shows Figure 2. The differentiation of climatic parameters over the years under review shows the graphs a) and b). It is possible to identify warmer and drier years during the period under review (2012 and 2015). The graph shows the years when there was enough precipitation during the

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

vegetation period with the appropriate temperature conditions (2010 and 2014). Relative fluctuations between years were recorded in the analysis of precipitation during the vegetation period of the years under review.

Already in 2009, the authors [17] presented the results of a study, where they were analysing spatial and economic conditions for establish of the energy plants plantations in Illinois regions (USA), which they differ in soil quality and climatic conditions.

In China, authors [21] solved a similar spatial differentiation of regions eligible for growing of *Miscanthus* on the basis of climatic parameters. They determined the length of the vegetation period defined as the time for biomass start of the start at an average daily temperature ≥ 10 ° C and a total precipitation during the vegetation time ≥ 400 mm as a limiting factor in the assessment of climatic conditions.

The authors [8] evaluated regional differences in relation to the climatic parameter. Specifically, they focused on the influence of low temperatures at the beginning of the vegetation period on the tolerance of energy grasses against spring frost. They confirmed the variation in the possibility of growing these plants due to differences in air temperature.

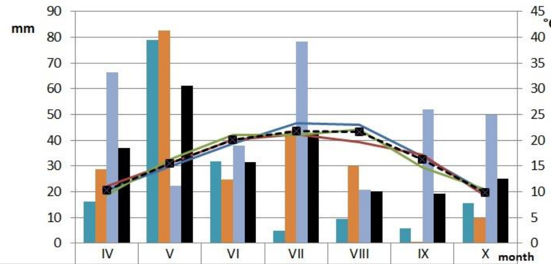
Based on the assessment of the average monthly air temperatures and the average monthly precipitation during the vegetation period for an eight-year period, the differentiation of the regions where it is appropriate to establish and cultivate such plantations was evaluated (Table 2). In the ZA and PO regions were detected a short vegetation period, the temperatures above 10 ° C occur between mid-May and mid-September. The early end of the vegetation period was indicated in the TN, PO and KE regions, the temperatures dropping below 10 ° C in late September and early October., In the BA and NR region were indicated favorable conditions in terms of average air temperature during vegetation time and were indicated early onset of daily temperatures above 10 ° C.

Table 2. Evaluation of regional differentiation of selected climatic parameters in Slovakia regions

region / parameters	temperature conditions	humidity conditions
BA	+	+
TT	+	+ / -
TN	+ / -	+ / -
NR	+	+ / -
ZA	-	+
BB	+ / -	+
PO	-	+
KE	+ / -	+ / -

Legend: + appropriate, + / - acceptable, - inappropriate
Source: own processing, 2018

In the TN, TT and NR regions, there is less sums precipitation at the beginning of the vegetation period, which limits the growth of new shoots in *Miscanthus* and the slowing of foliage formation for *Populus*. In the western and southern regions, there is also a lower average of the sums precipitation during the culmination of biomass growth of these plants at the end of June and early July. ZA, BB and PO are regions where the humidity conditions are suitable for growing throughout the vegetation period.



	IV	V	VI	VII	VIII	IX	X
mm 2015	16.00	78.80	31.38	4.80	9.40	5.60	15.60
mm 2016	28.60	82.60	24.80	43.80	30.00	0.60	9.60
mm 2017	66.20	22.20	37.80	78.40	20.80	51.80	49.80
mm average	36.93	61.20	31.47	42.33	20.07	19.33	25.00
°C 2015	10.28	14.19	19.28	23.24	22.94	16.84	9.98
°C 2016	11.07	15.48	20.01	21.21	19.69	17.22	9.14
°C 2017	9.36	16.24	20.94	21.08	22.14	14.69	10.39
°C average	10.24	15.54	20.08	21.84	21.59	16.25	9.84

Fig. 3. The average values of climate parameters for the years 2015 – 2017 at the model plantation of fast-growing plants in the village Kolíňany in Nitra region
Source: own processing, 2018

The average air temperatures and average precipitation during the vegetation period over a three-year period were analysed according to measurement of the meteorological station located in field conditions on the model area (Figure 3). Values where precipitation reaches lower values than the temperature curve is a period of physiological dryness. This is a period when plant species have a lack of water for their growth and biomass production. This period was identified at the model plantation, especially during the summer months (June and August) - based on three-year measurements of climatic parameters. Nevertheless, the stands reached a balanced production (Table 3). A lot of precipitation in the spring period has provided enough water for plants to produce biomass. The culmination of the shoots formation in *Miscanthus* is the turn of the months of June and July. The average air temperature during the vegetation time was 16.48 ° C. The temperature value is comparable to the data analysed for regional differentiation. The three-year rainfall average during the vegetation period (236.33 mm) is below the eight-year average measured in the Nitra region.

The length of the vegetation period at the experimental plantation in the Nitra region was 196 days (2015 - 184 days, 2016 - 189 days and 2017 - 214 days). The sum of average daily temperatures ≥ 10 ° C was on average 3,317.72. According to the climatic regionalization of Slovakia, this value indicates the location in a very warm to warm, very dry, lowland region.

In Table 3 is documented the evaluation of the production potential of the monitored plants. *Miscanthus* has been observed since the establishment in 2010 and the *Populus* since 2012.

Table 3. Production of dry above-ground biomass by *Miscanthus* (t.ha^{-1}) and *Populus* (t.ha^{-1}) planting on the research base in Kolíňany, Nitra region

Year / plant	*Miscanthus*	*Populus*
2010	10.95	-
2011	17.5	-
2012	24.85	51.47
2013	27.2	15.97
2014	28.6	41.98
2015	27.95	135.14
2016	33.66	34.67

Source: own processing, 2018

The *Miscanthus* production grows dynamically during the monitor period and in the seventh year of vegetation the average harvest of dry biomass reached 33.66 t.ha^{-1}. The slight drop in harvest in 2015 could be affected by low precipitation during June - July (25.2 mm and 16.5 mm). These months are the period when the *Miscanthus* reaches the culmination of growth new shoots. The sum of precipitation during the 2015 vegetation period was only 162 mm.

The cost-effective production yields of *Miscanthus* were confirmed in different regions of Europe (regions differentiated by climate). The authors [1] confirmed in southern Europe, under optimal climatic conditions, the production of above-ground dry biomass of approximately 25-30 t.ha^{-1}. In Serbia, on two different soil-climatic sites, the authors [5] reported the yield of *Miscanthus* biomass varies from 15.5-37.5 t.ha^{-1} depending on the soil type. Similarly, authors [2] in their work confirmed that *Miscanthus* production varies depending on environmental conditions, crop management and collection time. The authors [13] confirmed the yield of 26.9 t.ha^{-1} of the *Miscanthus* biomass in the hilly region of Sicily (Italy).

Vegetable year 2012 was the last year of the first and the vegetation year 2015 was the last year of the second three-year cultivation cycle of energy woody plant *Populus* with an average production of 51.47 t.ha^{-1} (2012) and 135.14 t.ha^{-1} (2015). Comparing biomass production during the first and second cultivation cycle were differences in biomass production. The polynomial trending function [11] of the growth of *Populus* biomass points to fluctuations in annual production. This is a three-year cultivation cycle and at the end of this cycle, the biomass is harvested.

Authors [18] also watched the performance of seven hybrid poplar clones on Boian's experimental basis in the soil-climatic conditions of southern Romania. On the basis of their research, they confirmed the equilibrium of production even 15 years after planting in the region.

CONCLUSIONS

The occurrence and impacts of climate change also occur in the regions of Slovakia.

Significant regional rise in air temperature is accompanied by significant changes in other climatic parameters in individual regions, in particular the fall in precipitation and the increase in extreme weather conditions. Such changes lead to influencing the production capacity of energy plants. Therefore, it is necessary to regionally and subsequently locally designate suitable areas for the foundation and cultivation of plantations of energy plants in order to achieve economically profitable production.

For the cultivation of the energy grass *Miscanthus* and the energy woody *Populus*, the climatically most tolerant regions are situated in the southern and south-eastern regions of Slovakia. By contrast, the northern regions are less suitable for climatic factors. In the Žilina and Prešov regions, the short vegetation period required to achieve high yields of biomass was detected. In terms of air temperature during the vegetation period, favorable conditions were indicated in the Bratislava and Nitra region. There is also a lower average precipitation during the culmination of biomass production of these plants. However, the production performance of model plants was not affected by the lack of precipitation. A lot of precipitation in the spring period has provided enough water for plants to produce biomass. Average air temperature during the vegetation period was 16.48 ° C in field conditions in the village of Kolíňany (Nitra region). The three-year precipitation average of the experimental site during the vegetation period (236.33 mm) is below the eight-year average measured in the Nitra region (423.39 mm). Growth of *Miscanthus* production increased dynamically and in the seventh year of vegetation the average yield of dried biomass reached 33.66 t.ha^{-1}. The *Populus* plantation reached an average biomass yield of 135.14 t.ha^{-1} after the second cultivation cycle. Under the climatic conditions of the Nitra region, efficient biomass production was achieved on the model plantation of energy plants on unused agricultural land as an alternative source for further energy recovery.

ACKNOWLEDGMENTS

This work was supported by the Grant Agency FESRD projects no. 2/2017 and 3/2017.

REFERENCES

[1]Angelini, L.G., Ceccarini, L., O Di Nasso, N.N., Bonari, E., 2009, Comparison of *Arundo donax* L. and *Miscanthus* × *giganteus* in a long-term field experiment in Central Italy: analysis of productive characteristics and energy balance. Biomass and bioenergy, Vol. 33(4):635-643

[2]Brosse, N., Dufour, A., Meng, X., Sun, Q., Ragauskas, A., 2012, *Miscanthus*: a fast-growing crop for biofuels and chemicals production. Biofuels, Bioproducts and Biorefining, Vol. 6(5):580–598

[3]Demo, M., Prčík, M., Tóthová, D., Húska, D., 2013, Production and energy potential of different hybrids of poplar in the soil and climatic conditions of south-western Slovakia. Wood Research, Vol. 58(3):439-450

[4]Dornburg, V., van Vuuren, D., van de Ven, G., Langeveld, H., Meeusen, M., Banse, M., van Oorchot, M., Ros, J., van den Born, G.J., Aiking, H., Londo, M., Mozaffarian, H., Verweij, P., Lysen, E., Faaij, A., 2010, Bioenergy revisited: key factors in global potentials of bioenergy. Energy & Environmental Science, Vol. *3*(3):258-267

[5]Dželetović, Ž., Maksimović, J., Živanović, I., 2014, Yield of *Miscanthus* × *giganteus* during crop establishment at two locations in Serbia. Journal on Processing and Energy in Agriculture, Vol. 18(2):62-64

[6]European Council, 2014, Conclusions on 2030 Climate and Energy Policy Framework EU Council (23-24 October 2014), SN 79/14, Brussels, 23 October 2014.

[7]European Council, 2015, Conclusions (17-18 December 2015), EUCO 28/15, Brussels, 18 December 2015.

[8]Friesen, P.C., Peixoto, M.D.M., Lee, D.K., Sage, R. F., 2015, Sub-zero cold tolerance of Spartina pectinata (prairie cordgrass) and Miscanthus× giganteus: candidate bioenergy crops for cool temperate climates. Journal of experimental botany, Vol. 66(14):4403-4413.

[9]Kalt, G., Kranzl, L., 2011, Assessing the economic efficiency of bioenergy technologies in climate mitigation and fossil fuel replacement in Austria using a technoeconomic approach. Applied Energy, Vol. 88(11):3665-3684

[10]Kotrla, M., Mandalová, K., Prčík, M., 2017, Regional Disparities in Slovakia and The Czech Republic in the Context of Sustainable Growing of Energy Plants. European Journal of Sustainable Development, Vol. 6(2):165-180

[11]Kotrla, M., Mandalová, K., Prčík, M., 2017, Assessing the production potential of purpose-grown energy crops in Slovak regions. SGEM 2017. Sofia:

STEP92 Technology, pp. 75-82.
[12]Kotrla, M., Prčík, M., 2013, Environmental and socio-economic aspect of growing Miscanthus genotypes. Scientific papers. Series "Management, Economic Engineering in Agriculture and rural development" Vol. 13(1):201-204
[13]Mantineo, M., D'agosta, G. M., Copani, V., Patanè, C., Cosentino, S. L., 2009, Biomass yield and energy balance of three perennial crops for energy use in the semi-arid Mediterranean environment. Field Crops Research, Vol. 114(2):204-213
[14]Mikó, P., Kovács, G.P., Alexa, L., Balla, I., Póti, P., Gyuricza, CS., 2014, Biomass production of energy willow under unfarouble field conditions. Applied Ecology and Environmental research, Vol. 12(1):1-11
[15]Rumanovská, Ľ., 2016, Impact of EU common agricultural policy 2014-2020 implementation on agriculture in Slovak Republic. Scientific Papers. Series" Management, Economic Engineering in Agriculture and rural development, Vol. 16(1):459-466
[16]Rumanovská, Ľ., Takáč, I., 2013, Common agricultural policy and support in areas of sustainable agricultural systems. Nitra: 2013.
[17]Scheffran, J., BenDor, T., 2009, Bioenergy and land use: A spatial-agent dynamic model of energy crop production in Illinois. International Journal of Environment and Pollution Vol. 39(1-2):4–27
[18]Şofletea, N., Curtu, A.L., Vasile, A.L., Ciocīrlan, E., 2016, Growth performance of hybrid poplars (*Populus × canadensis* MOENCH) in the Danube floodplain southern Romania. Bulletin of the Transilvania University of Braşov. Series II: Forestry, Wood industry, Agricultural food engineering, Vol. 9(1):21-28
[19]Union Europeene, 2009, Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. Official Journal of the European Union, 5, 2009
[20]Viglasky, J., Barborak, O., Suchomel, J., Langova, N., 2009, Status and vision for the biomass-to-energy sector. World Futures, Vol. 65(5-6):389-405
[21]Xue, S., Lewandowski, I., Wang, X., Yi, Z., 2016, Assessment of the production potentials of *Miscanthus* on marginal land in China. Renewable and Sustainable Energy Reviews, Vol. 54:932-943.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE INFLUENCE OF RURAL DEVELOPMENT PROGRAMMES ON AGRICULTURAL LAND USE IN UKRAINE

Roman KURYLTSIV, Nadiya KRYSHENYK

Lviv National Agrarian University, Ukraine, 1, V. Velykoho str., Lviv Region, 80381, Ukraine, Phone: +38 032 22 42 961; E-mails: kuryltsiv@ukr.net, nadya_kryshenyk@ukr.net

Corresponding author: kuryltsiv@ukr.net

Abstract

The article deals with the implementation of the State Target Program on Ukrainian Village Development of Ukraine. The aim of the paper was to present the influence Ukrainian Village Development Programme 2007 – 2015 on agricultural land use taking into account its objectives. This topic is current in the context of the Village Development Programme 2007 – 2015 evaluation and search for effective tools for supporting agricultural land use. The results of research conducted in 2017 based on the data of Ministry of Agrarian Policy and Food of Ukraine and Accounting Chamber of Ukraine are presented. During the period of the State Program, about a half part of the projected amount of funds was allocated from the budget on agricultural market development. Consequently, ineffective state management and limited budget funding did not contribute to the efficient use of agricultural land by rural areas and the achievement of the expected results of the Village Development Program.

Key words**:** *rural development, agricultural land use, rural policy, state program, rural areas.*

INTRODUCTION

Predominantly rural regions account for about 75% of the land and almost a quarter of the population in OECD countries [8]. Rural regions face significant challenges in comparison to metropolitan and even intermediate areas [7].

Rural Development includes all activities that are related to rural functions:

• Food production (agriculture and forestry);

• Environmental function (biodiversity, air, water, soil); and

•Social function (basic services, income outside agriculture, cultural heritage) [4].

Traditionally, rural territories are engaged in agrarian production. Nowadays, agrarian sector makes 18 % of GDP and its share has constituted 8-9% in the total budget of Ukraine in the recent years. Above three millions of people are currently employed in agrarian sector. It is 80% of the country's territory with one third of the country's population living on it.

Three out of every four poor people in developing countries live in rural areas, and most of them depend directly or indirectly on agriculture for their livelihoods [3].

The agricultural sector plays a major role in the Ukrainian economy. Ukraine has approximately 43 million hectares (ha) of agricultural land, including 32 million ha of arable land, an area equivalent to one-third of the arable land in the European Union (EU). Half of it is black soil, the highest productive soil type in the world and a commodity in such demand that an illegal market has developed in selling it. While Ukraine has some of the largest farms in the world, covering up to 500,000 ha. small-scale farmers' produce about 50% of agricultural output [9].

Thus, the issue of rural territories development is always actual for Ukraine. Ukraine possesses substantial land resources, which could supply high living standards for rural population under conditions of rational and efficient use of them. However, actually one observes opposite tendencies.

Problems of inappropriate land uses, over-exploitation of natural assets and environmental degradation are complex and long-term in Ukraine. They are exacerbated by their linkage with poverty, inequality and social conflicts. [5].

Development of rural territories and solution of economic, social and ecological problems in a village is defined as a strategic goal of the state land policy. Economic changes in Ukraine of the recent years considerably influence the structure, character and tendencies of land use. Redistribution of lands, introduction of a variety of the forms of ownership and farming, new land relations have caused formation of a new land status and appearance of negative phenomena in land use.

Negative effect of land use has caused soil erosion, loss of favorable living environment, excessive sensitivity of soils, reduction of carrying capacity of lands, modification of landscapes and loss of esthetic attractiveness of natural environment [2].

The main problem is that intensity of land use is not going down but up. Consequently, rise of the rates of land resources consumption forces deterioration of natural processes of natural environment revival. Excessive load on lands has caused activation of negative processes and erosion processes are the most intensive ones. The most fertile layers of soil and the most important constituent of it, i.e. humus, are destroyed, physical and physical-chemical properties are deteriorated. The area of acid and saline soils expands due to improper employment of lands.

The current situation in land relations and land use of Ukraine is still complicated and requires an urgent reconsideration of the most important directions of the state policy concerning rural territories development.

MATERIALS AND METHODS

The scope of the study is to make a retrospective examination of the state programs of rural territories support as a precondition for agricultural land use development in Ukraine. A particular stress is made on the analysis of a gradual implementation of the State Target Program on Ukrainian Village Development as a key instrument for development of rural territories, agrarian market and agricultural land use in Ukraine. The purpose of the article is to assess conditions of the state support for agricultural land use within the state target program, to define the level of financial supply for its tasks and measures, as well as to determine perspective directions of agricultural land use for development of rural territories.

To solve the set problems the research used the monographic method to review the relevant literature as well as the laws and program documents that regulate rural development in Ukraine. Additionally, a comparative analysis was made between the amount of planned and actual financing of the state program over the analyzed period. The information on activities and expected amounts of financing were derived from the records of passport of the State development program from the Ministry of Agrarian Policy and Food of Ukraine, and the actual data were extracted from the audit report of Accounting Chamber of Ukraine.

A stimulus for undertaking this research problem arose from two sources: the negative tendency in agricultural land use and the growing interest in territorial planning of rural areas over the past few years.

The focus was to analyze the legal regulations of rural development in Ukraine and to explore influence of state target programs on agricultural land use under the land reform conditions.

RESULTS AND DISCUSSIONS

The Law of Ukraine of October 17, 1990, № 400 “Concerning priority of social development of a village and agro-industrial complex in the economy” has initiated legislative regulation of rural territories development. The Law determines that priority of social development of village and agro-industrial complex is objectively forced by extreme importance and irreplaceability of the produced products of agriculture in life activity of people and society, by the need of peasants’ revival as land masters, representatives of morality and the national culture [12].

However, improvement of the conditions of rural population has not happened. Thus, the Decree of the President of Ukraine of June 15, 2002 № 640/2002 “Concerning the urgent measures of support for development of social sphere of a village" approved the State program of social sphere development in a village for the period until 2005. The Program expects rise of rural population employment at agricultural enterprises of different organizational and legal forms and private peasant farms by increase of the output of agricultural products, its primary processing and storage, application of the practice of differentiation of the kinds of economic activity in rural location [11].

Having completed the State program of social sphere development in villages for the period until 2005, the state approved the Concept of a Complex program of support for development of Ukrainian village for 2006-2010 of December 21, 2005 № 536-p.

To implement the program in the field of development of land relations and forms of economic activity, the state has developed the measures concerning improvement of the system of state administration of land relations, creation of legal and social-economic mechanisms of efficient enforcement of the right of ownership for land, development of the required regulatory base on the issue of agrarian land use and performance of agricultural land market. Particular attention is paid to the position of the state in development of land relations. The state should supply:

- inventory and probing of lands of different intended use;
- stimulation of withdrawal of degraded, low-productive and technologically polluted agricultural lands out of exploitation;
- support for sustainable performance of melioration systems, improvement of conditions and efficiency of meliorated lands exploitation;
- protection and reclamation of soil fertility, particularly by application of soil-protective technologies;
- improvement of maintenance of the state land cadaster and monitoring of lands;
- formation and performance of agricultural land market with protection of the rights of the market subjects;
- formation of an ecological network as an efficient mechanism to protect landscape biological diversity;
- development of a competitive land use on the base of cooperation, intensification, concentration and specialization of production and partnership production relations [1].

To implement the Concept, the state approved the State Target Program on Ukrainian Village Development for the period until 2015 of September 19, 2007 № 1158. The Program was a separate chapter of the State program of economic and social development of Ukraine for the corresponding year. Its main tasks include:

- creation of organizational-legal and social-economic conditions for a complex development of rural territories and balancing of the conditions of life activity of urban and rural population;
- rise of the efficient employment level, intensification of rural population motivation to develop entrepreneurship in rural location as the main condition for improvement of living standards of the population;
- support for competitive capacity of agrarian sector under conditions of Ukraine's integration into the world economic environment;
- liquidation of unregulated and shadow agrarian market;
- supply of ecologically safe conditions for life activity of population, protection of natural environment and rational use of natural resources, particularly agricultural lands [10].

In 2008-2015, there were 64 billion UAH or almost 50% of the expected amount (128.2 billion UAH), approved by the State program, spent for implementation of the State Target Program on Ukrainian Village Development for the period until 2015. Particularly, 63.8 billion UAH or 52.8 % of the expected amount (120.8 billion UAH), were spent from the state budget, 0.2 billion UAH or 2.7 % of the expected amount from the local budgets (Table 1).

Within the State program, the financial resources were focused on implementation of the program tasks and measures in 2008-2015 and used in the following directions: development of agrarian market – 39.5 % (25,279 million UAH), professional education

– 27,4 % (17,529.9 million UAH), improvement of the existing instruments and reforming of the management system in agrarian sector – 17.9 % (11,502.5 million UAH), financial supply for agrarian sector – 7.3 % (4,703.2 million UAH), development of social sphere and rural territories – 4.1 % (2,608 million UAH), agrarian science – 3.8 % (2,427.5 million UAH), development of extension service – 0.02 % (10.2 million UAH).

Table 1. Expected and actual amounts of financing for the State Target Program on Ukrainian Village Development in 2008-2015

Sources of financing	Amount of financing, million UAH		By years							
			2008	2009	2010	2011	2012	2013	2014	2015
State budget	plan	120,750.5	15,318.9	15,153.5	14,550.4	75,727.7				
	actual	63,330.2	12,681.9	9,377.7	9,118.1	10,137.9	8,367.0	6,525.0	4,865.5	2,757.0
Local budgets	plan	11.2	0.1	0.3	10.1	0.7				
	actual	225.2	0.0	0.0	0.0	51.0	47.9	52.6	53.5	20.2
Other sources	Plan	7,402.4	407.2	984.1	1,028.2	4,982.9				
	Actual	4.9	0.0	0.0	0.0	0.0	1.9	1.4	1.6	0.0
Total	Plan	128,164.1	15,726.2	16,137.9	15,588.7	80,711.3				
	Actual	64,060.3	12,681.9	9,377.7	9,118.1	10,188.9	8,416.8	6,579.0	4,920.7	2,777.2

Source: Source: Own calculation based on the statistical data from Decree [10] and Accounting Chamber of Ukraine

Consequently, in 2008-2015 the state support for supply of development of rural territories, agricultural production and agrarian market was lower than the expected one due to the State program (Fig. 1).

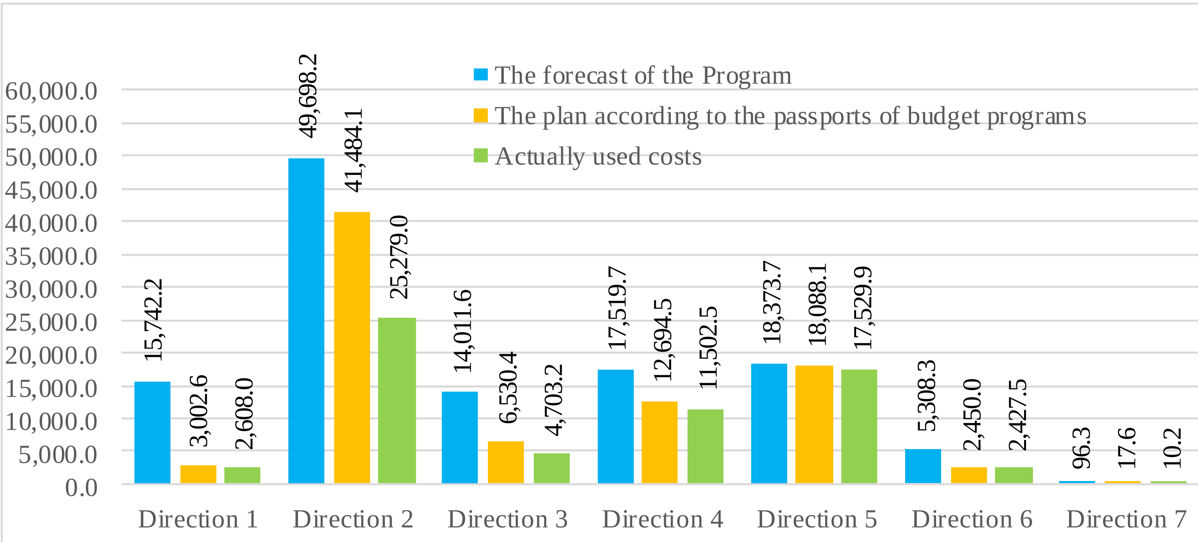


Fig. 1. Financing within the State Target Program on Ukrainian Village Development for the period until 2015 (million UAH)
Source: Own design based on the statistical data from Decree [10] and Accounting Chamber of Ukraine

Development of social sphere and rural territories expected implementation of the measures concerning development of agricultural land use in villages by means of financial support for farming enterprises. Such measures applied costs of the state budget in the amount of 378.8 million UAH, or 70.6 % of the expected amount (536.5 million UAH). The state support was gained by 4,691 farming enterprises obtaining interest free credits on both non-repayable (start-ups in 2008-2010) and repayable basis (Fig. 2).

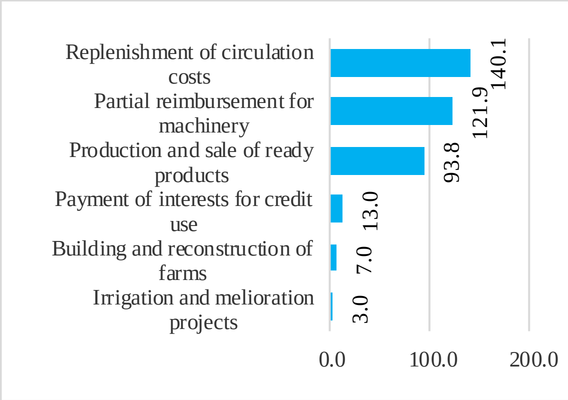


Fig. 2. Directions of budget costs application for financing of farming enterprises in 2008-2015 (million UAH)
Source: Own design based on the statistical data from Accounting Chamber of Ukraine

The program of agrarian market development determines the following directions of development of rural territories, particularly:
- development of crop production;
- land organization and state land cadaster;
- protection and improvement of soil fertility, greening of agricultural production;
- improvement of land monitoring system;
- land melioration.

It is planned to develop crop production by improvement of land relations and introduction of modern technologies.

Table 2. Application of the state budget costs for support of agricultural land use

Measures	Unit of measure	Expected amount of financial resources	Actual amount of financial resources	Target achieved (%), increase (times)
Grants payment per 1 ha of crops of cereals and industry crops	million UAH	9,191.0	1,042.2	1.3
	million ha	108.9	130.2	1.2 times
State support for agricultural enterprises, located in complicated climatic conditions	million UAH	348.8	35.0	10.0
Fight against pests and diseases of agricultural crops	million UAH	49.9	65.7	1.3 times
	million ha	9.2	20.6	2.2 times
Partial reimbursement of electric energy costs, necessary for irrigated lands	million UAH	548.1	147.0	26.8

Source: Own calculation based on the statistical data from Decree [10] and Accounting Chamber of Ukraine

To implement the measures within the State program, only 31,7 % of the expected costs were supplied from the state budget. A part of the costs was used to support agricultural land use (Table 2).

Measures of the state policy concerning rational organization of rural territories and agricultural land users are to be fulfilled by means of a complex land management of rural territories and agricultural landholdings:
- to make inventory of agricultural landholdings and land uses;
- to prepare a methodology and examine agro-ecological conditions of agricultural lands;
- to develop recommendations concerning the rational location of agricultural production depending on soil quality;
- to secure organization of landholdings and land uses of agricultural enterprises, farming and peasants households with consideration of their optimal sizes and requirements of ecological-landscape organization of the territory;
- to implement environmental measures, including agro-forest-melioration and anti-erosion ones;
- to make evaluation of land-resource, recreational and curative potential;
- to make conservation of low-productive, degraded and technologically polluted lands;
- to make consolidation of land parcels by merging of land shares, creation of cooperatives and other partnership companies;
- to implement measures concerning reclamation of meliorated lands;
- to secure the legislative requirements concerning the order of assignment of land parcels to land share owners;
- to secure implementation of the owners' rights for land parcels, land shares and business entities concerning higher responsibility for holding of the terms of lease agreement and their state registration;
- to create a regulatory base and system of computerized recording of the state land cadaster;
- to improve the order of lands recording with consideration of quantitative and qualitative indicators and secure their intended use;
- to specify methodology of soil judging, economic evaluation of lands and normative monetary evaluation of lands with consideration of market conditions of agricultural production.

However, in the direction the Program only expects costs for protection and safety, rational use of forests, which are intended for permanent use by agro-industrial enterprises, i.e. only for one of the above-mentioned measures.

It looks illogical, considering the problem conditions of the other directions. It is also strange that other measures are not even included into the passports of budget programs.

Such non-system character is observed in the state policy on land protection, improvement of soil fertility and ecological safety of rural territories. According to the Program, it is expected to implement a complex of the following measures:

- optimization of the structure of cropping area and crop rotation to improve productivity of agricultural lands, prevent erosion processes and make reclamation of soil layer fertility;
- improvement of the balance of humus and main nutrients by increase of the applied amounts of mineral fertilizers and organic fertilizers, including peat composts and organic residues of crops;
- wider application of soil-protecting technologies of soil treatment;
- implementation of the measures concerning pollution of soils with heavy metals, industrial residuals, pests and other agro-chemicals;
- application of chemical melioration of soils to improve their fertility;
- state control for implementation of the measures concerning protection and reclamation of soil fertility;
- rise of responsibility of landowners and land users for rational use and protection of lands;
- stimulation of withdrawal of degraded, low-productive and technologically polluted agricultural lands out of intensive use;
- formation of an ecological network as an efficient mechanism to protect landscape biological diversity.

However, the direction defines only two priorities, which consider liquidation of the consequences of mine flooding and formation of the national ecological network.

Implementation of the state Program on improvement of the system of lands monitoring should be done by means of:

- compulsory agro-chemical examination of soils, control for the change of their quality conditions, implementation of agro-chemical certification of land parcels;
- evaluation of potential risks and harm, caused to land resources by emergency situations of natural and technological character;
- improvement of the standards and norms in the field of use and protection of lands, including protection and reclamation of soil fertility.

To improve the land monitoring system, 165.7 million UAH were spent for implementation of agricultural lands classification for the period of the State program (general fund constituted 133.5 million UAH, special fund – 32.2 million UAH), that was 2.1 times more than the expected amount of financial resources (78.8 million UAH).

There was an examination of agricultural lands on the area of 36.6 million ha, that constituted 94.1 % of the expected amount (38.9 million UAH). Samples were taken at 3.6 million ha and there were 17.6 million of analytical researches. The examination has resulted in issuing of 671.5 thousand of agrochemical passports (Table 3).

In Ukraine, financing for the process of creation of a common state system of standards, norms and rules in the field of land organization, land protection and sustainable land management has an impermanent short-term character. Currently, among the 17 developed projects of branch standards, i.e. 5 national standards (DSTU) and 12 branch standards (SOU), only two are enacted. One of them concerns the rules of completing of normative documents, development, presentation, design and requirements to the content of normative documents, the other one deals with the rules of development of technical documentation concerning normative money evaluation of settlements lands.

To improve the employment of potential capabilities of meliorated lands, the Program expects efficient performance of melioration

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

system, creation of the conditions for supply of the farms, which make irrigation of arable lands by high-productive watering machinery, and development of the system of regulation of soil water-air status under drainage conditions.

Table 3. Application of financial resources in the direction of agrarian market development

Principal directions	Costs, million UAH	Percentage, %
Formation and support for development of agrarian market infrastructure	11,529.8	45.6
Land melioration	5,090.1	20.1
Supply for crop production development	3,883.2	15.4
Supply for animal breeding development	2,999.4	11.9
Guaranty of safety and quality of food products	889.2	3.5
Formation and renewal of materials and technical resources	594.3	2.3
Improvement of land monitoring system	165.7	0.7
Rational organization of rural territories and land users	58.0	0.2
Protection and improvement of soil fertility, greening of production	54.5	0.2
Supply for development of foreign economic activity	14.8	0.1
Total	25,279	100

Source: Own calculation based on the statistical data from Accounting Chamber of Ukraine

However, only 5,091.1 million UAH were spent for land melioration that constituted 20% of total expenses in the direction of "agrarian market development" (Table 3). However, the costs are insufficient for efficient exploitation of state melioration systems. In 2012-2013 and the first half of 2014, on the territory of Odesa, Mykolaiiv and Kherson regions almost 520 thousand ha or about 62 % of the amount of irrigated agricultural lands were not irrigated because of unsatisfactory technical conditions of the state and internal economic melioration systems, pump and other equipment, its high energy capacity. Length of melioration system in the regions has reduced almost by 24 kilometer and the losses made above 20 million UAH [6].

CONCLUSIONS

Consequently, one should note that the State Target Program on Ukrainian Village Development for the period until 2015 had a positive impact on development of agricultural land management of rural territories in Ukraine. However, inefficient managerial decisions and limited financing prevent a complete achievement of the expected results.

The first reason for such conditions is that there is no relation and coordination concerning development and implementation of the state, inter-branch, departmental programs, connected with development of land management of rural territories, as well as coordinated goals, priorities, stages of performance and supply with appropriate resources for their implementation.

Such approach is described in the Concept of rural territories development until 2025, which was approved in 2015 and expected introduction of an inter-sectoral approach to its implementation.

The Concept expects improvement of the system of rural territories management and development of a natural-reserve fund by strengthening of the position of territorial communities of villages and settlements in planning of land management of rural territories development, support for development of state-private partnership for implementation of the projects of rural territories development in order to attracts investments, establishment of the fund of rural territories development, introduction of economic motivation for implementation of land-protective measures and creation of a register of unproductive lands, which can be used for growing of energy crops.

However, as in the recent years, one can observe the tendency of insufficient system interaction between declaring of goals, implementation of measures and their financing. A plan of measures to implement the Concept was approved only two years after its approval.

Thus, nowadays it is very important to develop regional programs of rural territories development within the approved Concept, which should expect the costs necessary to organize implementation of the planned measures.

It is practically impossible to secure efficient use of land-resource potential of rural territories without appropriate funding.

REFERENCES

[1]About the approval of the Concept of the Integrated Program for Supporting the Development of the Ukrainian Village for 2006-2010 (Decree of the Cabinet of Ministers of Ukraine, 2005).

[2]Beinat, E., Nijkamp, P., 1998, Multicriteria Analysis for Land-Use Management, Kluwer Academic Publishers, Dordrecht.

[3]Byerlee, D, De Janvry, A., Sadoulet, E., Townsend, R., Klytchnikova, I., 2008, World Development Report 2008: Agriculture for Development, World Development Report No. 30 (Washington, DC : World Bank Group).

[4]EU TACIS, 2004, Sustainable integrated land use Eurasian Steppes. Comprehensive policy approach for rural development in Moldova.

[5]Kuryltsiv, R., Hernik J., 2014, Land use administration in Ukraine: restrictions and zoning regulations, Acta Sci.Pol. Form. Cir., 2014, 13 (2), 51–58.

[6]Meliorative systems require state attention (Press office of the Accounting Chamber, 2014): www.ac-rada.gov.ua/control/main/uk/publish/article/16744878 (Accessed 21 February 2018).

[7]OECD, 2003, The Future of Rural Policy: From Sectoral to Place-Based Policies in Rural Areas.

[8]OECD, 2006, Rural Policy Reviews. The New Rural Paradigm. Policies and Governance.

[9]OECD, 2015, Ukraine Sector Competitiveness Strategy - Phase III. Review of Agricultural Investment Policies of Ukraine (OECD Eurasia Competitiveness Programme, Project Report).

[10]On Approval of the State Target Program for the Development of Ukrainian Village for the Period until 2015 (Decree of the Cabinet of Ministers of Ukraine, 2007).

[11]On priority measures to support the development of the social sphere of the village (Decree of the President of Ukraine, 2002).

[12]On the Priority of Social Development of the Village and the Agro-Industrial Complex in the National Economy (Law of Ukraine, 1990).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

DEVELOPMENT OF THE DIGITAL ECONOMY IN MODERN AGRICULTURE OF RUSSIA: OPPORTUNITIES, DRIVERS AND TRENDS

Nikolai Ivanovich KUZNETSOV, Nadezhda Viktorovna UKOLOVA, Sergey Vladimirovich MONAKHOV, Juliya Anatolyevna SHIKHANOVA

Saratov State Agrarian University, 1, Teatralnaya ploschad, Saratov, Russia, 410012, Phones: 88452233292, 89053207223, 89271020505, 89173193689;
E-mails: nikolai.i.kuznetsov@mail.ru, nadya_ukolova@bk.ru, monahovsv@mail.ru, juliya-shikhanova@yandex.ru

***Corresponding author**:* nikolai.i.kuznetsov@mail.ru

Abstract

The economies of the world's leading countries are characterized by a high level of development of digital technologies, the introduction and use of these technologies. Many countries make the construction of a new model for the development of the national economy, based on the development of the digital economy, the priority of their development. The construction of the digital economy in Russia is a strategic task that ensures national security, competitiveness and development effectiveness at various levels and in different sectors of the economy. The authors' interpretation of the concept of "digital economy" is given in the article, taking into account the prevailing level of development of digital technologies, their role and significance in modern society. The authors come to the conclusion that nowadays the Digital Economy is an economy using digital technologies. The study analyzes the current level of development of the digital economy in Russia, reveals that the country has significant scientific and resource potential for the development of the digital economy, including that of modern Russian agriculture. The current tendencies and perspective directions of development of the digital economy in Russian agriculture are considered.

Key words: *digital economy, agriculture, development economics, information and communication technologies, economic systems, e-agriculture*

INTRODUCTION

The agriculture of modern Russia is the guarantor of the country's economic system stability and security of its regions. Level of development of the agricultural sector of the country's economy depends on food security, social stability of society.
Russian agriculture, like other industries, is subject to changes in the world economy. One of the main trends in the development of the world economy is the active development of a digital economy. The national economies of countries also adapt to the changes taking place in the world economy, which are sometimes coordinated according to the previous level of development. Level of development of digital technologies is gradually affected by agriculture, which is manifested in the possibility of introducing new high technologies, expanding the capabilities of artificial intelligence in the production of agricultural products and other processes.
Information and communication technologies, computerization, the Internet, mobile communications and other attributes are an integral part of the development of a modern progressive society that can actively implement innovations. Economic systems that have developed in the highly developed countries of the world cannot be imagined without the use of digital technologies that provide subjects of economic systems with information, the ability to promote products, advertisements, etc.
Another driver for the development of the digital economy in the world is the activity of transnational companies in the process of globalization of the world economy, which erases the narrow framework of individual sectors and fields of national economies.

These companies are forced to look for the most effective ways of developing organizations, the mechanism of interaction within companies, reducing external and internal costs, which is largely possible due to the use of modern information and communication technologies.

In turn, medium and small companies also actively use digital technologies in their activities. As a rule, introduction of these technologies does not require large material and financial costs, and the effect obtained from the introduction of these technologies significantly exceeds the costs incurred.

In the context of the research, the purpose of the article was to study and economically substantiate the further development of the strategically important branch of Russia's economy taking into account globalization and transformation of the world economic system, formation of a single digital space, and identification of opportunities and prospects for the development of the digital economy in agriculture.

MATERIALS AND METHODS

Theoretical and methodological bases of the research include the works of scientists of Russian and world economic science, such as S.Yu. Glazyeva [8], N.S. Revenko [18], Negroponte N. [15], V.V. Ivanova [9], R.V. Meshcheryakova [13], Kelly K. [10], Serbu R. [22], Chung K. [1], Matei A. [11], Gatut B. [7], Pavlicek A. [17], Muniz C. [14]. The legal basis of the study was the current regulatory and legislation of the Russian Federation, namely, the decrees of the President of the Russian Federation [25, 3], federal laws of the Russian Federation [5, 6], decisions and orders of the government of the Russian Federation [2, 16], the current state program [24] and others.

The study is based on the fundamental principles of classical economic theory, the theory of economic growth and development, the category of institutional economics, micro- and macroeconomics.

The main method of investigation used is the dialectical method, which assumes that all events are considered in development and not a discontinuous connection between the causes of these events and their consequences.

The study of the development of the digital economy in agriculture of the national economy was carried out within the framework of the system approach, which allowed revealing the main development tendencies, establishing drivers and constraints of development, advantages and disadvantages. And the use of the reproduction approach was the basis for identifying opportunities for the development of the digital economy in the agrarian sector of Russia's economy.

At present, the main indicators of the development of the digital economy are the provision of economic growth of the national economy as a whole and its sole sectors (including agriculture); the formation of a qualitatively new economic system that fosters productivity growth; ensuring effective management of branch business structures and use of available resources; increase of competitiveness and economic security of companies, industries and national economies in the context of the formation of a global digital ecosystem.

Official statistical data, as well as the results of the authors' own research on this topic were the data base of the study. Abstraction as a general method of theoretical thinking along with dialectics as a universal method of cognition was used as the ground for conducting research. The study used general methodological principles, a systematic approach and a set of methods of scientific cognition. In addition, the methods of this study were monographic, computational-constructive, economic-statistical, abstract-logical, methods of analysis and synthesis.

RESULTS AND DICUSSIONS

Active development of the digital economy in the world began twenty years ago, in the 1990s. This is largely due to the development of the World Wide Web (WWW), Digital Internet, computerization, robotization, the activities of information and communication companies. Over time, digital technologies gradually spread to all spheres of human life, including its economic activities and, as a result, affected many sectors and fields of national economies, actively spread in the global economy.

Among the large number of definitions of the "digital economy" available in economic science, the most common is the following: The digital economy is an economic activity in which the key factor in production is data in digital form, processing large volumes and using analysis results in comparison with traditional forms of management can significantly improve the efficiency of various types of production, technology, equipment, storage, sale, delivery of goods and services [3].

Current level of digital technologies development and their influence on the ongoing processes allow us to give the definition of the term: "Digital economy" is an economy implemented using digital technologies. Inherent elements of this economy are the use of artificial intelligence, robotization of work processes, reduction of living labor costs in the production process, ability to model and program economic systems through the use of special computer programs, etc.

According to the level of development of information and communication technologies, Russia occupies the 43rd place in the world (2016), while the leaders in the development of digital technologies are the Republic of Korea, Iceland, Denmark, Switzerland and the United Kingdom [12]. However, intellectual capabilities and available resources of the modern Russian economy, as well as the goals of strategic development of the national economy, put the development of the digital economy in the category of the most important.

One of the main tasks of the modern Russian economy development is the development of "intelligent" agriculture and the active use of information and communication technologies in agriculture based on the construction of the e-agriculture system. For example,

information and communication technologies in agriculture have already been successfully applied in the leading countries of the Asia-Pacific region when creating an e-agriculture system in the agricultural segment of national economies [4], as well as in the leading countries of the European Union [22,11] and America [18].

Current level of technical support for Russian agriculture, as well as the level of production technologies used, includes the use of new innovative developments aimed at reducing the labor costs for workers. New high-performance equipment supplied to Russian agricultural producers is provided with modern management tools, computer monitoring and satellite navigation tools are used, fuel consumption control, load optimization and the most efficient use of equipment. The annual volume of financing of technical and technological modernization of Russian agriculture by 2020 should reach 8,254.4 billion rubles, of which about 50% of the federal budget funds (Figure 1).

Modern information and communication technologies allow the operative monitoring of production processes in agriculture, which allows adapting these technologies to the needs of modern agriculture based on the construction and development of the e-agriculture system in the agrarian sector of the Russian economy. One of the most promising areas of the use of modern digital technologies is the use of GIS technologies for monitoring the use of agricultural land. The use of satellite navigation systems in agriculture allows us to control the vast territory of Russia, to prevent or minimize losses from the onset of adverse weather events.

Another driver, which determines the active development of the digital economy, is the problem of improving the management efficiency of large companies (including agricultural ones).

The problem of ineffective management of large companies for a long time was the inadequate coordination of the activities of structural units, the adoption of untimely management decisions, which led to a decrease in the effectiveness of organizations.

Introduction of mobile information and communication technologies, creation of local networks in the activities within the companies practically minimized the loss of time when making managerial decisions, significantly increased the efficiency of organizations.

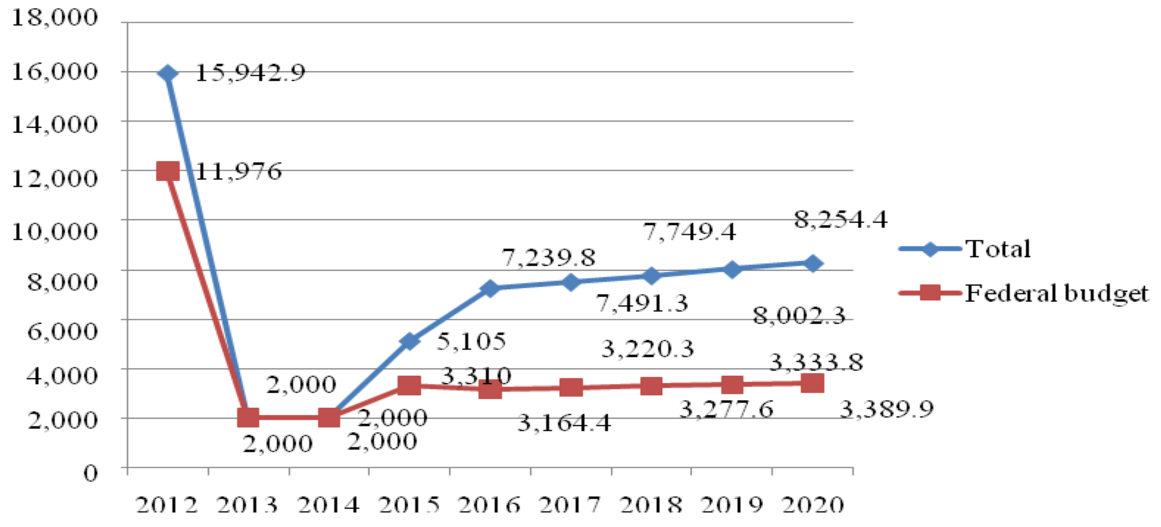


Fig. 1. The total amount of financing for technical and technological modernization, innovative development of the agrarian sector of the Russian economy, billion rubles.
Source: Calculated by the authors on the basis of data [24].

Total costs of companies for information and communication technologies in the Russian economy tend to increase. Thus, in 2005, the costs of Russian companies amounted to 215 billion rubles, then in 2015 it reached 1,184 billion rubles (Figure 2).

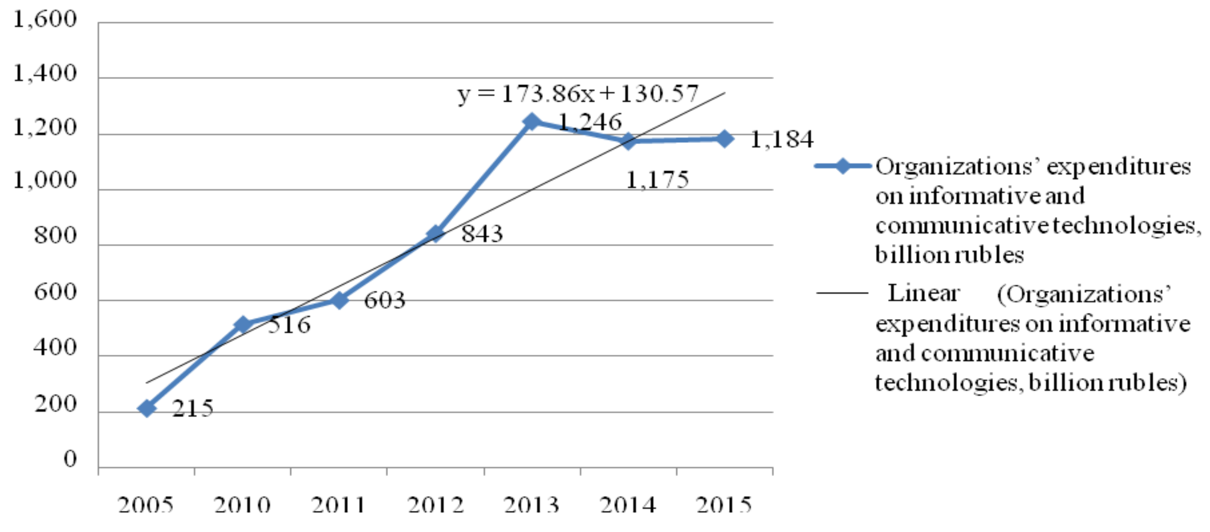


Fig. 2. Organizations' expenditures on informative and communicative technologies in the Russian economy, billion rubles.
Source: Calculated by the authors on the basis of data [20].

The use of digital technologies in the interaction of agricultural organizations and organizations of the financial sector of the economy is a promising area of digital technologies application. The use of electronic payments, special software, digital banking allows you to reduce transaction costs, improve the quality of service and reduce the timing of operations.

The possibilities of artificial intelligence, at this point in time, allow us to predict the development of the economy at the micro- and macro-level with a high degree of accuracy. The use of computer modeling, planning and forecasting of economic processes with the use of special software allows us to visualize various development scenarios, to reduce the risks of the onset of negative events.

General availability of the Internet and software allows the Internet to be used as an interactive platform for trade in agricultural products, promotion of products. Search engines of large Internet companies, such as Google, Yandex and others are an indispensable tool for finding the necessary products, goods and services. Many agricultural producers create their own websites, where contact information and other information are placed.

The agro-food market is a promising area of application of digital technologies, both in international trade and trade within the country and regions. The activity of this market is based on the use of highly intelligent technologies, Internet facilities, possibilities of robotization and automation of production processes. Creation and development of this sphere allows the state and companies to control the processes of the product life cycle directly from production to consumption of the products produced.

Modern information and communication technologies are aimed at minimizing the resources spent, which is manifested in the possibility of saving production resources, including labor, and more accurate control over the flow of material and technical resources. So, for example, applied "accurate" farming systems use resource-saving technologies that are aimed at minimizing human labor, using robotic high-performance equipment, and using GPS navigation. The use of micro-irrigation, reclamation of water using high-tech installations in land reclamation also contributes to resource saving, lower water consumption and, as a consequence, environmental impact and cost savings, which in turn is manifested in lower cost and competitiveness of products.

At the same time, to ensure the process of building a digital economy, an active development of the system of modern Russian education (including the agricultural profile) is necessary. This system should meet the needs of the digital economy in specialists who are knowledgeable and able to apply information and communication technologies in practice, and have appropriate competencies. An important role in this should be given to the system of higher education, as the basis for training specialists of a new generation for various branches of the digital economy of the future.

The basis of the emerging VI technological order in the world economy are digital technologies, the formation of the digital economy, the development of human potential, the formation of a new technological basis for development.

The studies of many scientists emphasize the importance of the development of modern ecosystems of the digital economy. Russian economists consider an actively developing digital economy the basis for the further development of the national economy. In the writings of scientists of the world economic science special attention is also paid to the development of the digital economy in various sectors and spheres of activity.

Many Russian scientists [8,19,21] understand only the sector of information and communication technologies under the name of “digital economy”. This, in our opinion, is an inadequate approach to the concept that does not reflect the current level of development of digital technologies, their role and significance for the real sector of the economy.

Professor Meshcheryakov R.V. believes that in the disclosure of the term digital economy, two approaches should be considered. The first approach is based on the fact that the digital economy is the economy based on digital technologies and at the same time it is more correct to characterize exclusively the field of electronic goods and services. The second approach is based on the fact that the digital economy is the economic production using digital technologies [13].

In our opinion, the most accurate definition of the term "digital economy" reflecting the current level of development of digital technologies is the term we uncovered earlier. The digital economy is an economy implemented using digital technologies. (author's interpretation of the concept).

Leurent H. and Rösler P. [23] substantiated the drivers that affect the development of production in the real sector of the future economy: technologies and innovations; regulation and legislation; global economy, trade and investment; production resources; human capital; consumer behavior. The combination of these drivers for the development of the economic systems of the future will, in their opinion, be the basis of economic growth and development, including the digital economy in the world.

Chung K. [1] links the development of the digital economy in the world with the possibility of international trade in food products between countries, their cooperation and the ability to coordinate the activities of large multinational companies.

Large multinational companies such as AT & T, Cisco, Citi and others [26] are trying to identify new opportunities for the development of companies in today's economy, while determining the importance of developing a global digital economy.

In his study Serbu R. [22] analyzed the possibilities of the development of the digital economy of the European Union and the construction of the system "e-agriculture".

According to Muniz C. [14], further growth of the European economy is associated with the development of digital technologies, as the basis for building a new economy.

Integral elements of the application of information and communication technologies that contribute to the development of the digital economy in Russia's agriculture, in our view, will be the following: provision of information to producers and consumers; possibility of sharing knowledge via the Internet; possibility of interactive exchange of operational information; promotion of products in various markets; possibilities of using digital banking services; provision of information on weather phenomena and the use of land resources; software for the use of artificial intelligence, robotic equipment and other processes.

CONCLUSIONS

Our study of the development of the digital economy in agriculture in Russia and in the leading countries of the world made it possible to draw the following conclusions:

The digital economy will help reduce the negative consequences of the economic crises of the world economy, and also contribute to the economic development of individual industries (including agriculture) and national economies in general.

The digital economy will be the basis for the development of the Russian economy of the future, and will also stimulate the effective development of individual industries, including agriculture.

The construction of a new Russian economy is possible only on the basis of modernization of education, the training of highly qualified specialists, taking into account the requirements of the digital economy.

The application of information and communication technologies in agriculture creates equal opportunities for promoting products between large and small companies, which increases the efficiency of their activities and provides equal opportunities for ensuring competition in the industry.

The use of digital technologies in agriculture is possible not only as a necessary infrastructure of the production process, but also as the sphere of application of artificial intelligence directly in the production process, the creation and development of the e-agriculture system.

The further development of the digital economy in agriculture will be closely interrelated with the level of accumulated knowledge, the development of science, the technical and technological equipment of production processes, the ability to control processes at all stages of the product life cycle.

REFERENCES

[1]Chung, K. C., Fleming, P., Fleming, E., 2013, The impact of information and communication technology on international trade in fruit and vegetables. APEC Asian-Pacific Economic Literature, 27(2): 117-130

[2]Decree of the Government of the Russian Federation of August 25, 2017 N 996 "On the approval of the Federal Scientific and Technical Program for the Development of Agriculture for 2017 - 2025 years". http://www.consultant.ru/document/cons_doc_LAW_2

23631/, Accessed on November 20, 2017.
[3]Decree of the President of the Russian Federation of May 9, 2017 No. 203 "On the Strategy for the Development of the Information Society in the Russian Federation for 2017-2030", http://www.garant.ru/hotlaw/federal/1110145/#ixzz4uQZ2M43J, Accessed on November 20, 2017.
[4]E-Agriculture Strategy Guide. http://www.fao.org/3/a-i5564e.pdf, Accessed on November 20, 2017.
[5]Federal Law "On Science and State Science and Technology Policy" of 23.08.1996 N 127-FZ, http://www.consultant.ru/document/cons_doc_LAW_11507/, Accessed on November 20, 2017.
[6]Federal Law of June 28, 2014 No. 172-FZ "On Strategic Planning in the Russian Federation", http://base.garant.ru/70684666/#ixzz4uQGu3xWG, Accessed on November 20, 2017.
[7]Gatut, B. L., Vincent, A. D. W., 2011, Modelling The Digital Economy Development in Indonesia. 18th International Economic Conference on Crisis After the Crisis - Inquiries from a National European and Global Perspective “Crises After The Crisis: Inquiries From A National, European And Global Perspective”, I: 309-314.
[8]Glazyev, S. Y., 2017, The Great Digital Economy. http://sobityadnya.ru, Accessed on November 20, 2017.
[9]Ivanov, V.V., 2015, Innovative territories as the basis of the spatial structure of the national innovation system. Region: Economics and Sociology, 1: 227-255.
[10]Kelly, K., 1998, New Rules for the New Economy: 10 radical strategies for a connected world. New York: Viking, pp. 224.
[11]Matei, A., Savulescu, C., 2012, Empirical analysis of ICT, economic growth and competitiveness. The EU Proceedings Of The International Conference On ICT Management For Global Competitiveness And Economic Growth In Emerging Economies (ICTM 2012), 201: 42-58.
[12]Measuring the Information Society Report 2016. https://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2016/MISR2016-w4.pdf, Accessed on November 20, 2017.
[13]Meshcheryakov, R.V., Savchuk, M.V., 2011, Approaches to the implementation of ERP-systems in large enterprises. Business Informatics, 2 (16): 63-67.
[14]Muniz, C., Salome, A., 2011, ICT Technologies in Europe: Technological Diffusion and Economic Growth. 16th International-Business-Information-Management-Association Conference: Kuala Lumpur, Malaysia, 1-4: 950-959.
[15]Negroponte, N., 1995, Being Digital. New York: Knopf, pp. 256.
[16]Order of the Government of the Russian Federation of 28.07.2017 N 1632-r "On the approval of the program" Digital Economy of the Russian Federation”. http://www.consultant.ru/document/cons_doc_LAW_221756/, Accessed on November 20, 2017.
[17]Pavlicek, A., Kacin, R., Sigmund, T., 2011, The Position Of Ict Sector In The National Economy Of Czech Republic. 19th Interdisciplinarity Information Management Talks Jindrichuv Hradec, Czech Republic, 36: 147-155.
[18]Revenko, N.S., 2017, The US Digital Economy in the Age of Information Globalization: Current Trends. USA and Canada: Economics, Politics, Culture, 8: 78-100.
[19]Rusin, A.O., 2017, What does the digital economy mean. http://rusrand.ru, Accessed on November 20, 2017.
[20]Russia in figures. 2017: Brief stat.sub. 2017. Moscow: Rosstat, pp. 511
[21]Ryabchenko, L.A., 2017, "Digital" man - a new product in the "digitized" Russia. http://allpravda.info, Accessed on November 20, 2017.
[22]Serbu, R. S., 2014, An Interdisciplinary Approach to the Significance of Digital Economy for Competitiveness in Romanian Rural Area Through E-Agriculture 21st International Economic Conference Of Sibiu 2014, IECS 2014 Prospects Of Economic Recovery In A Volatile International Context: Major Obstacles, Initiatives And Projects, 16: 13-17.
[23]Shaping the Future of Production: Four Contrasting Perspectives in 2030 In collaboration with A.T. Kearney March 2017. https://www.weforum.org/whitepapers/shaping-the-future-of-production-four-contrasting-perspectives-in-2030, Accessed on November 20, 2017.
[24]State program for the development of agriculture and regulation of markets for agricultural products, raw materials and food for 2013 – 2020. http://mcx.ru/documents/document/show/22026.htm, Accessed on November 20, 2017.
[25]The decree of the President of the Russian Federation from 01.12.2016 N 642 "About the Strategy of scientific and technological development of the Russian Federation". ConsultantPlus. http://www.consultant.ru/document/cons_doc_LAW_207967, Accessed on November 20, 2017.
[26]The New Digital Economy. How it will transform business. A research paper produced in collaboration with AT & T, Cisco, Citi, PwC & SAP. 2016. Oxford Economics, pp. 34.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

PRELIMINARY IDENTIFICATION OF POTENTIAL INDIGENOUS YEASTS FROM NAPA CABBAGE (*Brassica rapa subsp.pekinensis*) WASTES FOR CELLULASE ENZYME PRODUCTION

Widia Dwi LESTARI[a], Dwi Wahyudha WIRA[b], Gemilang Lara UTAMA[a]

Universitas Padjadjaran, Faculty of Agro-Industrial Technology[a], Faculty of Medicine[b], West Java, Indonesia, Emails: widiadwibunzani@gmail.com, lugemilang@gmail.com

Corresponding author: lugemilang@gmail.com

Abstract

The aims of the research was to determine the occurrence of indigenous yeasts isolated from napa cabbage (Brassica rapa subsp. pekinensis) wastes potentially in produced cellulase enzyme. Indigenous yeast isolated from 1 g napa cabbage wastes with using modified Potato Dextrose Agar / PDA (Oxoid Ltd.) with the addition of 3% Yeasts Extract / YE (Kraft Foods) and 10 ppm amoxicillin. The identification of yeasts performed under microscope for size and shape then tested with Rapid Yeasts Plus System. Cellulase enzyme production was done with the addition of 2% indigenous yeasts into the substrates in the ratio of napa cabbage and water 1:15 with basal medium contains 0.05% KH_2PO_4 and 0.025% Mg_2SO_4 then incubated for 96 hours at 37ºC (modification of Gupta, et al., 2012). Every 24 hours, 1.5 ml of fermented substrates were centrifuged and the supernatant was taken as crude enzyme. The cellulose enzyme activity determined by measuring the glucose resulted using the DNS method, then tested spectroscopically using UV-Vis 9200 spectrophotometer at 540 nm. Results showed that there are 3 indigenous yeasts isolates that 2 of the isolates identified as Candida krusei and one isolate identified as Hanseniaspora guilliermondii. The cellulase enzyme activity increased in the first 24 hours then decreases until 96 hours. The best isolates activity shown by C.krusei A that resulting glucose contents of 15.9 ppm with the enzyme activity of 0.007U/ml.

Key words**:** *Candida krusei, cellulase enzyme Activity, H. guilliermondi, napa cabbage wastes*

INTRODUCTION

The damaged parts of napa cabbage will throw away and become a waste. Napa cabbage waste contains the same components with napa cabbage that can be utilized. Components contained in the napa cabbage is polysaccharides such as cellulose. Cellulose is known as a structural component of the cell wall composition that is commonly found in napa cabbage. The previous solution in the utilization of waste of cabbage is for animal feed, but there is a more economical and useful alternative that is cellulase enzyme production. Cellulase enzyme can be produced from utilization of cellulose content in napa cabbage waste by microorganisms such as the yeast [8]. The yeast that has the ability to convert cellulose into cellulase enzyme called cellulolytic yeast, either indigenous or non-indigenous.

Cellulase enzymes have the ability to break down cellulose and bioconvert other agricultural wastes. The high content of organic cellulose causes the decomposition process to be longer [5]. The problem can be solved with the use of enzymes so that cellulose decomposition occurs more quickly. Therefore, the cellulase enzyme produced with this napa cabbage waste can solved the problem of unavailability of cheap and efficient enzymes.

MATERIALS AND METHODS

Isolation and Identification of Indigenous Yeasts

Indigenous yeasts were isolated from 1 g of inoculated napa cabbage waste using modified Potato Dextrose Agar (PDA) with the addition of 3% Yeasts Extract / YE (Kraft Foods) and 10 ppm amoxicillin, then incubated for 3 days at 37ºC. Isolates that grow on modified PDAs then identified under microscope for size and shape then tested with Rapid Yeasts Plus System

Cellulase enzyme production

Two percent of indigenous yeast inoculated then incubated with the substrate (napa cabbage) in basal media containing 0.5% KH_2PO_4 and 0.025% Mg_2SO_4 then incubated for 96 hours at 37ºC (modification of [2] and [3]. Every 24 hours, 1.5 ml of fermented substrates were centrifuged at 10000 rpm for 10 min at 4ºC, and the supernatant was taken as crude enzyme.

Enzyme Assay

The enzyme activity was determined by incubating 0.5 mL of supernatant with 0.5 mL of 1% Carboxymethyl cellulose (CMC) solution as a substrate into phosphate buffer (pH 7) for 30 min at 50ºC (Modification of [7]). The reactions was stopped by adding 3 mL of 3,5-dinitrosalicylic acid (DNS) reagent followed by boiling at 90ºC for 10 minutes. The developed color was read at 540 nm using UV-Vis 9200 spectrophotometer. One unit of enzyme activity releases 1µmol reducing sugars (measured as glucose) per mL per min [2].

RESULTS AND DISCUSSIONS

Isolation and identification of indigenous yeasts

Characteristics of colonies grown on the media are shown in Table 1.

Table 1. The Results of Isolate Characterization

Strain	Characteristics
S1.2	Isolate 2 : Round, Smooth, Broken White Colored, Wet, Aerobic
S2.2	Isolate 2 : Round, Broken White Colored, Aerobic
S2.4	Isolate 4 : Oval, Yellow, Anaerobic

Source: Own results.

After characterizing, the cells observed under a microscope to remove other isolates from the yeast. 1 isolates were selected from several isolates having the same characteristics. The results show that the isolates S1.2, S2.2 and S2.4 have similar characteristics, ie tend to be rounded, broken white to yellow and aerobic. Then it was purified until fifth purification because because the colonies grow well. The selected isolates were identified by RapID Yeasts Plus System (Table 2).

Table 2. The Results of RapID Yeasts Plus System with ERIC Analysis

Isolate	S1.2	S2.2	S2.4
Glucose	+	+	+
Maltose	-	-	-
Sucrose	-	-	-
Trehalose	-	-	-
Raffinose	-	-	-
Lipid	-	-	-
NAGA	-	-	-
αGlucoside	-	-	-
βGlucoside	+	-	-
ONPG	-	-	-
αGalactoside	-	-	-
βFucoside	+	-	-
PHS	-	-	-
PCHO	-	-	-
Urea	-	-	-
Prolyne	-	-	-
Histidine	+	+	+
Leucyl-Glycine	-	-	-
Yeast Name	***H.guillermondii***	***Candida krusei***	***Candida krusei***

Source: Own results.

The results showed that 1 isolate was identified as *H.guillermondii* (S1.2) and 2 isolates *C.krusei* (S2.2 and S2.4). *Hanseniaspora guillermondii* is the yeast of the *Saccharomyces* family where the strains of this species produce acetoin or chemicals found in many food products. *Candida* has characteristic cells with size between (2-5) x (2.5-10) µm and varied shapes of round, short oval, oval, oval lengthwise, cylindrical to elongate, rarely shaped apikulat, ogival, triangular or bottle-shaped [4]. Both strains of *Candida krusei* grow with different characteristics and suspected have a different growths.

Cellulolytic Potential of Indigenous Yeasts from Napa Cabbage

The cellulolytic activity determined as a total reducing sugars production. The indigenous yeasts isolates have the ability to degrading the cellulose. [7] Previously reported *Candida tropicalis* has a high activity to degrading a cellulose. Our study noted that *Candida krusei* and *Hanseniaspora guilliermondii*is a cellulolytic yeasts. It seen from the amount of reducing sugar formed that changes every 24 hours, it means that indigenous yeasts

degrades cellulose and produces cellulase enzyme. [10] Reported that reducing sugar formed from cellulose that hydrolyzed by the cellulase enzyme produced by yeast.
The substrate or CMC is converted by crude enzyme into reducing sugar. The reducing sugar produced from enzymatic hydrolysis of cellulose is suspected as glucose because the cellulose metabolism pathway. The mechanism of hydrolysis of cellulose in CMC into reducing sugars occurs via multi-enzyme action [6]. The cellulose metabolism pathway into reducing sugar is the breakdown of cellulose in the form of crystals into cellulose by the endo-cellulase, then the breakdown of cellulose into cellobiose or cellotetrose by exo-cellulase, and cellobiose or cellotetrose then breakdown into glucose by β-glucosidase or also called cellobiase [9].

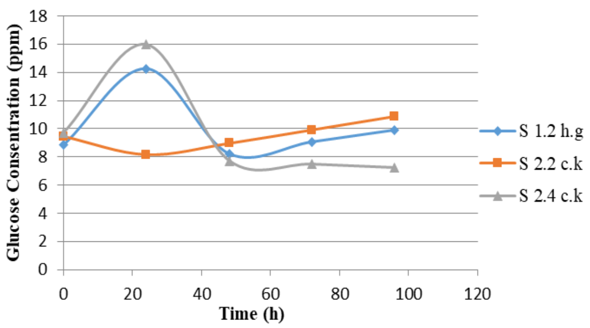


Fig. 1. Glucose Production from CMC by Cellulase Enzyme
Source: Own results.

The highest glucose produced from the substrate by *C.krusei* A (S 2.4 c.k) for 24 hours is 15.9 ppm (Fig. 1). The lowest glucose produced by *C.krusei* B (S 2.2 c.k) at 96 hours with a total of 7.2 ppm. The glucose production graph of *C.krusei* B (S 2.2 c.k) is different from other isolates presumably because the yeast has not yet reached a rapid growth phase. While, graphs of *C.krusei* A (S 2.4 c.k) and *H.guillermondii* (S 1.2 h.g) showed the best glucose production occurred at 24 hours. Each chart is different because each type of yeasts has different optimum growth characteristics.

Determination of cellulase enzyme activity

The results show that for 96 hours, indigenous yeasts can synthesize enzymes or crude enzyme as a supernatant of a centrifuged fermented solution [1]. It shows that the enzyme activity of *H.guillermondii* (S 1.2 h.g) and *C. krusei* A (S 2.4 c.k) increased for 24 hours and then decreased until 96 hours. But the enzyme activity of *C. krusei* B (S 2.2 c.k) decreased until 24 hours and then increased (Fig. 2). *C.krusei* A and *C.krusei* B are two different strains so that their growth (in enzyme production) is also different, where *C.krusei* A can produce many enzymes up to 24 hours, whereas *C.krusei* B can not produce as many enzymes. The production of the enzyme itself is influenced by various factors such as strains and growth rate of strains, available nutrients, temperature, pH, activity water and oxygen availability.

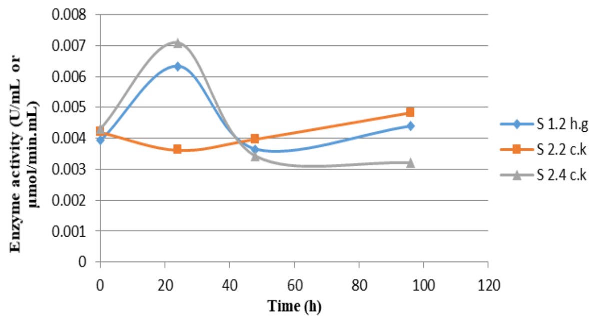


Fig. 2. Cellulase Enzyme Activity from Substrate-Medium Ratio of 1 : 15
Source: Own results.

The highest cellulase enzyme activity was produced by *C.krusei* A (S 2.4 c.k) ie 0.007 U/mL at 24 hours. However, the second *C.krusei* B (S 2.2 c.k) has cellulase enzyme activity below 0.004 U/mL at 24 hours. Then, the cellulase enzyme activity produced by *H.guillermondii* isolate is 0.0063 U/mL at 24 hours. And the smallest cellulase enzyme was produced by C.krusei A ie 0.003 U/mL at 96 hours. The value of cellulase enzyme activity is small because the ratio of substrate-medium is 1:15.

CONCLUSIONS

The results showed that 2 isolates identified as *Candida krusei* and 1 isolate were identified as *Hanseniaspora guilliermondii*. The yeasts are cellulolytic yeasts that have the ability to produce cellulase enzymes. The highest cellulase enzyme activity produced by *C.krusei* A is 0.007 U/mL with a highest glucose production of 15.9 ppm at 24 hours. Then, the cellulase enzyme activity produced by *C.krusei* B is 0.004 U/mL and by H.*guilliermondii* is 0.006 U/mL.

ACKNOWLEDGEMENTS

Authors would like to thank the the Rector of Universitas Padjadjaran for Fundamental Research Grants. Also thanked the Student Research Group who helped in the laboratory.

REFERENCES

[1]Gao, J., Haibo, W., Daheng, Z., Mingxue, Y., Fangxia, G., Yu Xi, 2008, Production and Characterization of Cellulolytic Enzyme From The Thermoacidophilic Fungal *Aspergillus terreus* M11 Under Solid-State Cultivation of Corn Stover. Bioresource Technology, 2008; 99:7623 – 7629
[2]Gupta, P., Kalpana, S., Avinash, S., 2012, Isolation of Cellulose-Degrading Bacteria and Determination of Their Cellulolytic Potential. International Journal of Microbiology, 2012 : 1 – 5.
[3]Kanti, A., Sudiana, I.M., 2002, Cellulolytic Yeast Isolated from Soil Gunung Halimun National Park. Berita Biologi, Vol. 6 (1) : 85 – 90.
[4]Nurhariyati, T., Ni'matuzahroh & Surtiningsih T., 2004, Keanekaragaman khamir pendegradasi minyak hasil isolasi dari Pelabuhan Tanjung Perak Surabaya. Berk. Penelitian Hayati, 9: 87-91.
[5]Rahmah, A., Munifatul, I., Sarjana, P., 2014, Pengaruh Pupuk Organik Cair Berbahan Dasar Limbah Sawi Putih (*Brassica chinensis* L.) terhadap Pertumbuhan Tanaman Jagung Manis (*Zea mays* L. var Saccharata). Buletin Anatomi & Fisiologi, Volume XXII (1) : 65 – 71
[6]Shoham, Y., Lamed, R., Bayer, E. A., 1999, The Cellulosome Concept as an Efficient Microbial Strategy for The Polysaccharide Degradation of Insoluble Polysaccharides. Trends Microbiology, 7 (7):275 – 281
[7]Sulman, S., Rehman, A., 2013, Isolation and Characterization of Cellulose Degrading Candida tropicalis W2 from Environmental Samples. Pakistan J. Zool., Vol. 45 (3) : 809 – 816
[8]Utama, G. L., 2016, Analisis Penggunaan Konsorsium Khamir Indigenous dalam Biokonversi Whey Keju dan Limbah Sayuran Menjadi Bioethanol serta Manfaat Sosial Ekonomi dan Lingkungan. Dissertation. Padjadjaran University.
[9]Zhang Y-HP, Himmel, M., Mielenz, J.R., 2006, Outlook for Cellulase Improvement: Screening and Selection Strategies. Biotechnol Adv, 2006; Vol.24 (5):452–481
[10]Zhang, M., Rongxin, S.U., Wei, Q.I., Ruoyu, D.U., Zhimin, H.E., 2011, Enzymatic Hydrolysis of Cellulose with Different Crystallinities Studied by Means of SEC-MALLS. Chinese Journal of Chemical Engineering, 2011; 19 (5) : 773 – 778.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE IMPLICATIONS OF TERRORIST ATTACKS OVER TOURISM IN ROMANIA AND THE EUROPEAN UNION

Liviu MĂRCUȚĂ, Maria STOIAN, Cristina TINDECHE, Alina MĂRCUȚĂ

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest, Romania, Phone: +40213182564, Fax:+40213182888, Emails: liviumarcuta@yahoo.com, maria.stoian@gmail.com, tindeche_cristina@yahoo.com, alinamarcuta@yahoo.com

Corresponding author: alinamarcuta@yahoo.com

Abstract

We live in a world where globalization is increasingly spoken about and its role in the development of humanity, where local economies and social groups have become the exponents of a dynamic system, being interconnected through communications, transport and commerce. All these elements have made humanity a very complex system, but vulnerable due to the economic, technological, socio-cultural, political and biological factors that contributed to the emergence of asymmetric threats to global security. One of these threats is terrorism. This paper proposes an analysis of the effects that terrorist attacks have had on the European Union tourism, given the large and increasing number of these attacks. Tourism offers the opportunity to visit, discover, know, observe how other civilizations live, is an important engine of the economy, but at the same time it is very sensitive to events that can affect personal safety. Thus, after taking over the statistical data on tourist traffic, data provided by Eurostat and the National Institute of Statistics in Bucharest, we analyzed and interpreted this information, which gave us some conclusions regarding the way in which the terrorist attacks affected the personal safety of tourists and how they influenced their choices.

Key words: *tourism, globalization, terrorism, European Union*

INTRODUCTION

Since the 1990s, the concept of globalization has become increasingly known and promoted by the great powers of the world, who have tried to create a new philosophy of cultural and existential organization. The definition of the date of globalization is the phenomenon of transforming the world into a unit that manifests itself globally, through specific means, in fact, a process or a set of territorial processes of structuring and global stratification of the generated social relations and transactions flows and intercontinental or interregional networks of activity, interaction and exercise of power.

The goal of globalization was to increase global trade, to improve the quality of collective and individual life, to bring together nations, cultures, to promote universal human rights and to support democratic reforms [1].

However, the effects of globalization have been positive, with particular opportunities for progress, but have been accompanied by effects such as insecurity, trafficking in human beings, drugs, weapons, legal and illegal immigration, phenomena that have contributed to the development of terrorism.

There have been and still are enough states or groups that disagree with the principles of globalization, this resistance being generated by poverty and its effects, such as: poor education and health systems, high unemployment, trade barriers, non-compliance with the rule of law , dramatic climate change. James Canton says that half the world's population lives on less than two dollars a day, that more than one billion people suffer from malnutrition, that 90% of all diseases worldwide are contacted in developing countries, and terrorists control trade, banks and leadership in the world's poor.

Terrorism has considerably influenced world economic activity [2]. On the other hand, the adoption of measures to combat and fight terrorism has touched on international tourism, directly and negatively affecting tourists' leisure, because personal safety and security are the main concerns of most tourists.

As terrorism and political violence secured their positions as contemporary issues in international affairs, their economic impact on demand in tourist destinations became increasingly apparent [7].

Tourism and terrorism reflect very different philosophies, but there are also some strange and sometimes disturbing commonalities. Both need modern technology to be effective today, both rely heavily on media management and both require the manipulation of perceptions and attitudes [5].

And at the level of Europe, these issues have been felt. Since 2004 and in Europe, terrorist attacks have intensified and have had negative effects on tourism. Thus, on March 11, 2004, an attack on three passenger trains in Madrid killed 191 people; on July 7, 2005, 52 London commuters were killed as a result of the bombing of three underground trains and a bus; on March 2, 2011, an airport bombing took place in Frankfurt; On November 2, 2011, the Charlie Hebdo Magazine offices in Paris were attacked; on July 22, 2011 a bomb was placed in Oslo and a shooting massacre took place in a youth camp on the Norwegian island of Utoya; in March 2012 there was an attack in a school in Toulouse; in January 2015 there was an armed attack at the Paris offices of the satirical magazine Charlie Hebdo and another attack on a Jewish store that resulted in the death of 17 people; February 14, 2015: Finn Noergaard was murdered and three cops were injured in Copenhagen; on November 13, 2015 an attack was committed in the concert hall in Bataclan, Paris, and in several areas of Paris, killing 130 people; on March 22, 2016, suicide attacks took place at Brussels Airport and the subway, 32 people being killed and hundreds injured; on July 14, 2016, a car bombing took place and 86 people were killed during the celebration of the Bastille Day in Nice; on December 19, 2016 a truck entered a Christmas fair in Berlin, killing 12 people; on March 22, 2017, an assault took place in Westminster Bridge, London; on April 3, 2017 in Russia, a strong explosion took place at the metro in Sankt Petersburg, Russia, killed 14 people and injured another 50 people; on April 7, 2017 in Sweden, a truck entered the crowd in the center of the Swedish capital, one of the busiest arteries being killed three people and another eight injured; in 20 April 2017 - France: terrorist attack on the Champs-Elysées in Paris; May 22, 2017 - United Kingdom, an assault took place at the end of a concert by American singer Ariana Grande at the Manchester Arena; June 3, 2017 - Britain: Eight people were killed and another 48 were injured in London in a terrorist attack in the London Bridge; August 17, 2017 - terrorist attack in Barcelona, Spain.

All these attacks have caused serious political challenges for the leaders of Europe, and the impact on the economy has been quite serious. For Europe, however, tourism is essential for post-crisis economic recovery, especially as it accounts for about 10% of Europe's GDP.

The present paper aims to analyze how terrorist events have affected tourist activity in European countries, given the role that tourism has in the economy of a country [11].

MATERIALS AND METHODS

This paper aims to analyze the impact that terrorism has had on tourism in Europe. The research has followed the evolution of the number of tourists who visited the main European tourist destinations, starting from the classification of these countries according to the degree of risk.

The paper is based on the analysis of the statistical data provided by the National Institute of Statistics and Eurostat surveys for the period 2014-2016. The indicators analyzed were: number of hotels and similar accommodation establishments, number of establishments, number of hotels and similar accommodation establishments in relation to the number of rooms, total number of arrivals in accommodation structures and number of arrivals of foreign tourists in the structures accommodation.

The methods used were calculating the number of tourists, interpreting the results and analyzing the effects of the terrorist attacks on

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

tourism.
The analysis and interpretation of these indicators allow the actors involved in the tourism activity to elaborate tourism development strategies and to track the reaction of tourists to the danger posed by terrorism.

RESULTS AND DISCUSSIONS

Each of us, when choosing a tourist destination, is concerned about personal safety. Different levels of risk perception, together with other internal factors, may determine the tourist's motivation to travel, their awareness of destination alternatives, the level of concern given to the security and terrorism threat, the extent of their information search, choice [3].
Studies show, however, that personal safety, although far outweighing fears of crime, disease or natural disasters, is relatively easily forgotten. A study by the World Travel & Tourism Council shows that tourism returns to its usual values 13 months after committing a terrorist attack, an epidemic that causes declines in tourism for 21 months or a period of political uncertainty that causes declines in tourism for 27 months.
A study in 2017 on terrorism hazards classifies European countries in terms of risk and shows that Britain is facing severe dangers, Russia with a high degree of danger, France, Belgium, Germany, Austria and Macedonia with a very possible risk, and countries such as Bosnia, Cyprus, Italy, the Netherlands, Spain, Sweden with a possible risk.
All these attacks have caused serious political challenges for the leaders of Europe, and the impact on the economy has been quite serious. For Europe, however, tourism is essential for post-crisis economic recovery, especially as it accounts for about 10% of Europe's GDP.
The present paper aims to analyze how terrorist events have affected tourist activity in European countries, given the role that tourism has in the economy of a country [11].
Each of us, when choosing a tourist destination, is concerned about personal safety. Different levels of risk perception, together with other internal factors, may determine the tourist's motivation to travel, their awareness of destination alternatives, the level of concern given to the security and terrorism threat, the extent of their information search, choice [3].
Studies show, however, that personal safety, although far outweighing fears of crime, disease or natural disasters, is relatively easily forgotten. A study by the World Travel & Tourism Council shows that tourism returns to its usual values 13 months after committing a terrorist attack, an epidemic that causes declines in tourism for 21 months or a period of political uncertainty that causes declines in tourism for 27 months.
A study in 2017 on terrorism hazards classifies European countries in terms of risk and shows that Britain is facing severe dangers, Russia with a high degree of danger, France, Belgium, Germany, Austria and Macedonia with a very possible risk, and countries such as Bosnia, Cyprus, Italy, the Netherlands, Spain, Sweden with a possible risk.

Table 1. Number of establishments

Country	2014	2015	2016
Germany	50,925	50,572	50,152
France	28,895	30,045	30,047
UK	Missing data	Missing data	Missing data
Belgium	5,139	7,990	8,210
Austria	20,329	20,315	20,619
Spain	47,689	48,328	48,701
Portugal	3,429	3,485	4,171
Italy	158,412	167,697	178,449
Netherlands	9,214	9,101	8,950
Poland	20,329	20,315	20,619
Norway	2,707	2,555	:
Finland	1,408	1,392	1,368
Denmark	1,118	1,113	1,136
Czech Republic	9,013	9,163	9,168
Slovakia	2,687	2,908	2,755
Poland	9,885	10,024	10,509
Croatia	67,724	73,439	83,233
Hungary	4,176	4,356	4,436
Romania	6,191	6,949	7,028
Bulgaria	3,163	3,202	3,331
Cyprus	802	788	785

Source: Eurostat , 2017.

In 2014-2015, the number of establishments existing at European Union increased from 570,268 in 2014 by 1.3% in 2015 and by 6.6% in 2016 as compared to 2014. Countries in which the number of establishments

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

decreased during the analyzed period were Germany, the Netherlands, Norway, Slovakia and Cyprus, this being due to the global economic situation. For the other countries, however, the number of establishments increased, with Belgium gaining 60% in 2016 compared to 2014, Croatia by 23%, Portugal by 21% and Slovenia by 12%. In Romania, the increase in the number of establishments was 12% in 2015 compared to 2014 and almost 14% in 2016 (Table 1).

In the year 2016, according to data published by Eurostat, the number of hotels and similar accommodation establishments was 202,519, distributed in hotels with less than 25 rooms, from 25 to 99 rooms, from 100 to 249 rooms and more than 250 rooms. In the first place, the number of hotels and similar accommodation establishments is 20% of the total number of hotels in the EU, followed by Italy and Germany by 16%, Spain 10%, France 9% and Austria by 6% (Table 2).

Table 2. Hotels and similar accommodation establishments by size class, 2016 (%)

Country	Total number of hotels and similar accommodation establishments	Less than 25 rooms	From 25 to 99 rooms	From 100 to 249 rooms	250 rooms or more
EU 28	**202,519**	**59.5**	**32.5**	**7.90**	
Germany	33,061	69.00	25.50	4.70	0.7
France	18,424				
UK	40,272				
Belgium	1,522				
Austria	12,366				
Macedonia	missing date				
Spain	19,524	61.70	25.80	9.00	3.5
Portugal	2,430				
Italy	33,163	54.8	40.9	4.30	
Netherlands	3,585				
Poland	3,965				
Sweden	2,011	19.90	44.80	21.90	13.40
Norway	1,082	27.10	46.70	20.80	5.50
Finland	772				
Denmark	537				
Czech Republic	6,022	77.20	19.80	2.60	0.50
Slovakia	1,475				
Poland	3,965	49.80	42.80	6.50	1.00
Slovenia	692				
Hungary	2,202	66.60	25.50	5.50	1.40
Romania	2,638	51.50	37.40	9.30	1.80
Bulgaria	2,158	20.80	46.20	17.10	15.00
Greece	9986	52.00	41.01	5.90	2.00
Cyprus	783	54,00	27.10	15.30	3.60
Serbia	676				

Source: Eurostat, 2017.

As we can see, there are countries with high tourist traffic, who also faced terrorist attacks. The opposite is Denmark, Serbia and Slovenia. Romania with 2638 hotels and similar accommodation establishments owns 1% of the existing accommodation spaces at E.U. (Table 2).

In Romania's tourism have registered a continuous development [8]. At the level of 2016, the number of hotels was 2,638 accommodation units, more than half of which were small hotels.

The allocation of hotels and similar accommodation establishments in relation to the number of rooms for the available data is shown in Figure 1.

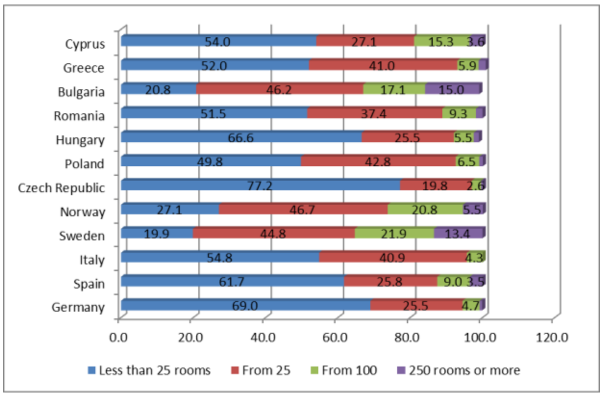


Fig. 1. Breakdown of hotels by size (%)
Source: Eurostat, 2017.

In the following we will analyze the tourism activity in the main European countries during 2014-2016.

At European Union level, the number of tourists' arrivals has decreased by about 5% in the 3 years. Germany is the country with the largest number of tourists arriving in the European Union and was hit by both terrorist attacks but also faced with problems related to the immigration crisis. In 2016 there was a decrease in the number of tourists by 1% compared to 2014 and by 5% compared to 2015.

At 2016, France ranks second in terms of number of tourist arrivals after Germany, and Paris was the second most visited city in Europe after London. Tourism is also an important engine for growth in France. Figures show a 3% drop in tourist arrivals in 2016 compared to 2014 and 6% over 2015.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Average room rate, the measure that measures the robustness of the hotel sector, declined in Paris by 13% in the first two months of 2016, compared to the similar range in 2015. This was triggered by the attacks in Brussels when the hotel occupancy rate in Paris dropped to 67%. The American, Asian and Arab tourists spending large sums in France were particularly discouraged by the terrorist attacks that hit France on other destinations.

Table 3. Total number of arrivals of tourists in accommodation structures in the countries with high risk of terrorism
Millions

Country	2014	2015	2016
EU 28	900.66	944.46	858.32
Germany	155.96	161.16	154.83
France	152.96	157.59	148.16
UK	102.55	106.80	82.64
Belgium	14.66	15.85	Missing date
Austria	33.65	35.35	37.09

Source: Eurostat, 2017.

In Belgium, the economy suffered nearly one billion Euros in losses in the first months of the 2016 bombing, and the most severely hit were hotels, restaurants and the tourism industry, as well as entertainment, after the cancellation of concerts, sporting events and other types. The occupancy rate of some hotels in Brussels fell to even 25% a few days after the terrorist attacks, as the usual occupancy rate was over 80%. However, the following things have come back to normal during the up building period, but the attacks in Brussels also affected the tourism of neighboring countries.

Britain has faced numerous terrorist attacks itself, but has also suffered after the attacks in Brussels when the occupancy of London hotels fell to 58% in 2016, 15% less than the same period of the year 2015. Another concern was the repercussions of the UK referendum vote for the UK.

Although Austria and Macedonia are countries that are on the list of countries at risk of terrorism, they have recorded increases in the number of tourists during the analyzed period.

As France, Germany, Belgium are considered to be at high risk of terrorism, tourists have moved to more peaceful places such as Spain, Greece or Scandinavia [6], which has made the number of tourists in these countries to grow at a rising pace.

Table 4. Total number of arrivals of tourists in accommodation structures in the countries with a potential or low level of terrorism
Millions

Country	2014	2015	2016
Spain	107.47	114.27	123.14
Portugal	17.99	18.12	18.77
Italy	106.55	113.35	102.08
Netherlands	36.12	37.24	34.03
Poland	25.08	27.49	30.11
Sweden	25.85	27.49	25.45
Norway	18.58	19.16	20.32
Finland	10.66	10.73	11.06
Denmark	6.71	7.18	7.48
Czech Republic	15.59	17.19	18.51
Slovakia	3.69	4.26	4.61
Poland	25.08	26.66	30.11
Slovenia	3.39	3.76	3.86
Hungary	10.13	10.91	11.64
Romania	8.44	9.08	10.92
Bulgaria	5.95	6.28	7.20
Greece	21.83	23.10	22.45
Cyprus	2.37	2.32	2.50
Serbia	1.91	2.36	2.75

Source: Eurostat, 2017.

In Spain, the number of tourists increased by 14% in 2016 compared to 2014 and by 8% compared to 2015. The Netherlands, which is in the category of countries at risk of possible terrorist attacks, registered a decrease in the number of tourists by almost 5% in 2016 compared to 2014 and by 6% compared to 2015. Denmark, the country that faced a sporadic terrorist attack in 2015, is considered to be one of the stable countries in terms of terrorist attacks. The increase in the number of tourists was 10% in 2016 compared to 2014 and 4% as compared to 2015. Sweden that faced a terrorist attack barely in 2017 saw a decline in tourists in 2016 by 2% compared to 2014 and by 7% compared to 2015.

The occupancy rate has increased from one year to another, from 42% in 2012 to almost 50% in 2016.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Among the countries that have experienced declines in tourist numbers in 2016 are Italy, the Netherlands and Sweden and Greece. Although Greece has attracted part of the tourists heading for Turkey (which also faced ethnic problems and political instability), it has gone through the euro crisis and has been a gateway to immigrants, which has made some of tourists to bypass her.

An alternative for Turkey was represented by Bulgaria, which although in 2016 had a 3% drop from 2015, this year's figure was 5% higher than in 2014.

Among the countries that registered increases in the number of tourists are Portugal, Poland, Finland, Czech Republic, Slovenia, Hungary, Cyprus, Serbia and Romania.

Romania benefits from a wide variety of natural and anthropogenic resources that make it a sought-after tourist destination [4], and the contribution of this sector to GDP formation has significant weightings [10]. During the analyzed period, the number of tourists increased by 16% in 2015 compared to 2014 and by 29% in 2016 compared to the same year. In the first 9 months of 2017, the number of Romanian tourists in Romania increased by 1 million to 9.5 million. Based on these data, it is estimated that in 2017 the number of tourists could reach 12.3 million, the increase compared to 2014 being almost 46%. In fact, the year 2017 was a record year in terms of the number of tourists coming to our country.

This may be due to the fact that Romania is a safe country in terms of terrorist attacks. The Global Terrorism Index included 162 countries ranked by the impact of terrorist attacks at the level of 2015, with Romania ranked 124 on a par with other 30 states that did not report any terrorist incident in the previous year. The same index shows that as of 2014, 32,658 people lost their lives after terrorist attacks, compared to 18,111 in 2013.

Data on the number of arrivals of foreign tourists in reception facilities in the European Union countries shows that the number of foreign tourists in 2016 in the European Union was nearly 331 million, down nearly 6 million compared to 2014 and almost 24 million by 2015.

Countries with significant declines in 2016 compared to the previous year were France with over 4 million, Germany with 2 million, Britain with nearly 6 million, the Netherlands with 1 million and Sweden with over 1 million.

The other European countries registered increases in the number of tourists, with Bulgaria's biggest tourist destinations being 21%, Bulgaria with 18%, Serbia with 16%, Cyprus with 13%, Norway with 12%, Spain, Portugal and Croatia with over 10%, Hungary by 8%, Denmark by 5% and Austria by 4%.

Table 5. Total number of arrivals of foreign tourists in accommodation structures
Millions

Country	2014	2015	2016
EU 28	336.56	354.58	330.83
Germany	32.89	34.85	32.90
France	46.09	46.85	42.69
UK	25.08	26.18	20.92
Belgium	7.89	8.35	missing date
Austria	22.25	23.54	24.68
Macedonia	0.42	0.48	0.51
Spain	52.34	55.37	61.11
Portugal	9.74	9.97	10.78
Italy	51.64	55.03	51.23
Netherlands	14.00	14.85	13.83
Poland	5.47	5.41	6.38
Sweden	0.88	1.11	1.29
Norway	4.81	5.19	5.84
Finland	2.73	2.62	2.77
Denmark	2.47	2.59	2.74
Czech Republic	8.10	8.71	9.33
Slovakia	1.46	1.71	1.87
Slovenia	2.31	2.58	2.72
Hungary	4.62	4.93	5.31
Romania	1.91	2.04	2.47
Bulgaria	2.79	2.86	3.39
Greece	14.40	15.50	15.03
Cyprus	1.94	1.87	2.12
Serbia	0.88	1.11	1.29

Source: Eurostat, INS, 2017.

The data published up to this date in Romania show that in the first nine months of 2017 77.2% of the tourists were Romanians and 32.8% were foreigners. Of the number of foreign tourists, 74.7% were European tourists and 86.2% of European tourists were tourists coming from the United States. (1,680,000 tourists). The difference is represented by US tourists (144,500 tourists), South American (17,900 tourists), Asian (315,100 tourists), Israeli (220,400 tourists) and African (14,500 tourists). The average length of stay was 2.4 days for Romanian tourists and 1.9 days for foreign tourists.

CONCLUSIONS

The effect of terrorism on tourism is much more visible than in other industries. While human costs are devastating, the economic impact of these attacks may be greater than those observed at first glance.

Published data show that a terrorist attack does not cause people to quit travel, but causes them to change tourist destinations, which leads to a decrease in the number of tourists, especially in the first year after an attack.

In Europe, the threat of terrorism adds to the serious problems surrounding the flow of immigrants and the impact of Britain's decision to leave the EU, phenomena that have serious economic consequences. In the cities where attacks took place, the most seriously affected were hotels, restaurants and tourism. Also, revenues from the entertainment industry have fallen dramatically, many cultural and sports events being cancelled, airlines have reduced their income in this period, so the whole economy is affected by these undesirable events.

Effects can be not only economic, but also social and political. This has increased scepticism towards foreign cultures, immigrants and refugees, and the closing of borders for merchants, immigrant workers, etc. have contributed to reducing economic transactions by limiting productive resources.

Specialists consider that every tourist destination should incorporate crisis management planning into its overall tourism planning, marketing, and management strategies. The purpose of such guidelines is to facilitate tourism recovery from negative occurrences by protecting or rebuilding a local area`s image of safety and attractiveness, reassuring potential visitors of the safety of the area, reestablishing the destination`s functionality and attractiveness, and aiding local travel and tourism industry members during their economic recovery [9].

The data shows that the number of tourists did not decrease with important figures, but what changed was the destination. Thus tourists headed for safer areas, but did not give up holidays. Probably also the culture component has a role in choosing the tourist destination. INSSE data showed that Romanians were less discouraged by terrorist attacks than tourists in America or Asia. An eventual future study could also include such a component in performing analyzes.

On the other hand, for Romania, terrorism could contribute to the development of domestic tourism. Given that record numbers have been reached in the last year in terms of the number of foreign tourists, tourism agencies could also seek solutions to promote domestic tourism.

REFERENCES

[1]Andreescu Anghel, 2015, Globalization, Between Security and Vulnerability, Timpolis, https://timpolis.ro/globalizare-intre-securitate-si-vulnerabilitate/, Accessed on 2.02.2018

[2]Arana Jorge E., Carmelo J. Leon, 2008, The impact of terrorism on tourism demand, Annals of Tourism Research, Volume 35, Issue 2, April 2008, Pages 299-315

[3]Baker, D. Mc, 2014, The Effects of Terrorism on the Travel and Tourism Industry, International Journal of Religious Tourism and Pilgrimage, Volume 2, Issue 1, Tourism and Terrorism.

[4]Iagaru Romulus, Iagaru Pompilica, Ciortea Gligor, Chindris Cosmin, 2016, The sustainable management of endogenous resources in rural areas of Sibiu depression, Scientific papers - Vol. 59 (2) / 2016, Agronomy Series.

[5]Korstanje E. Maximiliano, Clayton Anthony, 2009, Tourism and terrorism: conflicts and commonalities, Worldwide Hospitality and Tourism Themes.

[6]Necula Florin, 2016, How Terror Fears Fears in Tourists in Europe, http://www.ziare.com/international/terorism/cum-a-bag-terrorism-spaima-in-turistii-in-europa- 1432014, Accessed on 2.02.2018

[7]Pizam Abraham, Smith Ginger, 2000, Tourism and Terrorism: A Historical Analysis of Major Terrorism Acts and Their Impact on Tourism Destinations, Tourism Economics, 2000, 6 (2), 123–138.

[8]Popescu Agatha, 2016, The position of tourist and agrotourist guesthouses in Romania's accommodation

structures, Scientific Papers Series-Management, Economic Engineering in Agriculture and Rural Development, Vol. 16 (1): 417-424.
[9]Sonmez S. Sevil, Apostopoulus Yorgos, Tarlow P., 1999, Tourism in Crisis: Managing the Effects of Terrorism. Journal of Travel Research, 38(1):13-18.
[10]Toma Elena, 2014, Regional scale efficiency evaluation by input-oriented Data Envelopment Analysis of tourism sector, International Journal of Academic Research in Environment and Geography Vol. 1, No.1, June 2014, pp. 15 – 20.
[11]Vlad Ionela Mituko, Dinu Toma Adrian, Stoian Elena, 2016, Exploring the Links between the Average Income and the Arrivals' Number in Tourist Accommodation Establishments in Romania, Agriculture and Agricultural Science Procedia, Volume 10, 2016, Pages 591-597
[12] Eurostat - Statistical data, 2014, 2015, 2016.
[13] INSSE - Breviar touristic, 2016.

FACTORS INFLUENCING MEMBERSHIP OF FARMERS' IN COOPERATIVE SOCIETIES IN ABIA STATE, NIGERIA

Godwin Ndubuisi Ikechukwu MBAGWU

Imo State Polytechnic Umuagwo, Nigeria. Department of Cooperative Economics and Management, Email: godimbagwu@gmail.com

Corresponding author: godimbagwu@gmail.com

Abstract

The study analyzed factors influencing membership of farmer's in cooperative societies in Abia State, Nigeria. Simple random sampling technique was used to select 80 co-operators. Data were collected with structured questionnaire and analyzed with descriptive statistics such as: frequency counts, mean scores and percentages and inferential statistics (probit regression analysis). The result of socio-economic characteristics of showed the farmers had mean ages of 40.67 years, household size of 4.1 persons, mean farm income of ₦201, 000.00 with a mean farming experience 6.1years. The result revealed that 57.2% and 41.2 of the farmers belonged to farmers' multipurpose and agricultural cooperative societies. The result of probit regression estimates showed that coefficients age, farming experience, income, household size and poverty level influenced cooperative membership in the study area. Policies aimed at reducing household sizes by appropriate family planning techniques in order to reduce poverty and encouraging farmers to join cooperative societies for ease access of inputs and credit for enhanced productivity were advocated.

Key words: *factors, farmer's, membership, cooperative, societies*

INTRODUCTION

Cooperative as a business organization is owned and operated by a group of individuals for their mutual benefits. A cooperative may be owned and controlled equally by the people who use its service or by the people who work with cooperative enterprise [8]. Though an age-long legal organization, Cooperatives are the only means to bring the poorest segment of society into an organizational fold as legally recognized entities, providing opportunity for employment and better income along with the needed support services [17]. Agriculture in the post independent years was the main stay of Nigeria economy but suffered serious neglect due to the oil boom in 1970's. Agricultural production which then contributed about 80% to Gross Domestic Product (GDP) declined to less than 3% in the 1990's and 2000's. In order to redirect the situation, many programmes were initiated which were not able to meet the objective for which they were designed. This scenario was further constrained by the nation's agricultural sector which is characterized by small farm holdings [16]. He stated further that the peasant farmers produce over 90% of the food crop grown in Nigeria using traditional method coupled with obsolete farming implements. [15] opined that structural transformation of the present agricultural economy is inevitable for Nigeria to be food secured in future. This needed transformation could only be achieved through virile extension services because of its vital link between research stations and farmers.

Cooperative as defined by [10] is an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly-owned and democratically–controlled enterprise. Agricultural cooperatives are important in the socioeconomic development of the rural economy. Basically, poverty entails low income, low or no access to production inputs, low productivity, illiteracy and lack of access to information and basic necessities of life. It describes a condition of low income that leads to low saving, resulting in low investment and, as a consequence of that, productivity remains low [2]. Unfortunately, the performance of co-operatives in Nigeria and other African countries has been far from satisfactory [15]. He further stated that, those co-operatives which do not die off or go into coma soon after formation seem to be played down with poor leadership inefficiency, corruption, and membership apathy or disloyalty which has led poverty among members. Several categories of people such as rural inhabitants, poor people and uneducated people are not served by formal financial institutions in developing countries [3].

In an effort to raise awareness on the contribution of agricultural cooperatives to food security and poverty alleviation, there has been an increase in the promotion and registration of agricultural cooperatives. The extent to socio-economic characteristics of farmers influenced their membership in these agricultural cooperatives which has improved the standard of living is yet to be ascertained. In view of the foregoing therefore, this study was undertaken to determine the factors that influenced farmers' membership in cooperative societies in the study area.

The specific objectives were to:

(i)describe the socio-economic characteristics of co-operators;

(ii)identify different types of cooperative societies the respondents belong;

(iii)determine socio-economic factors that influence membership of farmers in cooperative society in the study area.

MATERIALS AND METHODS

The study was conducted in Abia State of Nigeria, which was created on the 27th August, 1991; out of the old Imo State. It is one of the five states in the South-East geo-political zone of Nigeria. Abia State comprises of 17 Local Government Areas (LGAs), grouped into three Agricultural zones, which include: Aba, Ohafia and Umuahia. The State is approximately within latitudes $4^o\ 41^1$ and $6\ ^o\ 14^1$ N and longitudes $7^o\ 10^1$ and 8^oE. The geographical location makes it a land-locked State. It occupies a land area of about 5,243.775 sq. Km^2 which is approximately 5.8% of the total land area of Nigeria with less than half of this land area being economically utilized [1]. It shares common boundaries to the North with Ebonyi State, to the South and Southwest with Rivers State and to the East and Southeast with Cross River and Akwa Ibom States. Abia State is located within the forest belt of Nigeria. Purposive and multistage random sampling techniques were adopted in the study. The lists of cooperators were obtained from the Abia State Ministry of cooperatives and Abia State planning Commission, Umuahia. This formed the sampling frame covering the clients/members (cooperators) from the selected cooperatives. From the list 10 cooperative societies were randomly selected across the state. Furthermore, 8 cooperators were randomly selected from the selected cooperative societies to give a total of 80 cooperators. Also 80 non-cooperators were randomly selected from the areas where the cooperators were selected. Descriptive statistics such as frequency counts, percentages and means were used to analyze objective i, ii, while the hypothesis was tested with probit regression analysis.

Measurement of Variables

Cooperative tenets were used to capture the active membership of co-operators in this study as adapted by [5]. The major areas for the measurement were:

(i)Frequency in attendance to monthly general meetings and Annual General Meetings (AGMs);

(ii)Range of personal savings by each member;

(iii)Patronage in credit delivery;

(iv)Loan repayment.

In this case, if a co-operator scores all the stated tenets, 1 was allotted i.e. 4/4 = 1 which makes the co-operator an active member and otherwise = 0.

Model Specification

The probit regression likelihood estimates, was used in analyzing the socio economic factors influencing membership of cooperative membership among cooperators in the study area.

The probit model is implicitly stated thus:

$Y1^* = Bx1+E$

$Y1^* = 0$ if $Y1^* = 0$

$Y1 = 1$ if $Y1^* = 0$

Y1 = 1 if Y1* = 0
Where
Y_1^* = an underlying latent variable that indexes cooperative membership.
Y_1 = Dummy variable indexing cooperative membership (active membership =1, non active membership =0).
B^1 = A vector of estimated parameter
E = Error term
X_1 = Gender (male = 1, female = 0)
X_2 = Age (continuous)
X_3 = Household size (continuous)
X_4 = Marital status (married =1, otherwise =0)
X_5 = Education (continuous)
X_6 = Farming experience (continuous)
X_7 = Extension contact (yes = 1, otherwise, 0)
X_8 = Farm size (continuous)
X_9 = Income (continuous)
X_{10} = Poverty level (continuous)
ei = Error Term.

RESULTS AND DISCUSSIONS

Selected Socio-economic Characteristics of Farmers

The socio-economic characteristics of respondents are shown in Table 1. The result showed that farmers had mean ages of 40.67 years with mean household sizes of 4.1 persons and 4.3 persons. This result is in tandem with the research findings of [6], that greater number of young people dominates membership of cooperatives in Nigeria. The result however, corroborates with [18], that majority of the young farmers had 4-6 persons in their households and a mean farming experience 6.1years. [12] also found that farming experience has shown to enhance the participation and adoption of improved farming techniques by farmers thereby increasing agricultural output. The mean on - farm and off - income for cooperators were ₦201, 000 and ₦ 130,863.8 respectively. The result suggests that the respondents also incomes form off farm activities. This result justifies that members of cooperatives were not full time farmers as they engaged in other income generating activities to meet family needs.

Table 1. Distribution of Respondents according to Socio-economic Characteristics (n = 80)

Variables	Frequency	Percentage
Age (years)		
20-30	25	31.25
31-40	28	35.0
41-50	9	11.25
51-60	8	10
61-70	7	8.73
Mean	40.67	
Household size (numbers)		
1-3	7	8.75
4-6	40	50.0
7-9	26	32.5
10 – 13	7	8.75
Mean	4.1	
Farming Experience (years)		
1-10	19	23.75
11 – 20	42	52.50
21-30	19	17.00
Mean	6.1	
On - farm income (₦)	6	7.5
51,000-100,000	25	31.2
1001,000-150,000	9	11.2
151,000-200,000	28	35.0
201,000-250,000	12	15.0
Mean	201,000	
Off Farm Income (₦)		
50,000-100,000	64	80.0
101,000 – 150,000	16	20.0
Mean	130,868.8	

Source: Field Survey, 2015
IUSD = 175 Nigeria Naira (NGN) @ time of this Research

Types of Cooperative Societies in the Study Area

Distribution of respondents according to types of cooperative societies is shown in Table 2. The table showed that a good proportion of the cooperative farmers (57.5%) belonged to farmers' multipurpose cooperative societies. The table also indicated a moderate proportion (41.2%) of the cooperative farmers belong to agricultural cooperative societies while only few (1.2%) of them were members of credit, thrift and loan cooperative society. Through the formation of farmers cooperatives, production output can be raised at minimal cost since the group would be able to take advantages of scale economics, overcome barrier to assets and manage available resources better, have access to larger piece of land either by pooling or leasing, have enhanced access to information delivery on agricultural production, especially information on market situation, have access to enriching educational and training programmes as well as attract financial resources from banks among others [19].Cooperatives are identified as autonomous association of persons united voluntarily to meet member's common economic, social and cultural needs and aspirations through a joint - owned democratically controlled enterprise [9].

Table 2. Distribution of Respondents According to Types of Cooperative Societies

Types Cooperatives	Frequency	Percentage
Agricultural cooperative society	33	41.2
Credit, thrift and loan cooperative society	1	1.2
Farmers multipurpose cooperative society	46	57.5

Source: Field Survey, 2015

Probit Regression of Factors Influencing Cooperative Membership

Results in Table 3 show the Probit estimates of the determinants of membership of cooperatives in the study area. The Chi square value of 48.70 was highly significant at 1% level indicating a probit regression of best fit. The coefficient for age was positively signed and significant at 5% level of probability. This indicates that any increase in age will lead to a corresponding increase in the probability of membership of cooperatives. This is expected probably because; the older may seem to be more credible in group formations than the younger who tend to be more aggressive. [7] affirmed that age of cooperators has implication on productivity of members. This result disagrees with [11] as he had negative relationship between age and membership and participation of cooperative members in Edo State, Nigeria. The coefficient for household size was negatively signed and significant at 10% level of probability. This implies that any increase in household size will lead to a corresponding decrease in the membership of cooperatives. This may be because of overwhelming domestic duties hindering the participation of members in cooperatives. This result is in contrast with the findings [13] as they found a positive relationship between household sizes of cooperative gari marketers in Abia State. The coefficient for farming experience was positively signed and significant at 5% level of probability. This implies that any increase in farming experience will lead to a corresponding increase in the membership of cooperatives. This is expected because with experience, the farmers are aware of the numerous benefits emanating from being members. This result is in tandem with the findings of [14] where farming experience of cooperators were determinants of participation and cooperative membership in Cross River State, Nigeria. The coefficient for income was positively signed and highly significant at 1% level of probability. This implies that any increase in income will lead to a corresponding increase in membership of cooperative societies. This result concurs with the findings of [7] where income of co-operator influenced their membership in cooperative society in Ekiti, State, Nigeria. The coefficient for poverty level was also positively signed and significant at 5% level of probability. This implies that any increase in poverty level of the farmers will lead to a corresponding increase in the membership of cooperatives. This is expected, because farmers who have low income pool their resources together in cooperatives to be able to access inputs and credit [4]. [14] in their study affirmed that poverty levels of FADAMA cooperative farmers influenced their participation and membership in the programme.

Table 3. Probit Estimates of the Determinants of Membership of Cooperatives by Farmers in the study area

Variables	Coefficient	Std. Error	t-value
Constant	-3.475	1.442	-2.41**
Gender	0.081	0.298	0.27
Age	0.053	0.025	2.62**
Household size	-0.129	0.076	-1.70*
Marital status	0.108	0.293	0.37
Education	0.104	0.151	0.68
Farming experience	0.083	0.048	2.72**
Extension services	0.040	0.178	0.22
Income	0.088	0.023	3.93***
Poverty level	0.235	0.080	2.93**
Chi^2	48.70**		
Log likelihood	-58.169		

Source: Results from STATA 4A

*, ** and *** is significant at 10%, 5% and 1% level.

CONCLUSIONS

Results from the study indicate that a good proportion of cooperative farmers belonged to farmers' multipurpose and agricultural cooperative societies. The result showed that coefficients age, farming experience, income, household size and poverty influenced cooperative membership in the study area. The study therefore recommends: enactment of policies aimed at reducing household sizes by appropriate family planning techniques to reduce poverty and encouraging both old and young farmers to join cooperative societies for ease access of inputs and credit for enhanced productivity.

REFERENCES

[1] Abia State Economic Empowerment and Development Strategy (ABSEEDS), 2005, Abia Sate Planning Commission, Abia State, Nigeria.
[2]Adegeye, A. J., Dittoh, J. S., 2005, Essentials of Agricultural Economics. Centre for Agricultural and Rural Development (CARD), University of Ibadan, Ibadan.
[3]Adjei, J. K., Arun, T.., 2009, Microfinance Programmes and the Poor: Whom Are They Reaching? Evidence from Ghana. Brooks World Poverty Institute, Working Paper 72.
[4]Alufohai, G.O., 2006, Sustainability of Farm Credit Delivery by Cooperative and Non Governmental Organizations in Edo State, Nigeria. Journal of Education Research and Development, 1 (8): 262 - 266. www.academic journals.org, Accessed on 21/10/2015
[5]Alufohai, G.O., Offiong, U. K., 2013, Effect of Membership Participation on Capital Formation among Framer Cooperative Societies in Cross River State, Nigeria. Journal of Agriculture, Food and Environment, 9(4): 91- 94.
[6]Anyanwu, G., 2010, Democracy in Cooperatives. A Journal of Applied Communication, Vol.12.
[7] Aribaba, F. O., 2013, An Investigation of the Performance of Cooperative Thrift and Credit Societies in Financing Small-Scale Businesses in Nigeria. Mediterranean Journal of Social Science, 4 (1): 34 – 49.
[8] Birchall, J., 2005, Co-operative principles ten years on International Cooperative Alliance, Issue 2, 98(2):45-63. http://www.ica.coop/, Accessed on September 1, 2005.
[9]International Cooperative Alliance (ICA), 2009, Review of international Cooperatives, Vol.85 (4):85 – 86.
[10]International Cooperative Alliance (ICA), 2004, http://www.ica.coop/, Accessed on September 1, 2005.
[11]Michael, K. K., 2014, The Effect of Improved Commercial Bank Services on Saving and Credit Cooperative Societies Membership: A Case Study of Murang'a Town, Kenya. International Journal of Academic Research in Economics and Management Sciences: 3(1) 2226-3624
[12] Nwaobiala. C. U., Onumadu, F. N., 2010, Youth Participation in Cassava Production through Rural Extension Project of Federal College of Agriculture, Isiagu, Ebonyi State Nigeria. Proceedings of the 44th Annual Conference of Agricultural Society of Nigeria held at LAUTECH Ogbomoso, Ogun State, Nigeria. 18th -22nd October, Pp 50-51.
[13]Obasi, I. O., Ogbonnaya, H. J., 2014, Factors Influencing the Income of Cooperative and Non Cooperative Marketers in Bende Local Government Area of Abia State, Nigeria. International Journal of Agriculture and Rural Development, 17(1): 1702 – 1706.
[14]Ogbonna, M. O., Nwaobiala, C. U., 2015, Evaluation of participation and poverty Levels of National FADAMA III Development Project Rural Farm Women in Gombe State, Nigeria. Discourse Journal of Agriculture and Food Sciences 3(6): 83-90 http://www.resjournals.org/JAFS/PDF/2015/June/Ogbonna_and_Nwaobiala.pdf, Accessed on 24/10/2015.
[15]Olayemi, A. O., Olayide, S. O., Eweka, J. A., Bello – Osagie, V. E., 2008, Nigeria Small Scale Farmers Problems and Prospect in Integrated Rural Development (CARD), University of Ibadan. Pp. 5 – 20.
[16]Olayide, S. O., 2008, Characteristics, Problems and Significance of small farmers. In: Small farmers in Nigeria, problem and prospects. By Emeka, J. A., Bello – Osagie, V. E. (eds.). University of Ibadan.
[17] Oni, O. A., Salimonu, K. K., Idowu. B. O., 2011, Social Capital Dimension and Food Security among Farming Households in Ogun State, Nigeria. Journal of American Science, 7(8): 19 -15.
[18]Onyima, J. K.C., Chijioke, N. O., 2009, Cooperatives: Elements, Principles and Practices. Maxiprints, Awka Anambra state, south – east, Nigeria.
[19]Salman, K. K., Akinbosoye, O. O., 2013, Food Security Status Among Cooperative and Non Cooperative Farming Households in Rural Akinyele Local Government Area of Oyo State, Nigeria. Nigerian Journal of Rural Extension and Development, 7 (1): 35 -45.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

SOME CONSIDERATIONS REGARDING THE PRIMARY WHEAT SUPPLY IN ROMANIA AND ITS COMPOSITION (2014 – 2016)

Dragoș Mihai MEDELETE, Radu Lucian PÂNZARU, Marius VLADU, Gheorghe MATEI

University of Craiova, Faculty of Agronomy, 19 Liberty, 200421, Craiova, Romania, Phone: +40741180976, Fax: +40251418475, Emails: medelete@yahoo.com, rlp1967craiova@yahoo.com

Corresponding author: rlp1967craiova@yahoo.com

Abstract

The study seeks to establish an anchoring, in time, of the Romanian primary wheat supply, having regard to the importance of the respective product for the Romanian agricultural economy (the second crop plant at national level based on cultivated areas and total yields). In the same context, the importance of wheat crop can be revealed through the role that this product can play as an export item - especially in years characterized by considerable levels of yields. In the period 2014-2016, the levels of the cultivated area and the total production (2,119,062.67 ha and 7,992,788.67 t) are highlighted, but also the less appropriate performance in terms of average production (3,771 kg/ ha). It is worth mentioning that certain aspects that influence the preforms of the respective culture need to be improved: the stronger atomicity of producers, the financing measures (non-reimbursable EU funds not accessible to the large mass of producers), the adequate upgrading of capital items mechanical capital and the upgrading of storage and preservation areas), the protection of certain categories of producers from the sensitive aspects of the market (for example, the evolution of the marketing prices).
.

Key words*: *wheat, offer, average production, total production, area

INTRODUCTION

The offer of a product is the amount of goods and services traders want to sell at a certain price [7]. The supply in the agricultural commodity market is scattered and quantitatively irregular [2]. In the long run, the supply of agricultural products is relatively stable depending on the volume of annual agricultural produce, the level of stocks accumulated over time, the impact of agricultural policies, etc. [4].

Wheat is the most important cultivated plant, the largest share food [9]. Wheat is one of the most important cereals grown in Romania and occupies between 22 and 28% of the country's arable land [12].

In Romania, the most favorable areas for wheat are: the Western Plain, the Romanian Plain, the Transylvanian Plain and a part of the Northeast of Moldova [10].

The wheat supply in Romania has seen different trends over time. Thus, for the period 2002-2007, the number of farms that cultivated wheat remained relatively constant, as well as the total area cultivated on the holding [14].

Wheat, as a grain production, is mostly used for human consumption in the form of flour, bakery products or as germs and to a lesser extent for animal feed [8].

In addition to bread and innumerable pastries, wheat can also be used in the manufacture of alcohol, starch, dextrin and glucose [9].

Shredding wheat in a suitable rotation provides convenient premises for obtaining the right produce. As a result, every time the wheat is sown after peas, considered a good predecessor to the recovery of peas [3].

At present, the total wheat production obtained in Romania ensures internal consumption and gives the possibility to export significant quantities of this culture [6].

Wheat is a current marketable product on the agrarian market. About 15% of total world cereal production and over 18% of wheat production are the subject of international trade. Wheat accounts for about 45% of world cereal trade [13].

The paper shows how the wheat production is distributed in the territory. From this point of view, it is intended to highlight the relative importance played by each macro region and development region.

MATERIALS AND METHODS

For the purpose of drafting the paper, it is aimed at the creation at national level of the primary supply: cultivated area (ha), total production (t) and average production (kg/ha), for the period 2014-2016.

This highlights the macroregional and regional contributions as follows: Macroregion 1 consisting of the North West Region and the Central Region; Macroregion 2 consisting of the North East Region and the South East Region; Macroregion 3 consisting of South Muntenia Region and Bucharest-Ilfov Region; Macroregion 4 composed of the South West Oltenia Region and the West Region.

The method of analysis used is the comparison. The comparison method evaluates the results obtained and compares them with certain reference bases. Comparisons are done over time, in space and mixed [1].

The paper used indices analysis, comparison over time being highlighted through the mobile base index, calculated by formula: $I_{bm} = \frac{Y_n}{Y_{n-1}} x100$, in which: Y_n - the level of indicator for each component of the dynamic series; Y_{n-1} - the level of temporal sequence indicator considered as a basis for comparison or reference period . It starts from the national, macro-regional and regional level of the indicators, determining the structure indices (for the cultivated area and the total production). In the case of average production, the macroregional and regional levels are reported at the national level of the indicator, with a position towards it being established.

In order to establish a correlation between cultivated area and total production, we used it:

- equation for the correlation coefficient:

$$Correl(X,Y) = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

$\bar{x}$ şi $\bar{y}$ - are the averages for samples, average (matrix1) and average (matrix2);

RESULTS AND DISCUSSIONS

The cultivated area. Data extracted from the site [15], refers to the evolution of the cultivated area (on the three reference levels - national, macroregional and regional) and is presented in Table 1.

In the case of 2014, a total area of 2,112,866 ha was cultivated, characterized by the following structure:

- 31.49% Macro-region 2 (665,414 ha total area of which 507,013 ha in the South East respectively 23.99% and 158,401 ha for the North East - 7.50%);
- 29.55% Macroregion 4 (a total area of 624,280 ha, which at regional level was divided as follows: 11.47% in the West and 18.08% in the South West, 242,244 and 382,036 ha respectively);
- 28.82% Macroregion 3 (608,942 ha distributed 590,583 ha for South Muntenia 27.95% and 18,359 ha for the Bucharest-Ilfov region 0.87% respectively);
- 10.14% Macroregion 1 (total cultivated area of 214,230 ha, with 5.82% for North West and 4.32% for Center, corresponding to areas 122,922 and 91,308 ha).

At the level of 2015, the structure of the national area (2,106,591 ha) was as follows:

- 11.21% Macroregion 1 (total cultivated area of 236,133 ha, distributed in the two component regions: 89,519 ha Center and 146,614 ha North West, actual values that determined weights of 4.25 and 6.96% respectively);
-28.41% Macroregion 4 (598,571 ha cultivated area, while the regions of West and South West Oltenia held shares of 11.14 and 17.27%, starting from 234,756 and 363,815 ha);
-28.67% Macroregion 3 (total area of 603,965 ha, for which the component regions contributed 18,531 and 585,434 ha respectively - Bucharest-Ilfov and South Muntenia - so that the structural weights were

0.88 and 27.79% at national level);
-31.71% Macroregion 2 (667,922 ha total area, with the percentage contributions being 7.98 and 23.73% on the basis of the actual values of the 168,028 ha for North East and 499,894 ha for the South East).

Table 1. Area cultivated with cereals (ha)

Specification	Year								Average**		
	2014		2015			2016					
	Eff.*	Str. (%)**	Eff.*	Str. (%)**	2015/ 2014**	Eff.*	Str. (%)**	2016/ 2015**	Eff.	Str. (%)	average/ 2016
Total	2,112,866	100	2,106,591	100	99.70	2,137,731	100	101.48	2,119,062.67	100	99.13
Macro region 1	214,230	10.14	236,133	11.21	110.22	235,339	11.01	99.66	228,567.33	10.79	97.12
Region North West	122,922	5.82	146,614	6.96	119.27	144,662	6.77	98.67	138,066.00	6.52	95.44
Region Centre	91,308	4.32	89,519	4.25	98.04	90,677	4.24	101.29	90,501.33	4.27	99.81
Macro region 2	665,414	31.49	667,922	31.71	100.37	647,598	30.29	96.96	660,311.34	31.16	101.96
Region North East	158,401	7.50	168,028	7.98	106.08	167,812	7.85	99.87	164,747.00	7.77	98.17
Region South East	507,013	23.99	499,894	23.73	98.59	479,786	22.44	95.98	495,564.34	23.39	103.29
Macro region 3	608,942	28.82	603,965	28.67	99.18	606,413	28.37	100.40	606,440.00	28.62	100.01
Region South Muntenia	590,583	27.95	585,434	27.79	99.13	588,039	27.51	100.44	588,018.67	27.75	99.99
Region Bucharest Ilfov	18,359	0.87	18,531	0.88	100.94	18,374	0.86	99.15	18,421.33	0.87	100.26
Macro region 4	624,280	29.55	598,571	28.41	95.88	648,381	30.33	108.32	623,744.00	29.43	96.20
Region South West Oltenia	382,036	18.08	363,815	17.27	95.23	399,710	18.70	109.87	381,853.67	18.02	95.53
Region West	242,244	11.47	234,756	11.14	96.90	248,671	11.63	105.93	241,890.33	11.41	97.27

*http://statistici.insse.ro/shop/ (24.07.2017)
** own calculation

The year 2016 is characterized by a total national area of 2,137,731 ha to which development regions contributed as follows: 27.51% South Muntenia (588,039 ha), 22.44% South East (479,786 ha), 18.70% South West Oltenia (399,710 ha), 11.63% West (248,671 ha), 7.85% North East (167,812 ha), 6.77% North West (144,662 ha), 4.24% Center (90,677 ha) and 0.86% Bucharest-Ilfov (18,374 ha). As a result of these situations, at macroregional level we can find variable weights from 11.01% for Macroregion 1 (235,339 ha) to 30.33% for Macroregion 4 (648,381 ha). The other two macro-regions had contributions of 28.37 and 30.29% (3 and 2 respectively) as a result of actual levels of the cultivated areas of 606,413 and 647,598 ha, respectively.

The average of the analyzed period was 2,119,062.67 ha highlighting variable structures at macroregions and development regions:
-31.16% Macroregion 2, 29.43% Macroregion 4, 28.62% Macroregion 3, 10.79% Macroregion 1 (660,311.34, 623,744, 606,440 and 228,567.33 ha);
- 0.87% Bucharest-Ilfov Region (18,421.33 ha), 4.27% Central Region (90,501.33ha), 6.52% North West Region (138,066 ha), 7.77% North East Region (164,747 ha), 11.41% West Region (181,890.33 ha), 18.02% Region South West Oltenia (381,853.67 ha), 23.39% South East Region (495,564.34 ha), 27.75% South Muntenia Region (588,018.67 ha), Figure 1.

Total production. Wheat acreage nationwide is an important factor that directly influences the production realized by farmers [11].

Table 2, according to the site [15], the data are shown for the total production.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

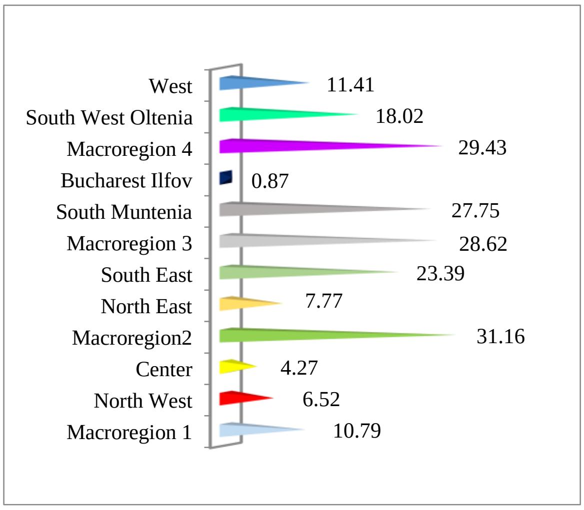


Fig. 1.Cultivated surface - macro-regional and regional structure, period average (2014-2016)

In the case of 2014, when total national production was 7,584,814 t, the structural weights (by regions and macro regions) reached:
-30.28% Macroregion 2 - 2,296,563 t (weights of 23.30 and 6.98% for the South East and North East, 1,767,518 and 529,045 t respectively);
-30.15% Macroregion 3 - 2,286,473 t (29.17% South Muntenia and 0.98% Bucharest-Ilfov, starting from the actual levels of 2,212,388 and 74,085 t respectively);
-28.89% Macroregion 4 - 2,191,580 t (16.10% South West Oltenia and 12.79% West, actual production of 1,221,507 t and 970,073 t, respectively);
- 10.68% Macroregion 1 – 810,198 t (6.23% North West and 4.45% Center, which was based on productions of 472,422 and 337,776 t respectively).

Table 2. Total cereal production (t)

Specification	Year								Average**		
	2014		2015			2016					
	Eff.*	Str. (%)**	Eff.*	Str. (%)**	2015/ 2014**	Eff.*	Str. (%)**	2016/ 2015**	Eff.	Str. (%)	average/ 2016
Total	7,584,814	100	7,962,421	100	104.98	8,431,131	100	105.89	7,992,788.67	100	94.80
Macro region 1	810,198	10.68	904,947	11.37	111.69	833,039	9.88	92.05	849,394.67	10.63	101.96
Region North West	472,422	6.23	570,476	7.17	120.76	488,888	5.90	85.69	510,595.34	6.39	104.44
Region Centre	337,776	4.45	334,471	4.20	99.02	344,151	4.08	102.89	338,799.33	4.24	98.44
Macro region 2	2,296,563	30.28	2,359,482	29.63	102.74	2,621,451	31.09	111.10	2,425,832.00	30.35	92.54
Region North East	529,045	6.98	509,032	6.39	96.22	605,596	7.18	118.97	547,891.00	6.86	90.47
Region South East	1,767,518	23.30	1,850,450	23.24	104.69	2,015,855	23.91	108.94	1,877,941.00	23.49	93.16
Macro region 3	2,286,473	30.15	2,443,208	30.68	106.85	2,493,160	29.57	102.04	2,407,613.67	30.12	96.57
Region South Muntenia	2,212,388	29.17	2,364,796	29.70	106.89	2,416,773	28.66	102.19	2,331,319.00	29.17	96.46
Region Bucharest Ilfov	74,085	0.98	78,412	0.98	105.84	76,387	0.91	97.42	76,294.67	0.95	99.88
Macro region 4	2,191,580	28.89	2,254,784	28.32	102.88	2,483,481	29.46	110.14	2,309,948.33	28.90	93.01
Region South West Oltenia	1,221,507	16.10	1,209,997	15.20	99.06	1,325,051	15.72	109.51	1,252,185.00	15.67	94.50
Region West	970,073	12.79	1,044,787	13.12	107.70	1,158,430	13.74	110.88	1,057,763.33	13.23	91.31

*http://statistici.insse.ro/shop/ (24.07.2017)
** own calculation

At the level of 2015, the structure of national production (7,962,421 t) was as follows:
- 11.37% Macroregion 1 - 904.947 t (4.20% Center and 7.17% North West, weights resulting from total regional productions of 334,471 and 570,476 t respectively);
- 28.32% Macroregion 4 - 2,254,784 t (13.12% West and 15.20% South West Oltenia, percentages based on actual levels of the indicator of 1,044,787 and 1,209,997 t in

the situation of the two regions);

- 29.63% Macroregion 2 - 2,359,482 t (23.24% South East and 6.39% North East, with total outputs of 1,850,450 and 509,032 t respectively);
- 30.68% Macroregion 3 - 2,443,208 t (0.98% Bucharest-Ilfov and 29.70% South Muntenia, based on total production of 78,412 and 2,364,796 t respectively).

For the year 2016, variable rates of the Macroregions were recorded at national level, from 9.88% for Macroregion 1 (833.039 t) to 31.09% for Macroregion 2 (2,621,451 t), while for the other two macro-regions finds 29.46 and 29.57% respectively Macroregion 4 (2,483,481 t) and Macroregion 3 (2,493,160 t). At the level of the development regions, variation limits from 4.08% for the Central Region (344,151 t) to 28.66% for the South Muntenia Region (2,416,773 t) are found.

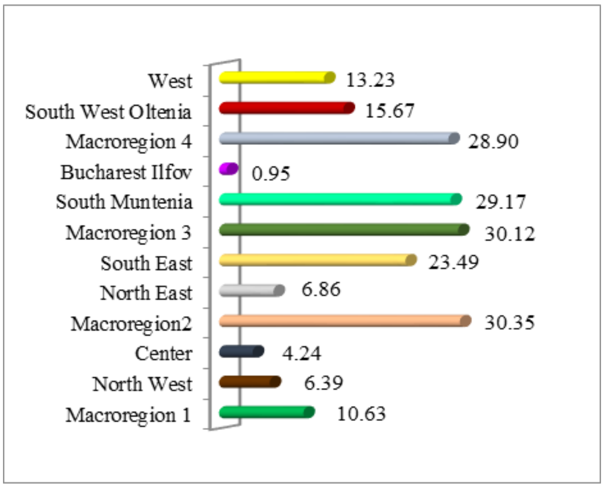


Fig. 2.Total cereal production - structure macro-regional and regional, period average (2014-2016)

For the analyzed period, the average total production (8,493,394.67 t) points out, on macroregions and development regions, variable structure as follows:

- the macro-region structure is as follows: 30.35% Macroregion 2 (2,425,832 t), 30.12% Macroregion 3 (2,407,613.67 t), 28.90% Macroregion 4 (2,309,948.33 t), 10.63% Macroregion 1 (849,394.67 t);
- the structure by regions was: 0.95% Bucharest-Ilfov (76,249.67 t), 4.24% Center (338,799.33 t), 6.39% North West (510,595.34 t), 6.86% North East (547.891 t) , 15.67% South West Oltenia (1,252,185 t), 23.49% South East (1,877,941 t), 29.17% Sud Muntenia (2,331,319 t) - Figure 2.

Average production. Romania has the lowest yield of production in the EU, there have been years (2011, for example), in which the yield has been more than half of that of the EU [5].

Table 3 contains information on the evolution of average production (kg/ha) conform [15].

For the year 2014, variable weights of the Macroregions are observed at national level, from 96.13% for Macroregion 2 (3,451 kg/ha) to 105.35% for Macroregion 1 (3,782 kg/ha), while for the other two Macroregions 97.80 and 104.60% respectively Macroregion 4 and Macroregion 3 (3,511 and 3,755 kg/ha) are recorded, if compared to the 3,590 kg/ha recorded at national level. Regarding the situation on development regions, positioning limits from 89.05% for South West Oltenia (3,197 kg/ha) to 112.40% for Bucharest-Ilfov (4,035 kg/ha) are found.

The year 2015 is characterized by a national level of the indicator of 3,780 kg/ha, against which macro-regions and development regions were positioned as follows:

- 107.01% Macroregion 3 - 4,045 kg/ha (111.93% Bucharest-Ilfov and 106.85% South Muntenia, actual levels of 4,231 and 4,039 kg/ha respectively);
- 101.38% Macroregion 1 – 3,832 kg/ha (102.94% North West and 98.84% Center due to actual levels of 3,891 and 3.736 kg/ha respectively);
- 99.66% Macroregion 4 – 3,767 kg/ha (117.75% West and 87.99% South West Oltenia, based on average yields per hectare of 4,451 and 3,326 kg respectively);
- 93.47% Macroregion 2 – 3,533 kg/ha (97.94% South East and 80.13% North East, actual levels of 3,702 and 3,029 kg/ha respectively).

In 2016, compared to the national average (3,944 kg/ha), macro-regions and regions are positioned as follows:

-89.76% Macroregion 1 - 3,540 kg/ha (85.70% North West and 96.22% Center due to average production levels per hectare of 3,380 and 3,795 kg/ha respectively);

-97.11% Macroregion 4 - 3.830 kg/ha (84.05% South West Oltenia and 118.10% West on the basis of the actual levels of 3.315

and 4.658 kg/ha respectively);
-102.64% Macroregion 2 - 4,048 kg/ha (106.54% South East and 91.51% North East, starting from the actual levels of the indicator 4.202 and 3.609 kg/ha respectively);
-104.23% Macroregion 3 – 4,111 kg/ha (104.21% South Muntenia and 105.40% Bucharest-Ilfov, actual levels of 4,110 and 4,157 kg/ha respectively).

Table 3. Cereal average yield (kg/ha)

Specification	Year								Average**		
	2014		2015			2016					
	Eff. *	% compared to the national level **	Eff. *	% compared to the national level **	2015/ 2014**	Eff. *	% compared to the national level **	2016/ 2015**	Eff.	% compared to the national level **	average/ 2016
Total	3,590	100	3,780	100	105.29	3,944	100	104.34	3,771	100	95.61
Macro region 1	3,782	105.35	3,832	101.38	101.32	3,540	89.76	92.38	3,718	98.59	105.03
Region North West	3,843	107.05	3,891	102.94	101.25	3,380	85.70	86.87	3,705	98.25	109.62
Region Centre	3,699	103.04	3,736	98.84	101.00	3,795	96.22	101.58	3,743	99.26	98.63
Macro region 2	3,451	96.13	3,533	93.47	102.37	4,048	102.64	114.58	3,677	97.51	90.83
Region North East	3,340	93.04	3,029	80.13	90.69	3,609	91.51	119.15	3,326	88.20	92.16
Region South East	3,486	97.10	3,702	97.94	106.19	4,202	106.54	113.51	3,797	100.69	90.36
Macro region 3	3,755	104.60	4,045	107.01	107.72	4,111	104.23	101.63	3,970	105.28	96.57
Region South Muntenia	3,746	104.35	4,039	106.85	107.82	4,110	104.21	101.76	3,965	105.14	96.47
Region Bucharest Ilfov	4,035	112.40	4,231	111.93	104.86	4,157	105.40	98.25	4,141	109.81	99.62
Macro region 4	3,511	97.80	3,767	99.66	107.29	3,830	97.11	101.67	3,703	98.20	96.68
Region South West Oltenia	3,197	89.05	3,326	87.99	104.03	3,315	84.05	99.67	3,279	86.95	98.91
Region West	4,005	111.56	4,451	117.75	111.14	4,658	118.10	104.65	4,371	115.91	93.84

*http://statistici.insse.ro/shop/ ((24.07.2017)
**own calculation

The national average of the analyzed period (3,771 kg) signals variable positions on Macroregions and Development Regions, as follows:
- for Macroregions the situation is as follows: 105.28% Macroregion 3, 98.59% Macroregion 1, 98.20% Macroregion 4, 97.51% Macroregion 2 (actual macroregional levels of 3,970, 3,718, 3,703 and 3,677 kg/ha respectively);
- positioning on Development Regions is as follows: 89.95% South West Oltenia (3,279 kg/ha), 88.20% North East (4,326 kg/ha), 98.25% North West (3,705 kg/ha), 99.26% Center (3,743 kg/ha), 100.69% South East (3,797 kg/ha), 105.14% South Muntenia (3,965 kg/ha), 109.81% Bucharest-Ilfov (4,141 kg/ha) - Figure 3.

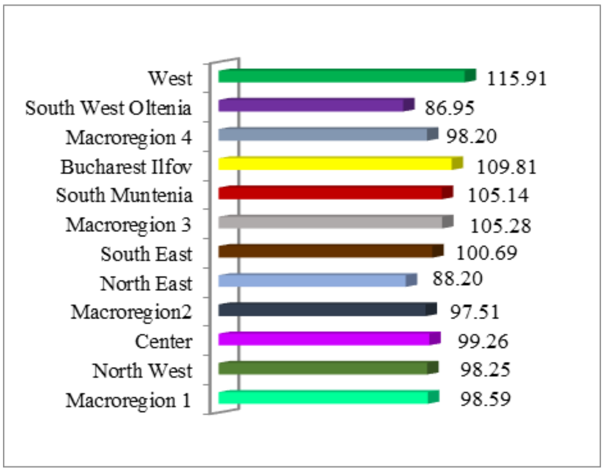


Fig. 3. Average yield - Macro regions and Regions of developing, position to the national situation (%), period average (2014-2016)

CONCLUSIONS

The cultivated area is characterized by a non-uniform evolution (amplitude of 1.78% - 31,140 ha and 1.46% of the average of the indicator - relatively insignificant variation), characteristic of all regions and macroregions, with the exception of the South Est Region where the evolution was strictly descending. As such, some degree of uniformity of the indicator may be observed.

Romania manifests itself as an important cultivator at the continental and regional (EU) level, accounting for approximately 3.5 and 8% respectively (weights are based on 2014 data for Europe and the EU) [16].

The total output has grown upward at national level (amplitude of 5.89%, 846,317 t, ie 10.59% of indicator average - somewhat appreciable difference). Similar issues are found for Macroregion 2, South East Region, Macroregion 3, South Muntenia Region, Macroregion 4 and West Region. In the rest there are non-uniform evolutions.

At continental and regional level, Romania achieved about 3.2 and 5% of total production [16], less convenient situation (less weights than those registered for the cultivated area, situation resulting from the weaker results, due to the technological, capitalization, etc. specific to the Romanian producers);

The correlation between the cultivated area and the total production is evidenced by the values of the correlation coefficient (r = 0.999039) and the grade 2 polynomial function (R^2 = 0.9981), values based on the levels of the two indicators for the average of the analyzed period. These situations signal the direct correlation between the two phenomena;

The average yield per hectare has been on a nationwide upward trend (variation amplitude of 354 kg - 9.38% in relative values, significant variation). Similar situations arise for the Central Region, Macroregion 2, South East Region, Macroregion 3, South Muntenia Region, Bucharest-Ilfov and West Region. The rest of the analyzed units show an uneven trend.

It is noteworthy that in the regional and continental context, Romania achieved about 89% and 64%, respectively, of the reference levels [16].

The macro-region 1 has a secondary role in influencing national levels of total wheat production, with some balance between the other macro-regions (2.64% for cultivated area and 1.45% for total production). As a result, wheat is a culture that at national level has an increased adaptability to characteristic agro-productive conditions;

Wheat represents an important crop for Romania (the second one for corn), generating a favorable economic aspect at the level of the local producers, especially in the conditions of favorable climatic and economic conjuncture. Hence the need to apply appropriate measures to protect producers in order to adequately exploit the existing national potential.

REFERENCES

[1]Alecu, I., Merce E., Pană D., Sâmbotin L., Ciurea I., Bold, I., Dobrescu, N., 1997, Management in agriculture, Ceres Publishing House, București, pp. 300 - 318.

[2]Alecu, I. I., Constantin M., 2011, Agricultural Marketing, Ceres Publishing House, București, pp. 5 - 46.

[3]Berca, M., 2011, Agrotechnics, Modern Transformation of Agriculture, Ceres Publishing House, București, pp. 78 – 123.

[4]Constantin, M., Lagrange, L., Ferro, O., Boussard, J. M., Montigaud, J. C., Persona, R., Floricel, C., 1999, Agro marketing, Edition IV, Didactical and Pedagogical Editing, București, pp. 47 – 79

[5]Marin, Diana-Elena, 2014, Evolution of supply and demand of wheat in Romania – Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 14, Issue 1, 2014 pp. 207-210

[6]Matei, G., 2014, Phytotechnics, Cereals and Legumes, Vol. 1, Sitech Publishing House, Craiova, pp. 40 - 288

[7]Mâlcomete, P., Merhidan, G., Munteanu, V., Adăscăliței, V., Anton, I., Constantinescu A., Dijmărescu E., Isărescu M., Vainer, A., 1994, Internal and International Marketing Lexicon, Junimea Publishing House, Iași, pp. 208 - 215

[8]Oancea, Margareta, 2007, Management, Economic Management and Strategy of Agricultural Units, Ceres Publishing House, București, pp. 602 - 638

[9] Roman, G., V., Tabără, V., Robu, T., Pîrșan, P., Ștefan, M., Axinte, M., Morar, G., Cernea, S., 2011, Phytotechnics, Vol. I - Cereals and pulses for grains, University Publishing House, București, pp. 42 - 291

[10] Sin, G., 2005, Technological Management of Field Cultures, Ceres Publishing House, București, pp. 16 – 36

[11]Soare, Elena, Chiurciu, Irina-Adriana, 2016, Research of the Romanian wheat market, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 16, Issue 2,

2016, pp. 287- 292

[12]Zahiu Letiția, Arion, F., Berevoianu Rozi, Constatin, M., Dachin Anca, Dobre Iuliana, Drăghici, M., Ene Irina, Giurcă Daniela., Grodea Mariana, Iatan Elena, Ion Raluca, Lazăr, T., Oancea, Margareta, Popescu Angela, Turek A., Turek Magdalena, Turek Antoaneta, 2005, Agricultural Policies and Markets, Reform and Integration, Ceres Publishing House, București, pp. 250 - 465

[13]Zahiu Letiția, Dachin Anca, Manole V., Ion Raluca, Popescu Adelina, Istudor, N., Poenaru, Ș., 2006, Agriculture of the European Union under the Impact of the Common Agricultural Policy, Ceres Publishing House, București, pp. 199 - 227

[14]Zahiu Letiția, Toma Elena, Dachin Anca, Alexandri Cecilia (coordonatori), Ailenei, D., Alboiu Cornelia, Angelescu Coralia, Molănescu Gabriela, Grodea Mariana, Huru, D., Iuliana, I., Luca, L., Moldovan Minodora, Socol Aura, Socol, C., 2010, Agriculture in the Romanian Economy, Between Expectations and Reality, Ceres Publishing House, București, pp. 58 - 96

[15http://www.insse.ro, Accessed on December 10, 2017.

[16] http://www.fao.org/faostat/fr/#data/QC, Accessed on December 10, 2017.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE INFLEUENCE OF THE MINERAL AND ORGANIC FERTILIZERS ON SOIL REACTION IN THE APPLE TREE PLANTATION OF THE TIMISOARA DIDACTICAL STATION

Casiana MIHUȚ, Anișoara DUMA-COPCEA, Aurelia MIHUȚ

University of Agricultural Sciences Banat Veterninară „King Michael I of Romania" Timisoara, 119 Arad Way, Timisoara, Romania, Phone: +4025627475, Fax: +40256200296, Emails:casianamihut@yahoo.com, duma_anisoara@yahoo.com, aurelia_mihut@yahoo.com

Corresponding author: casiana_mihut@usab-tm.ro

Abstract

The purpose of this paper is to observe and reevaluate the influence mineral and organic fertilizers have on soil reaction. Various dosages of fertilizer have been applied, chemical as well as natural (manure) and comparisons were made regarding their influence, depending on the culture system (intensive and superintensive) without changing the dosage, but taking fruit tree density per hectare into account. Research in this paper was carried out on an experimental field at the Didactic Station of the U.A.S.V. M. B. in Timişoara during 2016-2017 and later in the research laboratories of the Departments of Soil Science and Agro-chemistry of the Faculty of Agriculture in Timişoara. The soil on which the experiment is placed, is a chernozem, moderate gleized cambic, weakly decarbonated, clayey, on medium fine loss layers. The experiment is polyfactorial, type 2 x 6: factor A – the crop system: a_1 – the intensive system; a_2 – the superintensive system. Factor B – doses of fertilizer. The experiment includes 12 alternatives. Each alternative includes 4 trees, between the alternatives have been left two trees for insolation, between the repetition have been left four trees. In conclusion, a slight soil acidifying was accounted for, with the intensive system as well as with the superintensive one, on applying a combination of mineral + organic fertilizers. Also, the soil pH shows lower values in both culture systems when a higher dosage of mineral fertilizer is applied.

Key words**:** *soil, field, soil reaction, crop system, Timisoara*

INTRODUCTION

Researches over the cambic chernozem from Didactic Station of the U.A.C.V.M. in Timişoara have been prosecuted by I. Rusu, Dorina Sâmpăleanu, V. Ştefan, L. Niţă in 1997 and by L. Niţă, I. Rusu, V. Ştefan, in 1999 from the viewpoint of the influence of the organic and chemical fertilizers, as cited by [5].

Similar research was carried out by Rusu I. and Mihuţ Casiana during 2003-2004, but on three depths, taking into account the horizon thickness, respectively 0-25 cm; 25-51 cm and 51-70 cm. This work is a continuation of the research carried out in 2003-2004, with respect to the same doses of fertilizers in order to better observe the pH values and the changes that occur through the long application of the mineral and organic fertilizers. [7]

The tree growing measures a surface of 7 ha and the apple tree culture occupies 4 ha, from witch a surface of 1 ha in being occupied by the soil taken for study Generous de Voineşti.

The planting distance of trees in a row, in the intensive system is two metres and between rows the distance is four meters 4 x 2. In the superintensive system the planting distance of apple trees is one meters on a row and four meters between rows 4 x 1. [8]

The soil on wich the experiment is placed, is a chernozem, cambic gleized moderated, weakly decarbonated, clayey, on medium fine loss layers. [1]

The soil reaction in the intensive system and superintensive system, is placed between certain limits, depending of the horizon and implicitly on the depth of the soil. [3]

MATERIALS AND METHODS

The researches took place on the apple plantation within the framework of the

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Didactical Station Temeswar. The soil on which the experiment is placed, is a chernozem, moderate gleized cambic, weakly decarbonated, clayey, on medium fine loss layers. [2]

The experiment is polyfactorial, type 2 x 6:

Factor A – the crop system:

a_1 – the intensive system;

a_2 – the superintensive system.

Factor B – doses of fertilizer

The experiment includes 12 alternatives.

Each alternative includes 4 trees, between the alternatives have been left two trees for insolation, between the repetition have been left four trees. [4]

The planting distance of trees in a row, in the intensive system is two meters and between rows the distance is four meters (4 x 2). In the superintensive system the planting distance of apple trees is one meters on a row and four meters between rows (4 x 1). [9]

The soil reaction has made based on the potentiometric method, in water extract 1:2.5.

The samples of the soil have been taken from different depth as follow: 0-20 cm; 20-40 cm.

RESULTS AND DISCUSSIONS

The soil reaction in the intensive system is placed between certain limits, depending of the horizon and implicitly on the depth of the soil: 0-20 cm; 20- 40cm, as it can be seen in Table 1 and Figure 1.

Table 1. The influence of mineral and organic fertilizer on the soil pH in the intensive crop system

Horizon/ Depth cm	Year	Alternatives						Mean	Dif. %
		$N_0P_0K_0$	$N_{70}P_{30}K_0$	$N_{100}P_{50}K_{20}$	$N_{150}P_{100}K_{50}$	G.g.	G.g. + $N_{50}P_{30}K_{10}$		
Amp (0-20)	2016	6.19	6.16	6.14	6.09	6.05	6.00	6.10	-0.17
	2017	6.17	6.15	6.12	6.07	6.03	5.91	6.07	-0.10
Am (20-40)	2016	6.48	6.46	6.42	6.38	6.36	6.34	6.40	-0.04
	2017	6.49	6.46	6.43	6.39	6.34	6.31	6.40	-0.08

Source: Own calculation.

In intensive crop system, in 2016, at the 0-20 cm depth, the lowest pH values were 6.00 at the 6th variant and the highest, respectively, 6.19 in the variant 1.

In 2017, the lowest values of 5.91 were recorded in variant 6 and the highest, of 6.17 in variant 1.

At 20-40 cm deep, pH values ranged between 6.31 and 6.49. The lowest values were found in variant 6, respectively 6.34 and the highest in variant 1, respectively 6.48 in 2016 and 6.49 respectively in 2017.

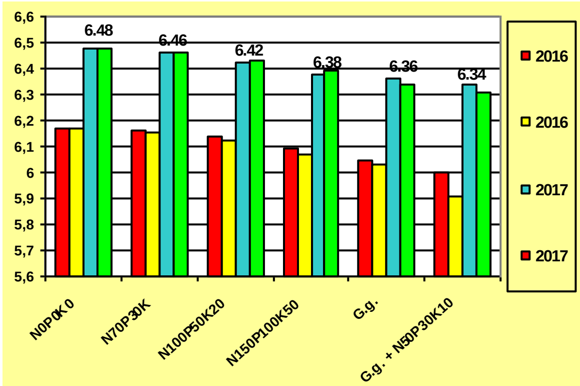


Fig. 1. The influence of mineral and organic fertilizer on the soil pH in the intensive crop system
Source: Own calculation.

In the unfertilized alternative (witness alternative), not only there was not recorded any acidification of the soil solution, hut there is a tendency of maintaining the same values of the pH level as the values the experimentation.

The differences between the pH values of those three depth (0-20 cm; 20-40 cm) are small and they are between the limits of experimental errors.

The pH values, in the year 2016, in Amp horizon (depth 0-20 cm) ware between 6.19 for the witness alternative and 6.00, for the + NPK manure alternative; in Am horizon (depth 20-40 cm) between 6.49 for the witness alternative and 6.34, for the + NPK manure alternative in the year 2017 and 6.48 in the year 2016.

In the year 2017 in the Amp horizon (depth 20-40 cm) the pH values were between 6.17, for the witness alternative and 5.91, for the + NPK manure alternative, in Am horizon (depth 20-40 cm) between 6.48, for the witness alternative and 6.50, for the + NPK manure alternative.

In the superintensive crop system given the intensive system were not recorded changes of the soil pH during those two years of research (2016–2017) under the influence of mineral and organic fertilizer as it can be seen in Table 2 and Figure 2.

Table 2. The influence of mineral and organic fertilizer on the soil pH in the superintensive crop system

Horizon/ Depth (cm)	Year	Alternatives						Average	Difference %
		$N_0P_0K_0$	$N_{70}P_{30}K_0$	$N_{100}P_{50}K_{20}$	$N_{150}P_{100}K_{50}$	G. g.	G. g. + $N_{50}P_{30}K_{10}$		
Amp (0-20)	2016	6.14	6.12	6.10	6.06	6.02	5.97	6.06	-0.08
	2017	6.14	6.10	6.08	6.04	6.00	5.92	6.04	-0.10
Am (20-40)	2016	6.40	6.38	6.35	6.31	6.27	6.24	6.32	-0.08
	2017	6.40	6.37	6.34	6.29	6.25	6.20	6.30	-0.10

Source: Own calculation.

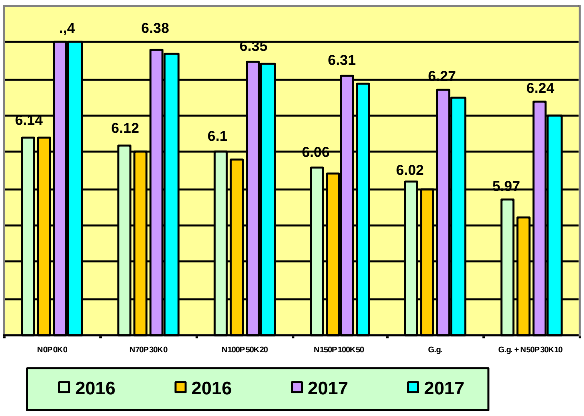


Fig. 2. The influence of mineral and organic fertilizer on the soil pH in the superintensive crop system
Source: Own calculation.

In the superintensive crop system in 2016, at the 0-20 cm depth, the lowest pH values were 5.97 at the 6th variant and the highest, respectively, 6.14 in the variant 1.
In 2017, the lowest values of 5.92 were recorded in variant 6 and the highest, of 6.14 in variant 1.
At 20-40 cm deep, pH values ranged between 6.20 and 6.40. The lowest values were found in variant 6, respectively 6.20 and the highest in variant 1, respectively 6.40 in 2016 and 2017.
The pH values in the year 2016, in Amp horizon (depth 0-20 cm) were between 6.14, for the witness alternative and 6.97, for the + NPK manure alternative; in Am horizon (depth 20-40 cm) between 6.40, for the witness alternative and 6.24, for the + NPK manure alternative.
In the year 2017, the pH values were in Amp horizon (depth 0-20 cm) between 6.14, for the witness alternative and 6.92, for the + NPK manure alternative; in Am horizon (depth 20-40 cm) between 6.40, for the witness alternative and 6.20, for the + NPK manure alternative.

CONCLUSIONS

Following the researches which took place on the apple plantation within the framework of Timisoara Didactical Station , were drawn the following conclusions:
-in the intensive crop system, in the year 2016, the pH values had been between 6.00 in Amp horizon (0-20 cm).
-in the year 2017, the value of the soil reaction were 5.91 in Amp horizon, for the + $N_{50}P_{30}K_0$ manure alternative.
-the average of soil reaction for different depth was between 6.07 at 0-20 cm in 2016 and 6.10 in 2017;
-in the superintensive crop system, in 2016 the values at the depth of 0-20 cm, were between 5.97, for the + $N_{50}P_{30}K_0$ manure alternative.
-in the year 2017, the values of soil reaction were 5,91 in Amp horizon, for the + $N_{50}P_{30}K_0$ manure alternative and 6.62, for the witness alternative and in the year 2017 between 5.92 in Am.
-the average of soil reaction was as it follows 6,04 for a depth of 0-20 cm, in 2016 and 6.10 in 2017.
In intensive crop system, in 2016, at the 0-20 cm depth, the lowest pH values were 6.00 at the 6th variant and the highest, respectively, 6.19 in the variant 1.
In 2017, the lowest values of 5.91 were recorded in variant 6 and the highest, of 6.17 in variant 1.
In superintensive crop system in 2016, at the 0-20 cm depth, the lowest pH values were 5.97 at the 6th variant and the highest, respectively, 6.14 in the variant 1.
In 2017, the lowest values of 5.92 were recorded in variant 6 and the highest, of 6.14 in variant 1.

REFERENCES

[1]Crista F., Boldea M., Radulov Isidora, Lato Alina, Crista Laura, Dragomir Cornelia, Berbecea Adina, Nita L., Okros A., 2014, The impact of chemical

fertilization on maize yield, Research Journal of Agricultural Science, 2014/3/1, Vol. 46 (1): 172-177;
[2]Domil, G., Okros A., Lațo Alina, 2014, The agricultural system from the Luncavița locality, Caraș Severin county, Research Journal of Agricultural Science, 46 (4): 124-127.
[3]Duma Copcea Anişoara, Ilea, R., Crîsta, I., 2017, Studies regarding grain loss in straw cereals, Research Journal of Agricultural Science, 49 (2):43-45 https://www.rjas.ro/paper_details/2440, Accessed 07.02.2018.
[4]Duma Copcea Anişoara, Mihut Casiana, Nita, L., Okros, A., Mateoc, T., 2014, Physical and chemical properties of psamosol, preluvosoil and chernozem in the Mehedinti county, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 14(1):175-180.
[5]Duma Copcea Anişoara, Mihut Casiana, Nita L., Okros A., Mateoc, T., Grad, I., 2014, Physical and chemical properties of psamosolului, preluvosoil and chernozem in the Mehedinti county, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 14 (1):107-110.
[6]Groszler Astrid-Simone, Ökros, A., Dragoescu Alina, 2017, A guide to basic Romanian agricultural terms and their English equivalents, Research Journal of Agricultural Science, 2017, Vol. 49(1):175-181.
[7]Niţă, L., Niţă Simona, Panaitescu Liliana, Mircov V.D., 2009, The influence of Banatite mining sterile on the bean and potato crops on a typical preluvosoil from Moldova Noua, Proceedings of the 52nd International Scientific conference "Ecological Agriculture– priorities and perspectives "Lucrări ştiinţifice Vol.52, Seria Agronomie, pp.407-414, http://www.revagrois.ro/PDF/2009_1_409.pdf, Accessed 18.01.2018.
[8]Nita Simona, Tabara, V., David, G., Nita, L.D., Alda, S., Dragos Marcela, Borcean, A., 2012, Results obtained for soybean, pea and lentils crops on a cambic chernozem in the banat's plain during 2008-2010, Romanian agricultural research, Volume: 29, Pages: 155-162, http://www.incda-fundulea.ro/rar/nr29/ rar29. 20.pdf., Accessed 16.01.2018.
[9]Okros A., Pop Georgeta, 2014, The influence of the western plain topoclimate on cereal and cereal derivative production quality and quantity, Research Journal of Agricultural Science, 46 (4) 78-83.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EVALUATION OF THE PRODUCTION CAPACITY OF AGRICULTURAL LAND FROM THE PERIMETRE OF THE PERIAM LOCALITY, TIMIȘ COUNTY FOR ITS SUSTAINABLE USE

Casiana MIHUȚ, Anișoara DUMA-COPCEA, Aurelia MIHUȚ

University of Agricultural Sciences Banat Veterninară „King Michael I of Romania" Timisoara, 119 Arad Way, Timisoara, Romania, Phone: +4025627475, Fax: +40256200296,
Emails: casianamihut@yahoo.com, duma_anisoara@yahoo.com, aurelia_mihut@yahoo.com

Corresponding author: casianamihut@yahoo.com

Abstract

The purpose of this paper is the evaluation of the agricultural land from the Periam commune, Timiş County, for their sustainable use. The proposed objectives cover the following aspects: characterization of the natural environment; identifying and outlining soil and land units; characterization of the mapped out soil units; land assessment and establishing the favourability of various crops; grouping the land in usage categories; identifying and characterizing soil types and subtypes; calculating assessment grades, establishing usage categories and grouping soils in favourability classes; identifying sustainable options and selecting the ones insuring the best usage; monitoring soil evolution after applying or non-applying of some pedo-ameliorative measures; insuring optimal solutions for various problems regarding the protection, improvement and efficient use of soils, and land characterization depending on the management requirements of an agricultural exploitation. The paper is concluded by a series of results and discussions referring to the production capacity assessment for two types of soil identified on the locality territory, namely chernozem and gley soil.

Key words: *evaluation, favourability, usage class, fertility, assessment grades, mapping, productive potential, soil*

INTRODUCTION

Similar research has been carried out by researchers from the Pedology discipline in Timișoara, namely Anișoara Duma-Copcea, V. Ștefana and Casiana Mihuț, during 2009. [2]
The importance of land evaluation activities resides in the fact that due to the data they supply, these studies make up the basic documentation for establishing the optimal practical measures for soil protection, amelioration and rational usage, in order to produce biomass with an optimized dynamics, rigorously correlated with increasing environmental protection requirements. [1]
For the appreciation of production capacity of agricultural land in the Periam commune, Timiş County, [13] we chose 17 indicators from the entire ensemble of environmental conditions, more significant and more precisely determined. [6] [11]
Based on these indicators, assessment grades were calculated, which express the favourability degree of an indicator for each crop and land usage category. [6]

MATERIALS AND METHODS

For the current paper, we used data from field observations, as well as data from previous mappings. [3] In order to determine the chemical and physical-mechanical properties, samples were collected from 5 soil profiles, respectively 35 soil samples in deranged structure and soil samples from 3 profiles, respectively 9 soil samples in 3 and 4 repetitions for the determination of hydro-physical indices. [8]
The calculus of average productions per ha for each assessed plant is carried out according to the assessment grade in relationship with the technological level which can be insured at a certain moment and which establishes the productive capacity for each assessment point. [9]
The harvest quantity obtained per surface unit, that means the productivity of agricultural plants depends on the entire ensemble of environment conditions, as well as man's

influence, which can modify in a sense or another natural factors or the plant characteristics, so as to better capitalize the natural conditions. [4]

The assessment grade on usage and crops results from multiplying by 100 the coefficient product (the 17 indicators) [15] which directly participate in the establishment of the assessment grade: [5]

$$Y = (X_1 \text{ x } X_2 \text{ x } X_3 \text{ x........} X_{17}) \text{ x } 100 \ [14]$$

where y is the assessment grade. [10]

The weighted average assessment grade thus obtained, insures general information over the agricultural land usage category for various uses and their favourability for different crops, as well as over their correct use during the production process. [5] [12]

RESULTS AND DISCUSSIONS

The obtained results are presented in detail for various usage categories or for crop groups with the same biological or technologic particularities.

For each indicator, depending on its usage scale or on the crop, tables containing the respective coefficient values were set up.

Table 1 calculates the assessment grades for the main agricultural crops occurring in this area, namely wheat, barley, maize and sunflower, as well as the fertility class of each soil, respectively each crop.

Table 1 Soil favourability for the wheat, barley, maize and sunflower crops

Nr Crt.	Type of soil	wheat		barley		maize		sunflower	
		assessment grades	fertility classes	assessment grades	fertility classes	assessment grades	fertility classes	assessment grades	fertility classes
1.	Chernozeum	90	II	90	II	90	II	90	II
2.	Typical batigley chernozem	80	III	80	III	80	III	80	III
3	Gleiosoil cernic	46	VI	46	VI	45	VI	48	VI
4.	Gleiosoil typical	39	VII	43	VI	44	VI	48	VI

Source: Own calculation.

From the analysis of the assessment grades for the strawy cereals (autumn wheat and autumn barley) one may observe an accentuated differentiation of soil units from the point of view of the conditions they create for crop plants. [7] The highest grades are obtained by the typical batigley chernozem, falling under the 2nd respectively the 3rd fertility classes.

Table 2 presents the assessment grades and fertility classes for pastures and hay land.

Table 2. Soil favourability in the Periam commune, Timiş County, for pastures and hay land

Ct. No.	Type of soil	Pastures		Hay land	
		assessment grades	fertility classes	assessment grades	fertility classe
1.	Chernozeum	90	II	90	II
2.	Typical batigley chernozem	80	III	80	III
3.	Gleiosoil cernic	65	IV	56	V
4.	Gleiosoil typical	47	VI	41	VI

Source: Own calculation.

Hay land manifests a higher requirement regarding the physical and chemical properties of the presented soils, which leads to the accentuated decrease of assessment grades with the following soils: chernic gley soil and typical gley soil.

Table 3 Soil favourability in the Periam commune, Timiş County, for the apricot and peach cultures

Ct. No.	Type of soil	Apricot		Peach	
		assessment grades	fertility classes	assessment grades	fertility classe
1.	Chernozeum	80	III	70	IV
2.	Typical batigley chernozem	80	III	80	III
3.	Gleiosoil cernic	14	IX	14	IX
4.	Gleiosoil typical	12	IX	12	IX

Source: Own calculation.

Fruit tree cultures present higher requirements, especially with regard to gleization and alkalization processes. The occurrence of mineralized underground water at a low depth excludes planting apple, pear and plum tree cultures on chernic gley soil and typical gley soil.

CONCLUSIONS

From a geomorphologic point of view, the territory of the Periam locality presents general characteristics of all other loess plains from the great Tisa depression, the same large plane horizons, with slightly irregular forms represented by isolated, shallow depressions resulting from local compaction.

Of the frequently encountered forms and processes, we can count here: strong loops, floods with alluviations and divagations. The locality plain is crossed by the Aranca and Galaţca streams, which are old courses of the

Mureş river.

The soils occurring frequently in the studied perimeter, are of the chernozem type, with good drainage. This type of soil includes several subtypes, among which humid phreatic chernozem soils predominate.

In depression areas, gley soils occur (typical as well as chernic ones), due to the high level of potassium rich underground waters.

Chernozems are soils with the best physical and chemical properties. That is why they present the highest agro-productive potential.

Chernozems are optimal for all pants.

Very good results are obtained with: wheat, barley, maize and sunflower.

Good results are obtained with fruit trees.

In order to increase the fertility of these soils, the following measures are recommended:

- Agro-technical works which lead to the accumulation and preservation of water in the soil;
- Periodical application of organic fertiliser and moderate fertilisation with NPK;
- Avoiding monoculture and rigorously applying crop rotation;
- Complementing the humidity deficit through irrigations in the case of the sugar beet crop, maize crop, etc.

In *Gley soils*, due to periodic oscillations of the underground water which influence negatively the physical-chemical indices and the fertility, cultivated plants have problems adapting to the alternation of humidity excess and humidity lack.

Gley soils evolving on more permeable rocks, with a good drainage, are more productive, being covered with medium quality pastures or forests.

After their amelioration, one may cultivate: wheat, maize, barley, sunflower.

Gley soils are not recommended for fruit tree cultivation, due to the low depth underground water.

In order to increase the natural soil fertility, we recommend the following measures:

- Organic and mineral fertilisation;
- Applying calcareous amendments.

Chernozem soils present the best physical and chemical features. That is why they also present the highest agro-productive potential. These soils are optimal for all plants, with very good results in wheat, maize, barley and sunflower and good results in fruit trees.

Gley soils present periodical underground water oscillations, thus negatively influencing physical-chemical indices and fertility, cultivated plants having problems adapting to the alternation of humidity excess and humidity lack. Wheat, maize, barley and sunflower can be cultivated after amelioration, while fruit tree cultivation is no recommended due to low depth underground water.

REFERENCES

[1]Căbăroiu G., Niţă L., 2013, Land quality classes and natural landscape of the mining area Valea Mănăstirii 2, Gorj county, The 9th International Symposium "Young People and Agriculture Research" Timisoara, 29 November 2013, Research Journal of Agricultural Science, Vol. 45(4):14-18, www.rjas.ro/, Accessed January 10, 2018.

[2]Duma-Copcea Anişoara, Ştefan, V., Mihuț Casiana, 2009, Soil production capacity from Periam, Timiș Country for different crops and agricultural use, Research Journal of Agricultural Science, Vol. 41 (1), Timișoara

[3]Goian M., 2000, Agrochimie, Editura Marineasa, Timişoara, 43-44.

[4]Ianoş, Gh., Goian M., 1992, Influenţa sistemelor de agricultură asupra calităţii solurilor din Banat. Probleme de agrofitotehnie teoretica şi aplicata, Vol. 14, 3-4, ICCPT Fundulea

[5]I.C.P.A., Bucureşti, 1987, Metodologia elaborării studiilor pedologice vol. I, II, III.

[6]Lotreanu, I., 1985, Monografia Banatului, Institutul de Arte Grafice, Timişoara, pag. 103-105

[7]Mihuț Casiana, Lațo, K.I., 2007, Pedologie. Metode de analiză. Ed. Gutenberg, Arad, pag. 74

[8]Mihuț Casiana, Radulov Isidora, 2012, Științele Solului. Ed. Eurobit, Timişoara, pag. 86-88

[9]Niţă, L.D., 2007, Pedologie, Editura Eurobit, Timişoara, pag. 112

[10]Okros, A., 2015, Fertility status of soils in western part of Romania, Journal of Biotechnology, Volume 208, Supplement, 20 August 2015, -09.05.2015 Bucuresti Romania 3,14.

[11]Okros, A., Pop Georgeta, 2014, The influence of the western plain topoclimate on cereal and cereal derivative production quality and quantity, Research Journal of Agricultural Science, 46 (4):140-145.

[12]Rogobete, Gh., Ţărău, D., Chisăliţă, Gh., 1997, Evoluţia solurilor din Câmpia joasă a Banatului şi problemele de clasificare, Lucr.şt. Acad.Română, Fii. Iaşi, pag. 175-179

[13]Rogobete, Gh., Ianoş, Gh., 2007, Implementarea Sistemului Român de Taxonomie a solurilor pentru

partea de vest a României, Timişoara.
[14]Ţărău, D., Luca, M., 2002, Panonic al comunelor bănăţene din perspectivă pedologică, Editura Marineasa, 2002, pag. 58-60
[15]Ţărău, D., 2003, Bazele teoretice şi practice ale bonitării şi evaluării terenurilor din perspectivă pedologică, Ed. Solness, Timişoara, pag. 94
[16]Ţărău, D., 2003, Cartarea şi bonitarea solurilor, Ed. Eurobit, Timişoara, pag. 115

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ADOPTION OF IMPROVED FARM PRACTICES AMONG MAIZE (*Zea mays* L) FARMERS IN YOLA, ADAMAWA STATE, NIGERIA

Augustine Anthony NDAGHU, Maimuna MUKTHAR , Amurtiya MICHAEL

Modibbo Adama University of Technology, Department of Agricultural Economics and Extension, P.M.B 2076, Yola, Nigeria, Phone: +2348032576119, +2347063472148 Emails: mrndaghu@yahoo.com, michaelamurtiya@yahoo.com

Corresponding author: michaelamurtiya@yahoo.com

Abstract

Maize (Zea mays L) is among the most widely consumed staples and is also used in the production of livestock feeds. This study analysed the adoption of improved farm practices among maize farmers in Yola, Adamawa State, Nigeria. The specific objectives were to; describe the socio-economic characteristics of the respondents, identify the improved farm practices adopted by the respondents, and identify respondents' sources of information on improved farm practices. Systematic random sampling technique was used to select 117 respondents from whom primary data was collected using structured questionnaire. The data collected was analysed using means, frequency and percentages. The result showed that, majority (67.5%) of the respondents were male, married (76%), educated (70%), and 54.6% were within the economically active age of less than 51 years. Majority (81%) of the respondents were small scale farmers with land holdings of 1-4 ha, 77% of the respondents practiced maize farming for more than 10 years, 56.4% and 43.6% practiced sole cropping and mixed cropping respectively. Radio, friends, and extension agents were most preferred information sources. Use of herbicides, fertilizers, seed dressing, and mechanized farming were respondents' most adopted improved technologies. The study recommends that radio should be used to disseminate information on improved farm practices; farmers should also, be encouraged to form groups that would assist them share information and pool resources together to overcome transitional cost of certain technologies.

Key words: *adoption, improved farm technology, maize, Yola, Adamawa State, Nigeria*

INTRODUCTION

Maize (*Zea mays* L) is an important staple food crop with great economic significance in Sub-Saharan Africa. It is a cereal crop cultivated in both irrigated and non-irrigated land for food, livestock feed and other industrial uses. The demand for maize in Nigeria is always on the rise due to population increase and diverse uses. The crop is the third most important cereal crop after sorghum and millet [5]. Despite the economic importance of maize to the teeming populace of the nation, it has not been produced to meet the food and industrial needs of the country. This could be attributed to the low productivity from maize farms or that farmers have not adopted improved technologies for maize production [6]. To boost the production of this this crop and other crops, the government was able to implement some programmes and projects over the years. However, these programmes have had limited impact in boosting the local production capacity of the nation's farmers. In the recent past, the Agricultural Transformation Agenda was launched by the federal government in collaboration with the various state governments. Under the initiative, the Growth Enhancement Support (GES) scheme was lunched to provide subsidized farm inputs to farmers on some selected crops (including maize). The essence of the initiative is to boost the local production of the selected crops comparable to global standards.

The availability of a sustainable agricultural technology for Nigerian resources-poor farmers is important for the country's effort at achieving food security [4]. Improved agricultural technologies are known to enhance and improve agricultural production among farmers in a nation. Maize production in Nigeria and particularly in the study area has not been sufficient enough to meet the needs of people and livestock feeds. In Adamawa State, the crop has attracted some

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

studies owing to its prominence in social and economic life of the people [3, 7, 8]. These studies considered economic efficiency of the crop's production. However, there is paucity of literature on the level of adoption of improved farm practices among maize farmers in study area. Hence, it is imperative to examine the adoption of improved farm technologies in maize production so as to initiate and implement policies that would help in boosting the production capacity of the farmers. This will help improve the livelihood of maize farmers and food security in the area. Therefore, this study was undertaken to investigate the adoption of improved farm management practices among maize farmers in the study area. The specific objectives of the study were to:

(i)Describe the socio-economic characteristics of the respondents

(ii)Identify the improved farm practices adopted by the respondents

(iii)Identify respondents' sources of information on improved farm practices.

MATERIALS AND METHODS

The study was carried out in Yola-North and Yola-South Local Government Areas of Adamawa State. The study area has a total land mass of 1,213.3km^2 and lies between latitude 9^o 06′ and 9^o 29′ North and longitude 12^o 06′ and 12^o 38′East [1]. The area shares boundary with Fufore Local Government area to the South and East, Numan, to the West, and Song, to the North. The Areas lies within the Sudan savannah region and can be described as having a tropical climate characterized by two well defined seasons, being wet and dry seasons. The dry season starts in the late November and ends in April, while the wet season commences from May and ends in October. The average annual rainfall is about 956mm [2]. The temperature figure in the area is typical African savannah features, the average minimum temperature is 15.2^{o}C, while the seasonal maxima usually occur in March and April with the average maximal temperature of 39.7^{o}C. The high temperatures experienced in the area and long period of dry season of about seven months characterized by uncertainty in the onset and cession of rainfall have to some extent serious effect on agricultural production and sustainability.

The population of the study comprised of all maize farmers in Yola North and South Local Government Areas (LGAs) of Adamawa State. The Area falls within the Yola Agricultural Development Programme Extension block. The extension block consists of six cells, namely, Yolde-pate, Njoboliyo, Malkohi, Bachure, Bole and Mbamba. A total of 117 respondents were selected from the six cells using systematic random sampling technique. This was done by selecting every other fourth farmer after the first until the needed number was obtained.

Descriptive statistics involving the use of means, percentages and frequency counts were used to analyse the data.

RESULTS AND DISCUSSIONS

Respondent's Socio-economic Characteristics

The socio-economic characteristics of the respondents is presented in Table 1. The sex distribution of the respondent shows that, majority (67.5%) of the respondents were male while the females constituted 32.5%. This implies that, male farmers dominated the cultivation of maize in the area. This can be attributed to cultural/religious factors that gives the males more access to resources (both social and economic) than the female. Similarly, the tediousness and labour intensiveness of maize cultivation might have contributed to the sheer dominances of the male farmers in the cultivation of the crop. Based on the age distribution of the respondents, the Table indicated that, majority (54.6%) were less than 51 years of age while respondents above 60 years of age were 13.7%. This implies that, bulk of the respondents are economically active and can be able to provide the needed resources necessary for maize production. The Table also showed the distribution of the respondents based on their marital status. According to the Table, most of the respondents are married (87.7%) while,

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

single, divorced and widowed people made up 10.3% collectively. This is not surprising for the fact that the married people are known to have dependents that they have to cater for their basic needs. Hence, engaging in farming activities may be a means of meeting their family responsibilities. Further, education plays an important role in the farming profession. In the study area, about 29.9% of the respondents had no form of formal education, 31.6% attended primary school, while, 25.7% attended senior secondary school. Similarly, only about 4.3% of the respondents attained tertiary level of education. The implication of it is that, access to information may be limited by the respondents' level of education (especially from newspapers or those being transmitted using English Language).

Table 1. Socio-economic Characteristics of the Respondents (N=117)

Variable	Frequency	Percentage
Age (Years)		
20 – 30	15	12.8
31– 40	19	16.2
41 – 50	30	25.6
51-60	37	31.6
60 and Above	16	13.7
Gender		
Male	79	67.5
Female	38	32.5
Marital Status		
Married	105	87.7
Single	6	5.2
Widowed/Divorced	6	5.1
Educational Attainment		
No formal Education	30	29.9
Adult Education	5	4.3
Primary School	37	31.6
Senior Secondary School	30	25.7
Tertiary	10	8.6

Source: Field Survey, 2015.

Respondents' Farm Size, System of Farming, Variety of Maize Cultivated and Years of Farming Experience

Farm size which determines the scale of farming is presented in Table 2. From the result obtained, 81% of the respondents were small scale farmers (have land holdings of 1-4ha), while respondents with farm sizes up to 5ha constituted only 19%. The large number of small-scale farmers could be attributed to the high competition between the use of land for farming and its use for other developmental activities common in most urban and *peri*-urban areas. Farming experience can affect the decision of farmers to adopt certain technologies or packages. Farming experience of the respondent presented in the Table revealed that, majority (77%) of the respondents have practiced maize farming for more than 10 years. The long standing involvement of farmers in maize cultivation is not unconnected with the importance of this stable crop in the diet of communities in the study area. This is further supported by the suitability of the crop to the climate of the study environment and its use for wide variety of purposes such as food in various forms for example, *Tuwo,* cooked or boiled maize, roasted maize, popcorn, animals feeds for both livestock and chickens and medicinal uses among others. Respondents practice two systems of cropping, sole cropping (56.4%) and mixed cropping (43.6%). Further, the variety of maize cultivated mostly were the improved variety (62.4%), while 37.6% cultivated local variety of seeds. The high usage of improved maize varieties among the respondents may be attributed to the high yield associated with the variety and its provision by the government at subsidized rate by the government under the GES scheme in recent past.

Table 2. Farm Size, System of Farming, Variety of Maize Cultivated and Years of Farming Experience (N=117)

Variable	**Farm size (ha)**				**Total/Percent (%)**
Years of Farming Experience	1-4	5-8	9-12	13-16	
1-10	24	3	0	0	27 (23)
11-20	32	5	1	0	38 (32.4)
21-30	22	4	0	0	26 (22.2)
31-40	10	3	0	2	15 (13)
41-above	7	3	0	1	11 (9.4)
Total/Percent (%)	95 (81)	18(15)	1(1)	3(3)	117 (100)
System of Farming					
Sole cropping	51	12	1	2	66 (56)
Mixed cropping	44	6	0	1	51 (44)
Total/Percent (%)	95 (81)	18(15)	1(1)	3(3)	117 (100)
Maize Varieties					
Improve variety	58	13	0	2	73 (62)
Local variety	37	5	1	1	44 (38)
Total/Percent (%)	95 (81)	18(15)	1(1)	3(3)	117 (100)

Source: Field Survey, 2015

Adoption of Modern Farming Techniques by the Respondents

Table 3 reveals the respondents' adoption of improved farming technologies. Most of the respondents adopted improved technology, the calculated ranking of means show that herbicides, fertilizers, seed dressing, and mechanized farming were the most widely practiced in order of 1st, 2nd, and 3th respectively. Similarly, the use of standard spacing, insecticides and high breed seeds were the least used in order of 6th, 5th, and 4th. Means for herbicide and fertilizer use were 3.87 and 3.58 respectively being 1st and 2nd are high adopters, seed dressing, and mechanized farming system and high breed seeds with means of 2.93, 2.68, and 2.27 ranking 3^{th,} 5th, and 4th respectively are medium adopters. While, means for the use of insecticides and standard spacing are 2.26 and 1.83 which ranked 6th and 7th thus classified as the low adopters. The result also shows that there are non-adopters.

Respondents' Sources of Information for Modern Farming Practices

Respondents received information about modern farming techniques from varied sources such as the radio, television, farmers' associations, friends, extension officers as well as newspapers (Table 3). The result revealed that, information from radio (96%) and friends (82%) were the most readily available in the area. Further, information from extension officers (48%), farmers' associations (37%), television (36%) and newspaper (22%) were among the other information sources being utilized by the respondents. The high reliance on radio and friends may be attributed to the educational status of farmers in the study area. As earlier noted (Table 1), majority (69%) of the respondent had either no any form of formal education or had only obtained adult or primary education. This might have been the reason for very few of them accessing information from newspaper. Higher level of education is believed to be associated with access to information on improved technologies and higher productivity.

Respondents' Preferred Source of Information

In terms of the respondents' preferred information source (as presented in Table 3), the result obtained based on ranking showed that, radio had the highest mean of 4.7, friends 4.22 extension officers 3.44. Newspaper with mean of 1.43, associations 2.85 and television 2.90 were the least preferred on the order listed. The preference may not be unconnected to the ease of access accessing information through these media in terms of both cost and convenience.

Table 3. Adoption of Modern Farming and Sources of Information in order of Preference (N=117)

Use of modern technology	Mean	Rank
Herbicide	3.87	1st
Fertilizer	3.58	2nd
Seed Dressing	2.93	3rd
Mechanize Farming System	2.68	4th
High Breed Seeds	2.27	5th
Insecticides	2.26	6th
Standard Spacing	1.83	7th
Source of Information		
Radio	1.96	1st
Friends	1.82	2nd
Extension Officer	1.48	3rd
Association	1.37	4th
Television	1.36	5th
Newspaper	1.22	6th
Preference for Information		
Radio	4.70	1st
Friends	4.22	2nd
Extension Officer	3.44	3rd
Association	2.90	4th
Television	2.85	5th
Newspaper	1.43	6th

Source: Fieldwork, 2015

CONCLUSIONS

Access to information plays a very significant role in ensuring that farmers were able to adopt improved technologies that will boost their production. However, there is the need for the farmers to access this information with ease in terms of both cost and convenience. This will enable the farmers to adopt modern farming technologies in good time. Based on the findings of the study, the following recommendations are suggested to improve the adoption of improved technologies by maize farmers in the area:

(i)Agriculture related innovations or technologies should be made available to farmers on their most preferred information source, especially on the radio. The contents of such information should be appropriate and suitable to the needs of the farmers.

(ii)Government should prioritize the use of extension workers to reach farmers with relevant agricultural information. The ADPs should be adequately funded to meet the financial demands of reaching farmers with information and demonstrating it to them.

(iii)Farmers should be encouraged to form groups through which they will be able to share ideas and pool their resources together to reduce the transition cost of adopting some the innovations.

(iv)Farmland is a limiting factor to the adoption of modern technologies in the study area therefore, government policy should focus on addressing this problem by allocating significant portion of land for permanent farming purpose.

REFERENCES

[1]Adamawa State Government, 2016, About Adamawa State. www.adamawastate.gov.ng, Retrieved on March 8, 2016.

[2]Adebayo, A. A., 1999, Climate: Sunshine, Temperature, Evaporation and Relative humidity. In A. L. Adebayo, A. A. and Tukur (Ed.), Adamawa State in Maps (pp. 20–22). Yola, Nigeria: Paraclette.

[3]Dia, Y. Z., Zalkuwi, J. W., Gwandi, O., 2010, Economics of scale and cost efficiency in small scale maize production in Mubi North Local Government in Adamawa State, Nigeria. African Journal of Agricultural Research, 5(19), 2617-2623.

[4]Ladebo, O. J., 2004, Job Behaviour an Attitude of Agricultural Faculty: Beyond the Influence of

Biographical Factors. Journal of Extension System, 20 (2), 89-103.

[5] Ojo, M. O., 2000, Food Policy and Economic Department in Nigeria. Abuja: CBN and Paper Page Publisher Service Ltd.

[6]Onuk, E.G., Ogara, I.M., Yahaya, H., Nannim, N., 2010, Economic Analysis of maize production in Mangu Local Government Area of Plateau State, Nigeria. *PAT*, 6(1):1-11

[7]Zalkuwi, J. W., Dia, Y. Z., Dia, R. Z., 2010, Analysis of Economic Efficiency of Maize Production in Ganye local Government Area Adamawa state, Nigeria. Report and Opinion, 2(7), 1-9.

[8] Zalkuwi, J., Ibrahim, A., Kwakanapwa, E., 2014, Analysis of Cost and Return of Maize Production in Numan Local Government Area of Adamawa State, Nigeria.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

RISK SOURCES AND MANAGEMENT STRATEGIES AMONG CASSAVA FARMERS IN ABIA STATE, NIGERIA

Chijioke Nwaneri NDEM[1], Charles Kelechi OSONDU[2]

[1]Federal university of Technology Minna, Department of Agricultural Economics. Niger State, Nigeria, Email: chijiokemcndem@gmail.com
[2]Abia State University, Department of Agricultural Economics and Extension, Umuahia Campus, PMB 7010, Umuahia, Abia state, Nigeria, Phone: +2347037400876, Emails:; osonducharles87@gmail.com

Corresponding author: osonducharles87@gmail.com

Abstract

This study identified sources of risk and risk management strategies among cassava farmers in Abia State, Nigeria. A total of 518 cassava farmers were randomly selected from four local government areas and data were collected using structured interview schedule. Descriptive statistics such as mean, percentages and frequency were used to present data. Likert attitudinal scale was used to evaluate the risk attitude of cassava farmers. Results showed that the mean age and household size of the farmers was 48 years and 7 persons respectively, with 59.9% of the farmers being females. Main sources of risk in cassava production as identified by the cassava farmers were erratic rainfall (77.2%), inadequate credit facilities (70.3%), low price of output (69.1%), cassava pest and disease (59.1%), high cost of inputs (57.5%) and inadequate market for produce (51.7%). The Likert attitudinal scale showed that 69.5% of the farmers were risk averse. Some risk reducing strategies were not employed by the farmers, reason being that they are either not available or difficult to implement. The most popular risk reducing strategy used was enterprise diversification (100.0%).The study recommended that cassava farmers with support from government and private sector should develop comprehensive risk management strategies with maximum benefit when used in combination, also agricultural policy makers should make policies that will encourage cassava farmers to use formal insurance, cooperative marketing and forward contracting more as a means of reducing social and market risks.

***Key words**: cassava farmers, sources of risk, risk management strategies*

INTRODUCTION

Cassava farming is a common agricultural venture in Nigeria, providing food and job for a large number of households and serving also as a cash crop for farmers. In recognition of the dominant role played by the crop towards food security and development of rural households, various cassava programmes and policies had been implemented by successive Nigeria governments over the years to raise farmers' efficiency and productivity in cassava production [20]. However, according to [30], despite the implemented programmes and policies to boost cassava production in Nigeria, the sub-sector still produces below its potential. Some reasons posited for this situation, are that farming seasons in Nigeria are not adequately planned for and forecasted and cassava farmers usually base their production activities on guess estimates. The consequence is an increase of risk and uncertainties which could lead to decrease in cassava output.

Cassava farming in Nigeria is highly characterized by risks ranging from adverse climate changes, pests and diseases, marketing/price risk, institutional risks to human risks, which in turn leads to uncertainties [24]. Cassava farmers operate on the edge of extreme uncertainty, sometimes falling just below, and sometimes rising just above the threshold of survival. They have limited knowledge whether rainfall will be good or bad over a season; the prices they will receive for produce sold or whether their crops will be infected by disease. These risks are not under the control of farmers but some farmers have developed ways of coping and managing them [4,32].

Risk is an uncertainty that affects an individual's welfare and is often associated with adversity and loss [12]. Agricultural risks originate from different sources ranging from production risk to marketing risk, and from financial risk to institutional risk [7]. Production risk emanates from adverse change in weather conditions, pests and diseases attack, breakdown or unavailability of equipment and spare parts and poor farm decisions by the farm household, while institutional risks often arise from inconsistent government policies and programmes.

Analysing risks facing small scale farmers is essential to good planning in agricultural production and innovation [18]. Risk is believed to play an important role in the investment decisions of individual farmers [1, 40]. Taking more risk can increase a cassava farmer's expected profit. However, cassava farmers (like most farmers) are generally risk averse, which is why they are willing to pay a premium to reduce exposure to risk. If cassava famers can manage the risks on their farm at an acceptable cost, they will become better off as a result [15,37]. The method of managing risk and the extent to which different types of risks are managed depend on factors such as farmers degree of risk aversion, cost involved, relative magnitude of risk, correlation of the risk with other risks, other sources of indemnity, a farmers perception of the nature of risk and the farmers income and wealth [32,38].

Attitudes to risk are often related to the financial and social status of the farmer to accept a small gain or loss. The more risk-averse a farmer is, the more likely the farmer is to make managerial decisions that emphasize the goal of reducing variation in income, rather than the goal of maximizing income and vice versa [17]. For these reasons, farm households' attitudes towards risk are vital in understanding their behaviour towards adoption of new technology and managerial decisions [2,33,40].

Cassava production in Nigeria cannot attain optimum level without technical expertise in all aspects of its production including risk management. Risk management has become an issue of great concern to policy makers and stakeholders in agricultural sector. Identification of risks facing cassava farmers is relevant to enhance productivity through re-evaluation of current policies of the government and formation of new policies for the agricultural sector with cassava farmers as the focal point. The findings from this study are expected to assist in extending the frontiers of knowledge and guide government institutions such as the ADPs (Agricultural Development Programme) and FMARD (Federal Ministry of Agriculture and Rural Development) towards achieving their mandates.

To this end, this study intends to:
(i) describe socio-economic characteristics of cassava farmers in the study area;
(ii) identify risks faced by cassava farmers in the study area;
(iii) determine risk attitude of cassava farmers in the study area; and identify risk management strategies used by cassava farmers in the study area.

MATERIALS AND METHODS

Study Area

The study was conducted in Abia State. The State was chosen because it ranks high among the cassava producing States in south eastern part of Nigeria. Abia State is located between latitudes $5^0 47^1$ N and $6^0 12^1$ North of the Equator and between longitudes $7^0 23^1$ E and $8^0 02^1$ East of the Greenwich Meridian [35]. The State occupies an area of about 5,834 square kilometres and is bounded by Imo State at the western border; Ebonyi and Enugu States at the north; Cross River and Akwa-Ibom States at the east and Rivers State at the south. The projected population stood at 3,460,616 with an annual growth rate of 2.7 percent [29]. The State is divided into 17 Local Government Areas (LGAs), which are grouped into three (3) agricultural zones, namely, Aba, Ohafia and Umuahia zones. Aba zone is made up of 7 extension blocks, Ohafia Zone is made up of 5 extension blocks and Umuahia Zone is made up of 5 extension blocks. Agriculture is the dominant economic activity and main source of employment in the State providing employment and income for more than sixty (60) percent of the entire population [5].

Sampling Technique

The study adopted a multi-stage random

sampling technique. In the first stage, two agricultural zones out of the three agricultural zones in the State were randomly selected (Ohafia and Umuahia Agricultural zones). Two extension blocks(equivalent of LGA's) were selected randomly from each of the two agricultural zones, giving a total of four extension blocks. Ohafia block and Arochukwu block were selected from Ohafia zone, while Ikwuano block and Isi-ala Ngwa North block were selected from Umuahia Agricultural zone. The third stage involved selection of two extension circles from each of the selected blocks, giving a total of eight (8) circles. Elu and Ebem Ohafia circles were selected from Ohafia block, Amuru and Abam circles were selected from Arochukwu block. Umudike and Amaoba circles were selected from Ikwuano block while Apu-na-Ekpu and Ama-Asaa Nsulu circles were selected from Isi-ala Ngwa North block. A list of registered cassava farmers in each selected circle was obtained from Abia State Ministry of Agriculture. The formula used in selecting sample size proportionate to the population of registered cassava farmers is given as [19]:

$$n = \frac{N}{1+N(e)^2}$$

n = sample size,
N= the finite population,
e = limit of tolerable error,
1= unity

Table 1 shows the number of cassava farmers from the selected agricultural zones that were used for the study. The limit of tolerable error was chosen at 0.05 probability level to provide for an adequate confidence level. Applying the above formula, Ohafia and Umuahia agricultural zones had 501 and 1,142 registered cassava farmers, respectively. Elu (137 farmers) and Ebem (95 farmers) were selected from Ohafia LGA, Amuru (116 farmers) and Abam (153 farmers) were selected from Arochukwu LGA. Umudike (354 farmers) and Amaoba (242 farmers) were selected from Ikwuano LGA, while Apu- na- Ekpu Umuoha (321 farmers) and Ama- Asaa Nsulu (225 farmers) were selected from Isi-ala Ngwa North LGA. Thus a total of 518 cassava farmers were interviewed. The average population density of 118 persons per square kilometre masks the disparity that exists between the densely.

Table 1. Population of registered cassava farmers in Abia State, Nigeria

Agricultural Zone	Number of registered cassava farmers	Selected circles	Number of respondents	Sample size
Ohafia	501	Elu Ebem Amuru Abam	137 95 116 153	222
Umuahia	1,142	Umudike Amaoba Apu- na-Ekpu Ama-Asaa Nsulu	354 242 321 225	296
Total	1,643	8	518	518

Source: [9]

The survey was carried out in January to March, 2015 and data were collected on farmers' socio economic characteristics such as age, sex, marital status, household size and level of formal education. Furthermore, data on sources of risk (production risk, marketing risk, financial and institutional risk), risk attitude and management strategies (preventive, mitigating and coping strategies) were collected. Data were collected with the use of a pre-tested structured interview schedule. Four (4) enumerators, two (2) for each agricultural zone, were employed to administer the interview schedule.

Method of Data Analysis

Descriptive statistics such as mean, percentages and frequency were used to describe socio-economic characteristics of cassava farmers (objective i); identify risks facing cassava farmers (objective ii) and risk management strategies used by small scale cassava farmers (objective iv). Likert attitudinal scale (LAS) was used to determine the risk attitude of respondents (objective iii).
A 5-point Likert scale was used to measure cassava farmers' attitude towards risk. The farmers were asked questions graded on a five point likert scale, the responses are Strongly Disagree (SD), Disagree (D), Undecided/Neutral (U), Agree (A) and Strongly Agree (SA). The responses were

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

given scores of 1,2,3,4 and 5, respectively. The values were added to obtain a score of 15, which was then divided by 5 to obtain 3.0, taken as the mean (risk neutral). Farmers with mean score less than 3.0 were taken as risk averse while those with mean score above 3.0 were risk preference. To avoid bias in the result, both negative and positive responses were analysed. Also, how well the statements reflect on the risk attitude of the farmers were tested based on the score obtained, before making conclusions.

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics

Table 2 shows that 27.8%, 24.7% and 20.1% of the cassava farmers were within age brackets of 31-40 years, 41-50 years and 21-30 years respectively. The mean age of the farmers is 48 years. [25,28] asserted that the risk bearing abilities and innovativeness of a farmer depend on his mental capacity to cope with the daily challenges of farming, and his ability to do manual work decreases with advancing age. Table 2 also shows that 59.9% of the cassava farmers were female, while 41.1% were male. This indicates that females were more involved in cassava farming in the area and supports the findings of [23] that women are the backbone of agricultural sector and responsible for 80% of the food produced in Nigeria. Majority (72.2%) of the farmers were married while 13.5% were single. The added responsibility of marriage could be the reason to venture into cassava farming for household sustenance. About 51.0% of the cassava farmers had between 6-10 persons as household members with mean household size of 7 persons. [36] reported that large household size could lead to economic inefficiency where small farm sizes are available for cultivation. The finding confirms [21] assertion that rural farm households in Nigeria are characterized by moderate to large household size. Table 2 further shows that majority of the cassava farmers (88.7%) had one form of formal education or the other while 11.2% had no formal education. According to [22,34] education raises human capital and would significantly increase farmer's ability to make correct and meaningful choices for farm operations including use of appropriate risk management strategy. Also, 61.8% of the respondents had no extension contact and 51.4% relied on both family and hired labour for labour supply. Poor extension access could lead to high perception of risk.

Table 2. Distribution of cassava farmers according to socio-economic characteristics

Variable	Frequency (N = 518)	Percentage	Mean
Age (years)			**47.8**
< 21	3	0.6	
21-30	104	20.1	
31-40	144	27.8	
41-50	128	24.7	
51-60	96	18.5	
>60	43	8.3	
Sex			
Male	213	41.1	
Female	305	58.9	
Marital Status			
Married	374	72.2	
Single	70	13.5	
Widow (er)	60	11.6	
Divorced	2	0.4	
Separated	12	2.3	
Household size			**7.32**
1-5 persons	240	46.3	
6-10 persons	264	51.0	
11-15 persons	12	2.3	
16-20 persons	2	0.4	
Educational level			
No formal education	72	13.9	
Primary education	186	35.9	
Secondary education	194	37.4	
Tertiary education	66	12.7	
Farm size			**1.2**
≤1	278	53.7	
1.1 – 2.0	166	32.1	
2.1 – 3.0	74	14.3	
Extension contact			
No Contact	320	61.8	
Contact	198	38.2	
Source of farm labour			
Family labour	82	15.8	
Hired labour	170	32.8	
Both family and hired labour	266	51.4	

Source: Field survey data, 2015.

Sources of Risks to the Cassava Farmers

As presented in Table 3, 77.2% of the farmers identified erratic rainfall, as risk occurring very often within the last five years. Also, 31.3% had experienced flood occurring twice within the last five years. Another risk source identified by the cassava farmers were as pests and diseases(59.1%). [10] noted that the major causes of farm loss were pest and disease outbreak, erratic rainfall pattern, price fluctuation, changes in government policies and theft.

Table 3 further shows that 69.1% and 51.7% of the farmers had experienced low price of output and inadequate market for produce respectively occurring yearly in the last five years. This could be attributed to inconsistencies in agricultural produce marketing, poor road network to standard markets and unstable government policies [26]. [3] revealed that efficient marketing system is a pre-requisite for increased and sustained food production and agricultural development. Furthermore, 57.5% of the respondents had experienced high cost of input. This implies the absence of input price regulatory agencies and institutions to cassava farmers. [4] noted that the potential success to small scale farm enterprise rests on their ability to divide risks and reduce working capital. One way farmers can achieve this is by engaging in crop share lease.

With respect to financial risks, Table 3 shows that 3.9%, 50.6% and 3.9% of the respondents stated lack of adequate insurance coverage, inadequate credit facilities and high interest rate as their source of financial risks respectively. Lack of adequate insurance coverage (3.9%) implies that majority (96.1%) of the farmers do not have formal security against unforeseen circumstances in their farms. This could be attributed to the costs associated with acquiring agricultural insurance coverage. Having crop insurance plays an important role in mitigating risk in small farms [14]. In contrast, having crop insurance negatively influences a farmer's management decision and may lead to the farmer taking unnecessary risks [4]. Majority (70.3%) of the cassava farmers had no access to adequate credit and as such may not be able to purchase productive assets needed to expand their enterprise. This is attributed to absence of formal credit institutions in rural economies [27]. A fair percentage (30.9%) of the cassava farmers experienced very high interest charge. It could be that these farmers obtained their farm credit mainly from informal sources. [8, 11, 37] had posited that one of the principal characteristics of informal credit is the higher interest charge on loans relative to those by the formal banking sector. Most farmers prefer to access informal credit because of numerous bottle necks associated with obtaining credit from formal financial institutions in Nigeria [8].

About 18% and 50% of the cassava farmers stated that lack of microfinance banks and government policy lag respectively, were sources of institutional risks to cassava farming in the study area. This finding could be attributed to unstable agricultural finance policies and implementation strategies, and indicates that government agricultural policies and programmes are not sufficiently structured to suit the needs of small scale cassava farmers. This could also be related to the subsistence level of agriculture practiced by rural farmers which is essentially for family sustenance rather than commercial gains.

Results of human/personal risks show that 38.2 %, 32.4%, 60.2%, 20.5% and 1.5% of the cassava farmers had experienced inadequate family labour, ill health, lack of technical knowhow, adulteration of input and communal conflict, respectively, 1-5 times in the last five years. The shortage in family labour could be attributed to rural-urban migration of young people in search of white collar jobs [13]. About 60% of the respondents lack the technical skills to carry out modern farm operations. Modern farming skills such as agrochemical use and planting specifications for improved cultivars require additional training to be carried out. This could be attributed to certain socio-economic characteristics such as levels of formal education, access to land and extension contact [14,18]. Also about 24% and 4% of the respondents had experienced theft and conflict with Fulani cattle rearers respectively. This implies that the respondents had no formal security measure against threats on

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

their farms. This may possibly be attributed to the rural settings where farming activities take place at subsistence level in distant farms [31]. Theft in small farms might be as a result of the unemployment and under-employment and the need to sustain living. Job creation is bound to reduce crime rate especially among young farmers in rural areas. The finding with respect to conflict with Fulani cattle rearers is in contrast with [19] assertion that small scale farmers consider Fulani cattle rearers as posing grave danger to their farms.

Table 3. Sources of risks to cassava farmers in Abia State, Nigeria

Risk sources	*Percentage of respondents (N = 518)	Number of times experienced (last 5 years)
Production risk		
Cassava pest and disease	59.1	5
Erratic rainfall	77.2	5
Flood	31.3	2
Destruction by animals	2.1	1
Bush fire	24.3	1
Marketing risk		
Low price of output	69.1	5
Inadequate market for produce	51.7	5
High cost of inputs	57.5	3
Financial risk		
Inadequate insurance coverage	3.9	1
Inadequate credit facilities	70.3	5
High interest rate	30.9	3
Institutional risk		
Inadequate functional MFB/Cooperative societies	18.1	5
Government policy	50.2	2
Human/personal risk		
Farmer’s ill health	32.4	2
Inadequate family labour	38.2	2
Theft	23.6	3
Adulteration of inputs	20.5	3
Conflict with Fulani cattle rearers	4.25	2
Communal conflict	1.5	1

Source: Field survey data, 2015; *Multiple responses.

Cassava Farmers’ Attitude to Risk

The Likert scale result presented in Table 4 shows that majority (69.5%) of the respondents were risk averse.

Table 4. Distribution of respondents according to risk attitude

Risk attitude	Frequency	Percentage
Risk averse	360	69.5
Risk neutral	70	13.5
Risk takers	88	17.0
Total	518	100.0

Source: Field survey data, 2015.

About 13.5% and 17.0% of the respondents were risk neutral and risk takers respectively. Similar results were obtained by [18] on risk attitude of crop farmers in central part of Nigeria.

Risk Management Strategies Adopted by the Cassava Farmers

Risk management strategies can be grouped into three categories: prevention strategies to reduce the probability of an adverse event occurring, mitigation strategies to reduce the potential impact of an adverse event, and coping strategies to relieve the impact of the risky event once it has occurred [39]. Prevention and mitigation strategies focus on income smoothing, while coping strategies focus on consumption smoothing. As shown in Table 5, Majority (78.8%) of the cassava farmers adopted intercropping as preventive strategy against production risks such as adverse change in weather conditions and crop failure. Also, 79.9% used primary processing techniques to manage spoilage and extend shelf life of produce. Only 39.3% of the respondents had storage facilities. This indicates that majority (60.7%) of the cassava farmers do not have storage facilities for cassava produce [14]. Also, 20.5%, 23.9% and 14.7% of the cassava farmers use extension services, government assistance and resistant varieties respectively as preventive strategies. This means that majority of the farmers did not use the institutions and resistant varieties due to insufficient research information and policy lag associated with agricultural policies. Table 5 also shows that about 22.8% and 34.7% of the cassava farmers used pesticides/herbicides and fertilizer application, respectively. The low percentages could be attributed to inaccessibility and cost of agrochemicals, lack of awareness on the usefulness and method of applying agrochemicals in small farms. It could also imply that farmers practice shifting cultivation and land fallowing to restore the nutrient content of the soil due to the bottlenecks associated with fertilizer acquisition.

With respect to mitigation management strategies, 73.0% and 58.3% of the cassava farmers used gathering of market price

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

information and spreading sales respectively. This implies that farmers in the study area source information about the prevailing market prices for their produce before making sales. This can help put them in less compromising positions about future prices. One benefit of this is that farmers can actually make better short and long term marketing decisions. Spread of sale can relieve the farmer of seasonal price fluctuations and may even help raise earnings [4]. Few (4.63%) of the respondents adopted cooperative marketing as a mitigation strategy for risk of low price of output. Cooperative marketing is a way of sharing market risks with others and increasing market power to attract more favourable prices. It is shown in Table 5 that 39.8% of the cassava farmers diversified their source of income and engaged in non-farm activities from which they earned non-farm income. Engaging in and earning of non-farm income will lower the variance of income to the farm family by providing a steady income regardless of the success of the agricultural enterprises in a given season [6]. According to [4] farmers often sustain their farm income with earnings from off farm work. All the cassava farmers (100.0%) diversified their enterprises. Diversification of enterprises is the production of two or more crops or livestock enterprises simultaneously by a farmer and all the enterprises in the combination being in agriculture.

The results of coping strategies show that 56.0%, 24.3%, 45.2%, 68.0% and 48.6% of the cassava farmers used working off farm, reduced consumption, borrowing, hiring labour and planning expenditure, respectively, as coping strategies for risks. This confirms that farmers have alternative sources of income due to the unpredictable nature of agricultural activities. Majority (75.7%) do not reduce their food consumption level in order to manage risk. This is because household primary reason for farming is family sustenance. Cassava farmers often borrow from friends/relatives during planting season and customarily payback with crops or animals during harvest periods, as coping strategy against risks. This implies that cassava farmers in the study area rely on borrowing to make contingency financial plans for the farm. The use of hired labour by 68.0% of the farmers as risk management strategy can be attributed to the tedious nature of cassava farming, which necessitates farmers to hire people outside their household to augment household labour [31]. About 56% of the cassava farmers used local (*akawo*) contribution as risk management strategies. This implies that farmers have alternative local means of saving cash and obtaining loans for farming during the season.

Table 5. Risk management strategies used by cassava farmers.

Management Strategies	Frequency (N=518)	% of respondents*	Rank
Prevention strategies			
Intercropping	408	78.8	3rd
Spraying herbicides/pesticides	118	22.8	19th
Use of resistant varieties	76	14.7	21st
Fertilizer application	180	34.7	15th
Extension contact	106	20.5	20th
Government support	124	23.9	18th
Primary processing	414	79.9	2nd
Storage facilities	240	46.3	11th
Record keeping	56	10.8	22nd
Mitigation strategies			
Selling of asset	196	37.8	14th
Price support	160	30.9	16th
Cooperative marketing	24	4.63	23rd
Formal insurance	4	0.77	24th
Forward contracting	1	0.19	25th
Spreading sales/sequential marketing	302	58.3	6th
Gathering market information	378	73.0	4th
Diversification of enterprises	518	100.0	1st
Diversification of income sources	206	39.8	13th
Coping strategies			
Working off farm	290	56.0	8th
Reduced consumption	126	24.3	17th
Borrowing	234	45.2	12th
Change in production technique	264	51.0	9th
Hired labour	352	68.0	5th
Planning expenditure	252	48.6	10th
Akawo (local) contribution	292	56.4	7th

Source: Field survey, 2015.

CONCLUSIONS

From findings of the study it can be concluded that sources of risks to cassava farmers are varied and many. Erratic rainfall and pest and disease infestation were two main sources of production risks faced by the farmers, While, important source of market risk and financial risk were low price of output and inadequate credit facilities respectively. The farmers' were mostly risk averse and generally employed enterprise diversification as a means of reducing price risk, while very few of them used insurance, cooperative marketing and forward contracting. It is therefore evident that cassava production in the study area is done under a system fraught with numerous risks that necessitate the need for general policy solutions.

Based on findings of this study, the following recommendations are pertinent:

Agricultural policy makers should make policies that will encourage cassava farmers to use formal insurance, cooperative marketing and forward contracting as a means of reducing social and market risks.

Also, the state government in collaboration with private sector should institute a loan scheme specifically targeted towards empowering women in the agricultural subsector, since it has been observed that women are the dominant gender in cassava farming. Also, it is suggested that cassava farmers should organise themselves into cooperative societies to enable them pool resources together and negotiate jointly with input suppliers and produce buyers to manage the market risks in cassava farming.

The study showed that lack of inputs such as fertilizer and herbicides/pesticides are sources of risk to cassava farming. The current agricultural policies targeted at making fertilizer more accessible at subsidized rate under the growth enhancement support scheme should be sustained. Also, the on-going credit liberalization policy of the government aimed at encouraging lending to farmers at single digit interest rate should be continued to enable farmers purchase farm inputs.

The role of crop insurance cannot be over emphasized in risk management. Government should focus on creating a suitable insurance coverage against risks associated with weather conditions. More research should be carried out on the cost implications of this risk management strategy.

Farmers should develop a broad range of strategies through record keeping which take into account the advantages and disadvantages (benefits and costs) of each risk management option individually and in combination with others.

Cassava farmers in the study area should be encouraged by government and non-government organizations to join cooperatives in order to have access to better agrochemicals, financial services, extension services, and information that will help in cassava risk mitigation. Unions or cooperatives will further facilitate positive interactions especially on risk sharing and cooperative marketing. This will present a collective bargaining front, and serve as a conduct for transmitting government extension recommendations to the farmer.

The contact between farmers and extension agents should be strengthened to increase the number of extension contacts to cassava farmers. Farmers can manage risks effectively with technical knowledge got from research institutions through extension agents.

ACKNOWLEDGEMENTS

We appreciate the efforts of professors and other learned colleagues in Department of Agricultural Economics, Federal university of Technology Minna. This study would not have been completed without their inestimable contribution.

REFERENCES

[1]Abia State Ministry of Agriculture 2014,. Registered Cassava farmers in Abia State. Official gazette.

[2]Ajani, E.N., 2012, Occupational Diversification Among Rural Women in Anambra State, Nigeria. PhD Thesis, Department of Agricultural Extension, University of Nigeria, Nsukka.

[3]Ajijola, S. O., Egbetokunand, A. and Ogunbayo, I. E., 2011, Impact of risk attitudes on poverty level among rural farmers in Ogun State. Journal of Development and Agricultural Economics, 3(12): 581-587.

[4]Akinnagbe, O. M., Agwu A. E., Igbokwe E. M., 2008, Agricultural extension policy for enhancing women participation in sustainable agricultural development in Nigeria. Developing Agricultural

Extension Policy for Nigeria. Proceedings of the 13th Annual National conference of AESON 8 -11 April.

[5]Alphizar, A., Carlsson, F., Naranjo, M., 2010, The effect of risk, ambiguity and coordination on farmers' adaptation to climate change: A framed field experiment". Paper presented at the International Workshop on The social dimension of adaptation to Climate Jointly Organised by the International Centre for Climate Governance, Centro EuroMediterraneo Per: Cambiamenti Climatic and Fondazione Eni Enrico Mattei, Venice, February 18th -19th. Pp. 23-87.

[6]Ani, A. O., 2002, Factors Inhibiting Agricultural Projection Among Rural Women Farmers in Southern Ebonyi State, Nigeria. Unpublished Ph.D. Thesis. University of Maiduguri, Nigeria.

[7]Antón, J., 2008, Agricultural policies and risk management: A holistic approach. Proceedings of the 108th EAAE Seminar on Income Stabilization. Warsaw, February 2008. 1-113.

[8]Anyanwu, C.M., 2004, Microfinance Institutions in Nigeria, paper presented at the GS4 Workshop on Constraints to Growth in Sub-Saharan Africa. Pretoria. South Africa. Nov. 29th -30th.

[9]Asogwa, B. C., Umeh, J.C., Ater, P. I, 2006, Technical Efficiency Analysis of Nigerian Cassava Farmers: A Guide for Food Security Policy. Poster paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006.

[10]Ayinde, O. A., Omotesho, A. O., Adewumi M. O., 2008, Risk attitudes and management strategies of small-scale crop producers in Kwara State, Nigeria: A ranking approach. African Journal of Business Management, 2(12), 217-221.

[11]Ayinde, O. E., Muchie, M., Omotesho, O. A., Ayinde, K., Adewumi, M. O., 2012, Multi-risk model of small-scale agricultural entrepreneurs in Central Part of Nigeria. International Journal of Academic Research in Economics and Management Science, 1(2): 224-236.

[12]Binici, T., Koc, A. A., Zulauf, C. R., Bayaner, A., 2003, Risk attitudes of farmers in terms of risk aversion: A case study of lower Seyhan plain farmers in Adana province, Turkey. Turkey Journal of Agriculture, 27(1), 305-312.

[13]Bodie, Z., Robert, C., 1998, Finance. Upper Saddle River NJ: Prentice Hall, 1998. 234-251.

[14]Dankyang, Y., 2014, Risk Sources and Management Strategies of Small Scale Farmers in Kaduna State, Nigeria. Unpublished M.Tech Thesis. Department of Agricultural Economics, Federal University of Technology, Minna. 10-37.

[15]Ezeh, C. I., 2007, The Multiplier effect of Agricultural Development Programme's (ADP) Small Plot Adoption Technique (SPAT) on small holder farmers in Abia State, Nigeria. Journal of Agriculture and Food Sciences. 5(1), 41-51.

[16]Famorati, S., 1998, The Impact of Rural Infrastructural Facilities in Agricultural Product and marketing: A case study of Ekiti State. B. Sc Project. Department of Agricultural Economics, University of Ibadan.

[17]Hardeker, J.B., Huirne, R.B.M., Anderson, J.R,. 1997, Coping with Risk in Agriculture, AB International, Wallingford, UK.

[18]Harrington, S.E., Niehaus, G.R., 1999, Risk Management and Insurance, Irwin McGraw Hill, Boston, USA.

[19]Holzman, R. and Jorgensen, S., 2001, Social risk management: A New conceptual framework for social protection, and beyond. International Tax and public Finance, 8: 529-556.

[20]Isik, M., Khanna, M. 2003, Stochastic technology, risk preferences and adoption of site specific technologies. American Journal of Agricultural Economics, 85(1): 305-317.

[21]Izuchukwu, O., 2011, Analysis of the contribution of agricultural sector on the Nigerian economic development. World review of business research, 1(1), 191-200.

[22]Jirgi, A. J., 2013, Technical Efficiency and Risk Preferences of Cropping Systems in Kebbi State, Nigeria. Ph.D Thesis, Department of Natural and Agricultural Economics. University of the Free State, South Africa. 233-234

[23]Kahan, D., 2013, Managing Risk in Farming. Farm Management Extension Guide. Food and Agriculture Organization of the United Nations, Rome. 120 Pp.

[24]Knight, J., Weir, S., Woldehanna, T., 2003, The role of education in facilitating risk taking and innovation in agriculture. The journal of development studies, 39(6), 1-22.

[25]Liu, E. M., 2008, Time to Change What to Sow: Risk preferences and technology adoption decisions of cotton farmers in China. Working Papers (1064). Department of Economics, Princeton University.

[26]National Root Crops Research Institute (NRCRI) 2003, Annual Report. Umudike, Umuahia, Abia State, Nigeria.

[27]Nmadu, J. N., Eze, G. P., Jirgi, A. J., 2012, Determinants of risk status of small-scale farmers in Niger State, Nigeria. British Journal of Economics, Management and Trade, 2(2): 92-108.

[28]Nsoanya, L. N., Nenna, M.G., 2011, Adoption of improved cassava production technologies in Anambra-East Local Government Area of Anambra State Nigeria. Journal of research in National development, 9(3): 36-43.

[29]Nurudeen, A. J., 2012, Economics and social characteristics of registered poultry egg producers in Ilorin, Kwara State, Nigeria. Russian Journal of Agriculture and Socio-Economic Science. 11(11): 1-34.

[30]Nwaru, J.C., 2004, Rural Credit Market and Resource use in Arable Crop Production in Imo State of Nigeria, Ph.D Thesis, Department of Agricultural Economics and Rural Sociology. Michael Okpara University of Agriculture, Umudike, Nigeria.

[31]Ogbe, S. E., 2009, Determinants of microcredit and microfinance outreach to farmers in Abia State; a case study of National Special Programme on Food Security. MSc Thesis, Department of Agricultural Economics, Michael Okpara University of Agriculture, Umudike. pp. 51.

[32]Okojie, C.E. Monye-Emina, A. Eghafona, K. Osaghae, G., Ehiakhamen, J.O., 2010, Institutional Environment and Access to Microfinance by Self Employed Women in the Rural Areas of Edo State. International Food Policy Research Institute. Nigeria Strategy Support Program (NSSP) Background Paper, Brief No 14. pp. 1-3.
[33]Osondu, C.K., Anyiro C.O., Ijioma J.C., Obike, K., 2013, Analysis of risk management strategy by arable crop farmers in Abia State, Nigeria. World Research Journal of Agronomy. 2(1): 26-29.
[34]Osondu, C. K., Ogbonna, S. I., Emerole, C. O. 2015, Level and Determinants of Women Farmers Access to Informal Credit in Abia State, Nigeria. Asian Journal of Agricultural Extension, Economics and Sociology, 7(1): 1-10.
[35]Simonyan, J. B., Olukosi, J. O., Omolehin, R. A., 2010, Socio-economic determinants of farmer's participation in Fadama II project in Kaduna state, Nigeria. Journal of Food and Fibre Production, 1(1): 592-601.
[36]Taiwo, A., Ayanwale, A.B., 2005, Risk and risk management strategies in onion production in Kebbi State of Nigeria. Journal of Social Science, 10(1): 1-8.
[37]Takeshima, H., Yamauchi, F., 2012, Risks and farmers' investment in productive assets in Nigeria. Agricultural Economics, 43(2): 143-153.
[38]United Nations Population Fund (UNFPA) 2013, http://nigeria.unfpa.org/abia.html., Accessed: 5th June, 2014.
[39]Yamane, T., 1997, Statistics: An Introductory Analysis, 2nd edition, New York: Harper and Row.
[40]Yusuf, S., Malomo, D., 2007, Technical efficiency of poultry egg production in Ogun State: A Data Envelopment Analysis Approach. International Journal of Poultry Science, 6 (9): 622-629.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ANALYSIS OF SUPPLY STRUCTURE AND TRENDS OF FORMAL FUNDING OF AGRICULTURE IN NIGERIA (1992-2012)

Sylvanus Ibeabuchi OGBONNA, Charles Kelechi OSONDU

Abia State University, Department of Agricultural Economics and Extension, Umuahia Campus, PMB 7010, Umuahia, Abia state, Nigeria, Phone: +2347037400876, Emails: osonducharles87@gmail.com

Corresponding author: osonducharles87@gmail.com

Abstract

This study analyzed supply structure and trends of formal funding of agriculture in Nigeria. Time series data, covering the period 1992 to 2012 collected from Statistical Bulletin of Central Bank of Nigeria was used in the analyses. The data collected was analyzed using descriptive statistics and trend analysis. Issues addressed included formal credit supply structure and trends of supply of loans to agriculture in Nigeria. Results showed that structure of formal loan Supplies to agricultural production in Nigeria was one of dominance in number and values of guaranteed loans to individual farmers than to corporate farms. The trend in value of loans allocated to food crop within the period under review was increasing, consistent and positive. The trend in value of loans allocated to cash crops however fluctuated. More funds should be allocated to agriculture through the Agricultural Credit Guarantee Scheme Funds by Central Bank of Nigeria to enable the scheme expand its services to other farm enterprises (such as apiculture, heliculture, grass cutter rearing and mixed farming) and increase volume of loans to medium and large scale farmers.

Key words*: s*upply structure, agricultural financing, credit, Nigeria

INTRODUCTION

Emergence of crude oil as a major source of foreign exchange earner and revenue to Nigeria government, had forced agricultural sector to be neglected resulting to its observed decline [12,13,24]. Neglect of the sector is such that there has not been reliable and effective clear cut formal national finance structure policy directing flow of formal credit to the sector. What had existed is concessionary consideration of finance to the sector, which has not placed the sector in any strong commercial competitive setting as subsidized lending programmes to farmers have succeeded in obstructing development of a sustainable rural banking in Africa [14].

Agricultural sector in Nigeria has great potential to generate employment opportunities, alleviate food insecurity, encourage agro-industrialization and improve entrepreneurship through capacity building and is looked upon to generate required economic growth. The realization of this fact led successive Nigerian governments to embark on several agricultural development programmes, many of which, unfortunately, failed [15,18]. These programmes include National Accelerated Food Production Programme (NAFPP) in 1972, Operation Feed the Nation (OFN) in 1976, Green Revolution (GR) in 1980 and Agricultural Transformation in 2011.

To sustain these programmes and diversify her oil-based economy, Nigeria placed emphasis on financing of her agricultural sector by increasing flow of credit to the sector [2]. Formal financial institutions have been induced by moral suasion and correction to extend a minimum prescribed percentage generation of their loanable funds at concessionary interest to agriculture. Financing Agricultural sector remains one important instrument for economic policy for Nigeria, in her effort to stimulate growth and development in all sectors

[19] was able to chart the trend of supply of agricultural credit in Nigeria from 1978 to 2009 comparing effects of price reform policies on access to institutional credit to the sector before and after the reforms (1978 - 1985; and 1986 -2009). The lending to

agricultural sector in Nigeria during post financial reform era was trending upwards, relative to the sluggish and almost stagnant trend in the pre-reform era. This suggests that the financial sector reforms were paying off after all since its multiplier effects filtered through the sector engineering growth and development. To sustain the growth impact or positive real growth pattern induced by credit supply to the sector, the need to improve on policy variables inducing such becomes quite obvious.

[3] observed that robust economic growth can only be achieved by putting in place well focused programmes to enhance farm credit supplies and reduce poverty by empowering farmers through increasing their access to farm credit. Good implementation of such credit outreach Programmes will only be assured when executors have grip of correct knowledge of current structure and conduct of credit to agricultural production in the country.

In light of the foregoing this addressed the following: (i) describing supply structure and conduct of funds to agricultural production in Nigeria from 1992 to 2012; (ii) classifying and analyzing funds (credit) supplied to agriculture by sectors viz trend in credit from formal sources to food and cash crop production in Nigeria from 1992 to 2012; (iii) estimate growth rate of formal credit disbursement to agriculture within the period under review.

MATERIALS AND METHODS

Study Area

The study was carried out in Federal Republic of Nigeria. Nigeria. This country is located in West Africa covering a geographical area of 923,768 square kilometers and is bounded on the south by Gulf of Guinea, on the West and North by Republics of Benin and Niger, on the east by Republic of Cameroon. The country is located between latitudes 4^0 $02^/$N and 14^0 $03^/$North (south of Lake Chad) and longitudes 2^0 $59^/$ E and 15^0 $02^/$ East of the Greenwich Meridian covering a geographical area of 923,758 square kilometers. The population consists of 140, 003,542million people [17]. Nigeria has a land area of 98.3 million hectares, of which 71.2 million hectares are cultivable. However, only 34.2 million hectares (about 48 per cent of the cultivable area) are actually being cultivated, and less than 1 per cent of the arable land is irrigated [10,16].

The climate is semi-arid in the north and becomes increasingly humid in the south, with mean annual temperature ranging from 28^0C to 31^0C in the south. Rainfall is one of the important climatic factors influencing agriculture and three broad ecological zones rainfall pattern are commonly distinguished: the northern Sudan savannah (500 – 1,000 mm), the guinea savannah zone or middle belt (1,000 – 1,500mm) and the southern rainforest zone (1,500– 4,500mm). Generally, rainfall patterns are marked by an alternation of wet and dry seasons of varying duration. In the north, rainfall lasts from May to September with a peak in August, while in the south, rainfall is bimodal, increasing steadily from March and reaching its peak in September. About two thirds of the cropped area is located in the north with the rest equally divided between the middle and southern zones [1].

The average population density of 118 persons per square kilometre masks the disparity that exists between the densely populated South west and South east of Nigeria, where much of the urban population live and the less concentrated north. The economy is characterized by a large rural population, mostly agricultural based traditional sector and relatively smaller urban, and more capital intensive sector. The average per capita income (estimated by the World Bank in 2006) was US$300 per annum [7]. Agriculture is the largest single sector of the economy, providing employment for a significant segment of the work force and constituting the mainstay of the country's large rural community, which accounts for nearly two-thirds of the population. The proportion of the Gross Domestic Product (GDP) attributable to agriculture hovered between 30.0% and 40.0%, well ahead of mining and quarrying, as well as wholesale and retail trade, which are the other two major contributors to the country's GDP [9]. A large proportion (89.06%) of the total agricultural production was accounted for by rain fed crop production while livestock, forestry and fisheries contributed 6.38 per cent, 1.25 percent and 3.31 per cent respectively [7].

Data Collection

Data for this study was culled from secondary sources. The data provided information covering the period 1992-2012 and was gathered from various issues of annual reports and statement of account of Central bank of Nigeria and other relevant financial data in statistical bulletins of local and international agencies.

Data Analysis

To realize the objectives of this study, a number of statistical tools were employed in analyzing the obtained data. Descriptive statistical tools such as frequency tables and percentages were partly used to analyze objectives (i) and (ii). The data was further subjected to trend analysis to realize part of objective (ii).

Model specification

The linear trend equation for estimating agricultural growth was specified in line with [11] as:

LnQt = a + bt + Ut …………………........(1)

where:
Qt = Credit disbursed to food and cash crop producers by formal institutions during period under review (t);
a = constant of the regression line;
b = parameter estimate of the absolute increase in fund disbursed to food and cash crop;
U = error term;
Ln = natural logarithm.

For measuring acceleration or deceleration in the growth rate, log quadratic trend equation was fitted in line according to [21, 22] and stated thus:

LnQt = a + bt + ct^2+ Ut ……………….... (2)

A positive significant value of c indicates acceleration while a negative significant value implies a deceleration. A non – significant value shows stagnation in the growth process.

The compound growth rate equation is given as follows:

r = (eb – 1) x 100…………………… (3)

where e is Euler's exponential constant (2.71828). Most of the time series variables are non--stationary and we checked for stability in unit-root of the variables using the most recommended tests of Augmented Dickey---Fuller (ADF) test and the Phillips-Perron (P-P) test.

RESULTS AND DISCUSSIONS

Supply Structure and Conduct of Credit to Agricultural production in Nigeria (1992-2012).

The number and value of loans guaranteed to farmer users' over the period (1992-2012) in Nigeria are shown in Tables 1 and 2 respectively. Table 1.0 showed that annual number of loans ranged from 12,859 in 1999 to 56,328 in 2011. During the year of lowest number of disbursement (1999) the proportions of target disbursements were: 96.73% to individual farmers; 0.08% to informal groups; 2.81% to cooperative societies; and 0.38% to corporate groups respectively. During the year of highest number of disbursement (2011) the proportions of target disbursements were: 95.52% to individual farmers; 3.17% to informal groups; 1.20% to cooperative societies; and 0.00% to corporate groups respectively. Loans to individual farmers dominated in number. This revealed that in Nigerian agricultural sector, farmers who operated as small and medium scale individual units were most attended to in disbursement of formal farm credit; the next attended were informal groups and cooperative societies; and the least were the corporate groups. This trend truly reflected dominance of smallholder farm units producing bulk of locally consumed foods and remaining center-piece of Nigerian agriculture [8,23].

The cumulative annual percentage of number of loan beneficiaries (cooperative societies, informal groups and corporate units) was low over the years compared to that to individual farmers (Table 1).

Table 1. Total number of loans to agriculture by category of users in Nigeria (1992-2012)

Year	Total number of loans	% Total No. of Loans to individuals	%Total No. of Loans to informal Group	% No. of Total loans to Cooperatives	% Total No. of loans to Company	Total
1992	21,206	99.25	0.00	0.65	0.10	100
1993	15,514	98.81	0.00	1.10	0.09	100
1994	16,572	98.93	0.00	0.88	0.19	100
1995	18,079	98.73	0.00	1.14	0.13	100
1996	19,036	98.22	0.00	1.68	0.10	100
1997	17,840	96.68	0.13	2.98	0.20	100
1998	14,637	98.94	0.11	0.53	0.42	100
1999	12,859	96.73	0.08	2.81	0.38	100
2000	14,102	98.39	0.47	1.0	0.09	100
2001	20,298	99.99	0.00	0.00	0.00	100
2002	23,681	99.35	0.34	0.30	0.02	100
2003	24,303	98.57	0.96	0.46	0.01	100
2004	35,035	99.65	0.20	0.13	0.02	100
2005	46,238	99.04	0.64	0.31	0.01	100
2006	54,032	93.61	1.83	4.55	0.02	100
2007	43,233	95.00	4.88	0.10	0.01	100
2008	52,787	95.92	3.19	0.83	0.06	100
2009	53,639	92.40	1.53	5.73	0.34	100
2010	50,849	97.15	0.99	1.74	0.12	100
2011	56,328	95.52	3.17	1.20	0.00	100
2012	48,736	96.36	1.41	1.38	0.86	100

Source: Computed from CBN statistical bulletin, (2009; 2012), [4,5]

Table 2 shows that annual total value of loans was highest with individual farmer beneficiaries also. The highest disbursed sum of ₦8,349,509,300.00 was in the year 2009 with 89.77% of it given to individual borrowers; 7.03% of it given to cooperative societies; 1.66% of it disbursed to corporate organizations and 1.54%of it given to informal groups borrowers. Likewise, the least amount of these loans ₦9,706,761.23 were given out to farmers in 2012 with 94.04% of it given to individual borrowers; 2.92% of it given to corporate organizations; 2.75% to cooperative societies and 0.29% to informal groups. Even though individuals attracted bulk of this loan to themselves, the truth remains that groups and companies had higher capacities to utilizing such loans.

Structure of Loans Guaranteed By Size from 1992 to 2012

The pattern of loans guaranteed by size to users' over the period (1992-2012) in Nigeria is shown in Table 3. Loans in the bundle of at most ₦5000.00 dominated both in number and value of the guarantees. This does not present any surprises since about 65% of farmers in Nigeria operated on small scale with small holdings.

This result is in consonance with [20] that Agriculture in Nigeria is characterized by large number of small-scale farmers, scattered over wide expanses of land, withholding ranging 0.05-3.0 hectares, but not more than 10 hectares per farmer, with low capital use and low yield per hectare.

Annually, the loans of size at most ₦5,000.00 guaranteed over the period, were for farmers that ranged from 25 in 2010 to a maximum 20,185 farmers in 1992. The loans that ranged from ₦5,000.00 to ₦20,000.00 guaranteed by CBN, recipients ranged from a minimum of 748 farmers in 1992 to a maximum of 14,045 farmers in 2005.

Table 2. Total value of agricultural loans by category of users in Nigeria (1992-2012)

Year	Total value of Loans (NM)	% Total value of loans to individuals	% Total value of loans to informal groups	% Total value of loans to cooperatives	% Total value of loans to companies	Total
1992	88,031,800.00	85.82	0.00	7.79	6.39	100
1993	80,845,800.00	84.43	0.00	11.19	4.38	100
1994	103,186,000.00	83.78	0.00	8.72	7.50	100
1995	164,162,100.00	80.88	0.00	11.75	7.37	100
1996	225,502,500.00	79.74	0.00	15.27	4.99	100
1997	242,038,200.00	76.30	3.11	14.20	6.39	100
1998	215,697,200.00	88.23	0.79	4.15	6.83	100
1999	246,082,500.00	78.63	0.55	17.20	3.62	100
2000	361,450,400.00	89.69	2.77	6.34	1.20	100
2001	728,545,400.00	99.92	0.00	0.01	0.07	100
2002	1,051,589,800.00	97.53	1.01	1.35	0.12	100
2003	1,164,460,400.00	95.02	2.64	1.39	0.94	100
2004	2,083,744,700.00	96.81	1.02	1.52	0.65	100
2005	3,046,738,500.00	97.45	0.66	1.26	0.63	100
2006	4,263,060,300.00	93.47	1.94	4.03	0.55	100
2007	4,425,861,800.00	93.66	5.16	0.63	0.55	100
2008	6,721,074,600.00	91.61	4.30	2.46	1.62	100
2009	8,349,509,300.00	89.77	1.54	7.03	1.66	100
2010	7,740,507,600.00	95.23	0.55	3.23	0.99	100
2011	10,189,604.24	92.01	3.77	2.99	1.22	100
2012	9,706,761.23	94.04	0.29	2.75	2.92	100

Source: Computed from CBN statistical bulletin, (2012), [5]

Table 3. Number of loans guaranteed by size from 1992 to 2012

	<₦5,000.00	₦5,001-₦20,000	₦20,001-₦50,000	₦50,001-₦100,000	≥₦100,000
Year	Number of beneficiaries	Number of beneficiaries	Number of beneficiaries	Number of beneficiaries	Number of beneficiaries
1992	20,185	748	176	75	22
1993	14,255	961	175	110	13
1994	14,675	1,445	261	164	27
1995	14,167	2,981	501	356	74
1996	11,385	6,221	678	665	87
1997	8,112	7,948	927	647	206
1998	5,134	8,153	627	650	73
1999	2,596	8,379	1,152	586	146
2000	226	9,407	3,687	530	252
2001	529	8,828	8,193	2,244	504
2002	185	7,276	10,536	4,062	1,622
2003	280	9,848	7,904	4,776	1,495
2004	317	10,433	12,776	7,320	4,189
2005	85	14,045	16,346	8,749	7,013
2006	150	9,314	22,482	12,993	9,093
2007	26	3,186	15,334	13,133	11,554
2008	58	1,751	23,180	12,701	15,097
2009	28	5,707	16,674	11,823	19,407
2010	2 5	4 ,075	16,061	13,029	17,659
2011	50	4,540	13,957	14,395	23,386
2012	193	5,961	9,957	10,586	22,039

Source: Development Finance Department, Central Bank of Nigeria (2013), [6]

A minimum of 175 farmers in 1993 had loans in bundle of ₦20,001 to ₦50,000.00 guaranteed and a maximum of 23,180 farmers in 2008 had loans in the same bundle

(₦20,001-₦50,000) guaranteed.

Loans in the bundles of ₦50, 000 - ₦100,000 guaranteed by CBN within the period were given to farmers that ranged from a minimum of 75 farmers in 1992 to a maximum of 14,395 farmers in 2011.

Within the period also loans exceeding ₦100,000.00 bundles were given to a minimum of 13 farmers in 1993 and to a maximum of 23,386 farmers in 2011. The trend revealed that the maximum bundle of loan guaranteed and given to farmers was on the increase. This increasing trend was expected because more farmers joined the loan supply schemes as the years passed by.

Table 4 showed the classification of funds supplied to Agriculture by sectors under the Agricultural Credit Guarantee Scheme Fund (ACGSF) from 1992 to 2012.

Table 4. Values of loan guaranteed by purpose to agriculture through Agricultural Credit Guarantee Scheme Fund (ACGSF) in Nigeria from 1992 to 2012 (₦'000)

Year	Food crop	Livestock	Cash crop	Fishery	Mixed farming	Others	Sub-Total
1992	76,260.7	60,561	6,423.2	10,387	400	3,213.1	157,245
1993	70,252	5,505.8	2,384.9	428	0	2,703.1	812,73.8
1994	82,072.4	10,527.9	8,094.4	2,438	0	3,768.3	106,901
1995	121,068.6	18,048.5	13,499.3	1,512	1,000	11,517.7	166,646.1
1996	171,838.3	28,216.9	15,176	2,145	0	10,290.3	227,666.5
1997	187,491.8	23,404.7	13,755.5	3,554.5	0	13,822	242,028.5
1998	175,764.8	22,587.1	7,197.1	3,456	1,000	10,283.5	220,288.5
1999	204,058	11,952	4,920	6,180	205	14,524	241,839
2000	303,677	27,307	4,928	899	0	24,638	361,449
2001	605,525.7	60,415.7	17,169	15,742.2	0	29,692.8	728,545.4
2002	925,734.7	64,449.6	13,214.4	12,069.3	17,300	18,214.3	1,050,982
2003	1,015,195	100,486.4	10,961	13,050	8,333	2,990	1,151,015
2004	1,807,668	190,304	18,185	18,240	250	49,098	2,083,745
2005	8,167,102	844,882.8	154,830	262,195	15,210	49,635	9,493,854
2006	3,703,384	368,151	67,165	114,400	1,000	8,330	4,262,430
2007	3,871,443	353,487.3	42,331	140,690	0	17,510	4,425,462
2008	4,775,376	1,108,484	190,589	368,630	0	54,880.5	6,497,959
2009	5,517,229.66	1 ,725,801.27	2 98,967.80	708,621.24	1 2,930.01	85,959.30	8,349,509
2010	5,426,428.13	1,305,432.50	84,894.00	461,128.00	62,710.00	399,915.00	7,740,508
2011	6,797,632.69	1,882,283.35	109,029.92	590,167.50	357,885.00	443,645.80	10,200,000
2012	6,353,629.86	1,878,042.97	408,654.06	378,311.89	580,767.00	107,355.45	9,706,761
Total	50,400,000	10,100,000	1,492,369	3,114,245	1,058,990	1,361,986	67,500,000
Mean	2,398,040	480,952.5	71,065.17	148,297.4	50,428.1	64,856.48	3,213,179
Standard deviation	2735802	677063.6	109030.6	221693.8	144338.5	122107.3	3798106
Minimum	70,252	5,505.8	2,384.9	428	0	2,703.1	81,273.8
Maximum	8,167,102	1,882,283	408,654.1	708,621.3	580,767	443,645.8	10,200,000

Source: Development Finance Department, Central Bank of Nigeria (2013)

The total amount Guaranteed to food crop sub sector over the period was ₦50, 400,000,000.00 with a mean of ₦2, 398,040,000.00 and a standard deviation of₦2,735,802,000.00. The gap in value of loans supplied: minimum ₦70, 252,000.00 (in 1993) and maximum ₦8, 167,102, 000.00 (in 2005) to food crop sector was ₦8,

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

096,850,000.00 and is adjudged quite large.
Similarly, a total sum of ₦1, 492,369,000.00 supplied as credit to cash crop sector showed an increase during the period with a mean value of ₦71, 065.170. The difference between the minimum (₦2,384.900.00) disbursed in 1993 and maximum sum supplied (₦408, 654,060.00) in 2012 to cash crop sector was ₦406, 270,960.00 within the period under review. The total amount disbursed to livestock sector (₦10, 100,000.00) during the period under review was appreciably high with a mean loan value of ₦480, 492,952.5 and standard deviation of ₦677, 063.600.00. The gap between the minimum (₦5, 505,800) and maximum (₦1, 882,283,000) value of fund supplied to livestock sector was equally large. Similar increases were also recorded in the volume of fund supplied to fishery (₦3,114,245,000) with a mean of ₦ 148, 297,400 and other enterprises (apiculture, heliculture and grass cutter rearing) (₦1,361,986,000) with a mean of ₦ 64, 856,480 over the period under review. The gap between the minimum and maximum values of fund supplied to fishery (₦708, 193,300) sector and other agricultural enterprise (₦440, 942,700) within the period under review was equally quite large. The annual value of loans guaranteed to mixed farming over the period ranged from ₦205,000 in 1999 to ₦580,767,000.00 in 2012 with a mean of ₦50,428,100.00. The amount of fund supplied to mixed farming by the schemes showed dramatic distribution with no supplies in some years (1993, 1994, 1996, and 1997). The maximum loan of ₦580, 767,000.00 was supplied in 2012 and the large values of standard deviations within the sectors showed high variability in supply of funds over the years.

Trend in Loans Allocated to Food and Cash Crops Production in Nigeria (1992-2012)

The trend in the value of loans allocated to food crop within (1992-2012) is shown as Figure 1.

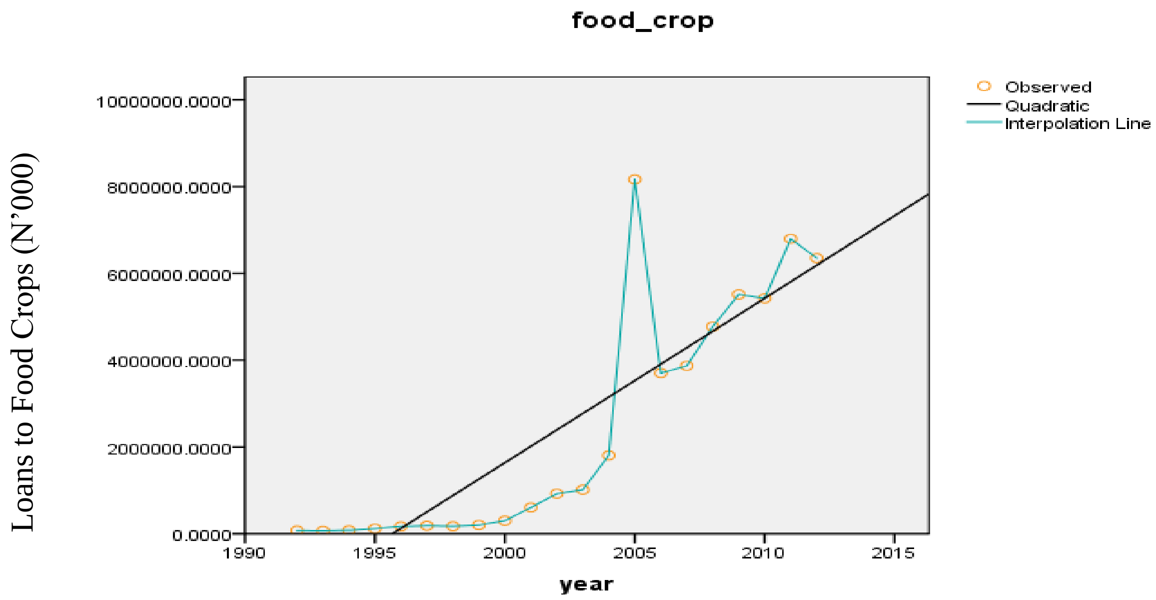


Fig.1.Trend in funds allocated to food crop sector in Nigeria from 1992-2012
Source: Computed from Table 4.

The figure shows the trend of funds as increasing and statistically significant. The computed R^2 value (0.737) of the trend line within the period (21 years) under review was significant at 1.0% alpha level of probability (Table 5). The Table shows that the lowest fund allocated to food crop (₦70, 252,000.00) was in the year 1993 with persistent higher funds below ₦2.0 billion allocated to the sub-sector from 2000 to 2004 and a sharp increase in loans to ₦8.67 billion in the year 2005 dropping again to ₦3.7 billion in the year 2006.

Table 5. Model Summary/parameter estimates of loan trend for food crop production in Nigeria.

		Model Summary			Parameter Estimates		
Equation	R Square	F	df	Sig.	Constant	b_1	b_2
Quadratic	0.737	53.171	1	.000	-3.764E8	.000	94.518

Source: Computed from Table 4.

Thus from 2006 to 2011 loans disbursed to food crop increased from ₦3.7 billion to ₦6.8 billion. Increments were on account of government policies aimed at improving food crop production in Nigeria.

The result of the trend analysis of funds supplied to cash crop production in Nigeria within the period under study is shown as Figure 2. The figure shows that the trend of funds allocated to cash crop production in Nigeria within the period had a significant positive trend with dramatic swings. Funds allocated to cash crop showed a series of non-consistent values with a zigzagged pattern. The lowest fund allocated to cash crops (₦2, 384,900.00) was observed in the year 1993. There were relatively higher values of funds allocated to cash crop:₦298, 967,800.00 in 2009 and 2012; with a sharp drop to ₦84, 890,000.00 in 2010.

The computed R^2 value (0.493) within the period was significant at 1.0% alpha level as was the case for food crops (Table 6).

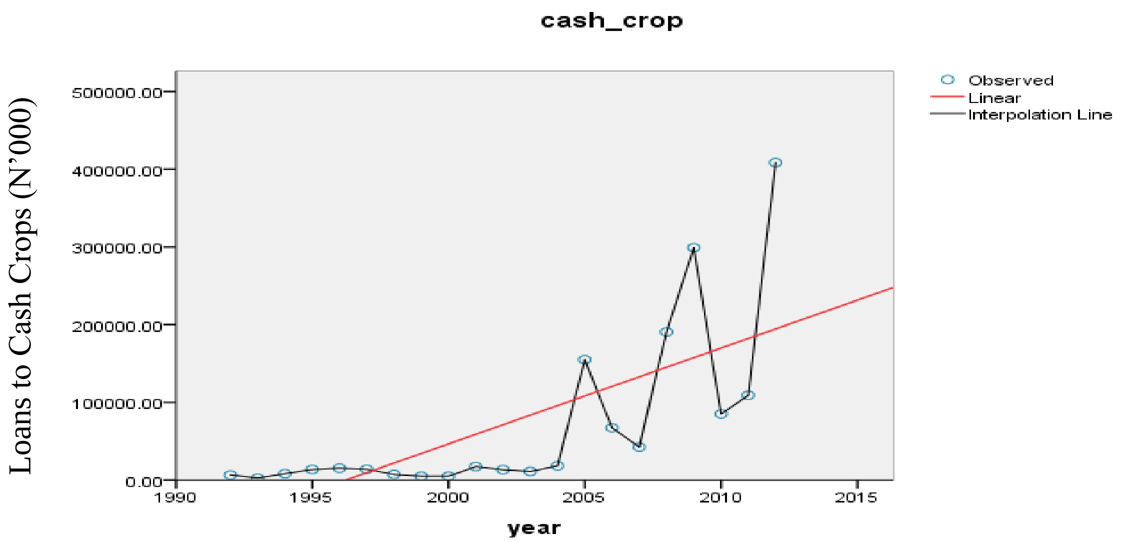


Fig. 2.Trend in funds allocated to cash crop sector in Nigeria from 1992-2012
Source: Computed from Table 4.

Table 6. Model summary/parameter estimates of loan trend for cash crop production in Nigeria

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	0.493	18.474	1	19	0.000	-2.463E7	1.234E4

Source: Computed from Table 4.

CONCLUSIONS

The empirical evidence from both descriptive and inferential statistics employed showed that there was increasing trend in size of loans guaranteed to agricultural sector from 1992 – 2012. The annual total value was highest with loans to individuals than with loans to corporate units.

Loan supplied to the food crop sub-sector was persistently increasing in trend. Loans to cash crop sub-sector fluctuated within the period under review. The Agricultural Credit Guaranteed Scheme was very effective in supplying credit to farmers (individuals and corporate farm units) in Nigeria.

The following recommendation suffices based on findings:

More funds should be allocated by Nigerian Government to farmers through the ACGSF. This will enable the scheme to expand its services (giving more loans) to other farm enterprises (such as apiculture, heliculture, grasscutter and mixed farming).

The formal lending institutions should increase the number and amount of loans disbursed to cooperative societies since loans to such organized groups can be easily managed with the effects of group pressure

REFERENCES

[1] African Development Bank (ADB) (2006). National Programme for Food Security (NFPS). Staff Appraisal Report.

[2]Ayoola, G.B., 2000, Essays on the Agricultural Development Policy and Administration in Nigeria. TMA publications, Ibadan.

[3]Central Bank of Nigeria (CBN) 2005, Statistical Bulletin. CBN. Abuja

[4]Central Bank of Nigeria (CBN) 2009, Annual/Quarterly Reports. CBN, Abuja.

[5]Central Bank of Nigeria (CBN) 2012, Statistical Bulletin.CBN, Abuja.

[6]Central Bank of Nigeria (CBN) 2013, Development Finance Department of Central Bank of Nigeria Annual Report.

[7]Coker, A.A., 2008, Empirical Analysis of Federal Government Expenditure Policy on Agriculture in Nigeria (1960 – 1998). Ph.D thesis, Department of Agricultural Economics, University of Nigeria, Nsukka.

[8]Dalhatu, M.B., 1991, Chairman's Statement. Nigerian Agricultural and Cooperative Bank Limited Annual Report and Accounts.

[9]Daramola, A., 2004, Competitiveness of Nigerian Agriculture in a Global Economy: Any Dividend of Democracy? Inaugural Lecture Series 36, Federal University of Technology, Akure, Nigeria.

[10]Federal Ministry of Agriculture and Rural Development (FMARD) 2001, National Fadama Infrastructure Survey Report, Sheda-Abuja: World Bank/Projects Coordinating Unit, Federal Ministry of Agriculture and Rural Development, Abuja.

[11]Ghosh, B.K., 2010, Growth and Variability in the Production of Crops in West Bengal Agriculture. Trends in Agricultural Economics, 3(3): 135 – 146.

[12]Ijaiya, G.T., 2000, Economic Growth in Nigeria, An Asymmet of Balanced Growth doctrine. In Usman A and Ijaiya G T (eds) Selected essays on the contradictions of Economic Development Theories in Nigeria. Haytee Publishing Co. llorin, Nigeria.

[13]Iweyemi, A., 1994, Perspectives and Problems of Economic Development in Nigeria (1960-1990). lbadan: CEAR.

[14]Making Finance Work for Africa (MFW4A) 2008, Agricultural and Rural Finance Projects in Africa. Rural Finance learning Center (FAO Rural Finance Group).

[15]Manyong, V. M., Ikpi, A., Olayemi, J. K., Yusuf, S. A., Omonona, B. T., Okaruwa, V., Idachaba, F. S. 2005, Agriculture in Nigeria: Identifying Opportunities for increased Commercialization and investment. IITA, Ibadan, Nigeria. Page 159.

[16]National Bureau of Statistics (NBS), 2007, Details of the Breakdown of the National and State Provincial Population Totals 2006 Census. National Bureau of Statistics, Federal Republic of Nigeria Official Gazette.

[17]National Population Commission (NPC), 2006, Census Report. National Population Commission (NPC). Abuja, Nigeria.

[18]Ogungbile, A. O., 2008, Poverty reduction and access to Agricultural inputs in Ingawa, S. A, Okuneye, P. A., Oredipe, A. A. and Adepoju S.O. (Eds). Government Seven Point Agenda: Implication for Agricultural Development. Nigerian Association of Agricultural Economists Economic and Policy Series.

[19]Onoja, A.O., Onu, M E., Ajodo-Ohiemi, S., 2013, Contributions of Financial Sector Reforms and Credit Supply to Nigerian Agricultural Sector (1978-2009). Central Bank of Nigeria Journal of Applied Statistics, 2(2):83-98.

[20]Olawepo, R.A., 2010, Determining rural farmers' income: A rural Nigeria experience. Journal of African Studies and Development. 2 (2): 15-26.

[21]Onyenweaku, C.E., 1993, Investigation of the Hypothesis of Deceleration in Crop Production in Nigeria, 1960/61 – 1987/88, Modeling Simulation and Control D. France, 7(1): 27 – 40.

[22]Onyenweaku, C.E., 2004, Stagnation, Acceleration and Deceleration in Agricultural Production in Nigeria, 1970 – 2000. Journal of Agriculture and Food Science, 2(2):131 – 140.

[23]Philip, D., Nkonya E., Pender, J., Oni, O. A., 2009, "Constraints to Increasing Agricultural Productivity in Nigerian: a Review Nigeria Strategy Support Program (NSSP) background Paper No. 6.

[24]Ukpong, G., Malgwi, U., 1991, Federal Government policies in Respect of Agricultural Finance.CBN Bulletin Lagos 47-59.

ANALYSIS OF CLIMATE-RELATED RISK AND MAIZE PRODUCTION IN SOUTHWEST, NIGERIA

Lawrence Olusola OPARINDE, Emmanuel Chilekwu OKOGBUE

The Federal University of Technology, Akure, Department of Agricultural and Resource Economics, and Department of Meteorological Science, P.M.B. 704, Akure, Ondo State, Nigeria, GSM: +2348062317878, Email: looparinde@futa.edu.ng.

Corresponding author: looparinde@futa.edu.ng

Abstract

One of the consequences of climate change in Sub-Saharan Africa is that farmers would be more exposed to production risk. Therefore, it is imperative to analyse the climate-related risk and maize production in Southwest, Nigeria. Secondary data between 1981 and 2012 were collected on relevant variables and analysed using Growth Function, Co-integration Model (Autoregressive Distributed Lag Approach) and J-P Model. The results confirmed the presence of long-run equilibrium between maize production and temperature, rainfall and relative humidity. The Error Correction Model (ECM) value was -0.0238 for the enterprise. The results of the analysis on the climate-related risk indicated that temperature increased the production risk of maize farmers. It can be concluded that farmers face climate-related risk as temperature increased the production risk of maize farmers. Therefore, stakeholders should create more awareness on the need to always practice eco-friendly activities and put in place coping strategies against the menace of climate change.

Key words*: *Climate, co-integration, maize, Nigeria, risk

INTRODUCTION

Maize (*Zea mays*) is known to be an important cereal crop being planted in the rainforest and derived Savannah zones of Nigeria. Maize cultivation was at subsistence level after which it later became more important food crop which has now grown to commercial level. It is largely depended on as raw materials to many agro-based industries [14]. Also, [20] stated that maize undoubtedly remains an important crop for rural food security. As a result of this fact, production of maize must be stepped up in order to ensure food security, which would translate to increased level of income of the farmers. This could be achieved through the development of improved maize varieties and technologies in Nigeria.

According to [34], about 80% of maize produced is consumed by man and animals, while the remaining 20% is used in various agro-based industries where starch, corn sweetener, ethanol, cereal, alkaline, etc are produced. Rainfall (intensity and duration), relative humidity and temperature constitute important climatic factors that influence maize yield and its inconsistency.

Climate change is one of the greatest challenges facing human existence on the surface of earth in this century. It is a process of global warming attributable to the 'greenhouse gases' generated by human activities. Climate change impacts are not only felt by developing countries but also developed countries, which tells us how serious it is to human race. However, the impacts are likely to be greatly felt by developing countries than developed ones. This is not necessarily attributable to the level of contributions of developing countries to climate change but lack of infrastructures (economic, social and political) to sufficiently address effect of climate change [8]. Weather and climate cannot be separated from agriculture because of existence of deep nexus amongst them. Also, climate and weather are dominant factors that influence the overall unpredictability of food production [43] and ongoing source of disturbance to ecosystem services [11].

Efficacy of rainfall in crop production depends on the temperature values which affect evaporation and transpiration, thereby making climate a dominant role in agriculture as it has direct impact on the productivity of physical production factors. Farming output can be adversely affected by climate change at any stage of agricultural production process up till harvesting. Sufficient rainfall is not only needed for good yield but also regular rainfall because its irregularity can adversely affect yields especially when rains fail to arrive during the crucial growing stage of the crops [26].

According to [16], it is likely that the frequency of heavy precipitation or the proportion of total rainfall from heavy falls will increase in the twenty-first century over many areas of the globe; and there is medium confidence that droughts will intensify in the twenty-first century in some seasons and areas, due to reduced precipitation and/or increased evapotranspiration.

Government policies, economic factors, availability of farm supplies, weather and climate variability constitute part of diverse pressures which influence agricultural production. This is the reason why farming business is inherently a risky business as a result of uncertainty relating to all these factors [44]. It is no more new that weather and climate variability affect farm revenue through some other factors, but only its influence on yield is given serious attention because it is the yield that translates to revenue. This indicates the importance of climate variables to agricultural production. [5] explained that increased temperature during growing season can drastically affect productivity in agriculture, farm revenue and food availability.

[30] stated that the sustainability of the environment to provide materials needed for life in order to achieve all planned developments of man and animal depends on the favourable climate which is undergoing changes.

The effect of these changes is posing threat to food security in Nigeria. As explained by [51], literatures have it that adverse weather conditions significantly contribute to continuous inherent uncertainties that lead to crop yield variation. [23] also acknowledged the fact that climate variability causes production risk through its impacts on resources, pests and diseases.

It is predicted that climate change (CC) will cause reduction in areas appropriate for cultivation of many crops in Sub Saharan Africa, unlike Europe and North America which would have an increase in area appropriate for cultivation as they have the greatest capacity and resources to manage CC impact [15]; [50].

Several studies on climate change indicated that climate variability is expected to be on the increase in the next few decades, which is expected to be severe for tropical regions. There will be increase in the frequency of extreme events, such as floods and droughts, thereby increasing the likelihood of revenue shocks with a larger impact on the poor [46]; [45]; [21]; [17]; [48].

The impacts of CC on water and agriculture on the African continent can be very calamitous as agriculture constitutes approximately 30% of Africa’s GDP and contributes about 50% of the total export value, with 70% of the continent’s population depending on the sector for their livelihood [24]; [7].

Despite the fact that climate change poses serious threat to agricultural production, little is known about climate related risk and maize production in Nigeria. This is the motivation for this study with the following specific objectives of examining the growth rate of maize production between 1980 and 2012, analysing the relationship that exists among the selected climate variables and maize production and identifying the determinants of climate risk in maize production between 1980 and 2012.

This study would help identify factors that determine climate risks in maize production in the study area. The findings from this study would also assist policy makers in formulating policies targeted at adaptation and coping strategies that would reduce climate risks drastically. It will also show how climate change as well as its risks affects food crop production and the need to proffer solutions to the problems emanating from it.

MATERIALS AND METHODS

Study Area

The study area is Southwest Nigeria comprising of Lagos, Ogun, Oyo, Osun, Ondo and Ekiti States. The area lies between longitude 2^0 31^1 and 6^0 00^1 East and Latitude 6^0 21^1 and 8^0 37^1N [1] with a total land area of 76,852km^2 and a population of 27,722,432 [28]. The study area is bounded in the East by Edo and Delta States, in the North by Kwara and Kogi States, in the West by the Republic of Benin and in the South by the Gulf of Guinea. The vegetation in Southwest Nigeria is made up of fresh water swamp and mangrove forest, the low land forest stretches inland to Ogun State and part of Ondo State while secondary forest is towards the northern boundary where derived and southern Savannah exist [1]. Southwest Nigeria is within the tropical rainforest, the area has bimodal rainfall distribution. There are distinct dry and rainy seasons. The wet season is associated with the Southwest monsoon wind from the Atlantic Ocean while the dry season is associated with the northeast trade wind from the Sahara desert. The region has an average annual rainfall and temperature of 1486mm and 26.70C respectively [33]. The region has high density of human population with rain-fed agriculture as primary occupation of the people. The states are known for the cultivation of food crops such as maize, cocoyam, cassava, vegetable and yam [37].

Data Collection and Analytical Techniques

Secondary data on maize output, temperature, relative humidity and rainfall were collected from the National Bureau of Statistics (NBS), Nigerian Meteorological Agency (NIMET) and Agricultural Development Programme (ADP). Two out of the six States in the region were randomly selected and the selected States are Ondo and Oyo. Growth Function Analysis, J-P (Just and Pope) Production Function Model and Co-integration Model Analysis (Bounds Test Approach) were used to achieve the objectives of the study.

Empirical Specifications

Growth Function Model

The growth rate was computed following [3] and [32] by fitting exponential function in time to the data. Normal economic, econometric and statistical criteria were used to select the lead equation which was subsequently used for further analysis. According to [32], this measure takes into account the entire observations, which has proven it to be more realistic in the computation of growth rates. There are other alternative methods of computing compound growth with some shortcomings and one of these methods is the use of data at the beginning and at the end of a period which has been shown to ignore important information. The compound growth rate is computed by fitting the exponential function in time to the data by using the following formula;

$$Y = b_0 e^{bt} \qquad (1)$$

After linearizing in logarithm, equation 1 turns to:

$$LogY = b_0 + b_1 t \qquad (2)$$

where:
Y= Output
t = Time trend variable
b_0, b_1, = Regression parameters to be estimated

The growth rate (r) is given by

$$r = (e^{b_1} - 1) \times 100$$

where e is Euler's exponential constant (e = 2.7183).

Data were fitted to the above function in estimating production between 1980 and 2012. The study further investigated the existence of acceleration, deceleration or stagnation in growth rate of maize output. Quadratic equation in time variables was fitted to the data for the period (1980-2012) following [42]; [35]; [2]as follows:

$$LogY = \beta_0 + \beta_1 T + \beta_2 T^2 \qquad (3)$$

The quadratic time term T^2 allows for the possibility of acceleration or deceleration or stagnation in growth during the period of the study. Significant positive value of the coefficient of T^2 confirms significant acceleration in growth, significant negative value of T^2 confirms significant deceleration in growth while non-significant coefficient of T^2 implies stagnation or absence of either acceleration or deceleration in the growth process.

J-P Model

A J-P approach is used to estimate the risk effects of a production function, since it relaxes the second moment of the production restrictions. The approach also aids econometric testing of risk related hypotheses directly [49]. According to [10]; [18], J-P model is based on the principle that the variance of the production function error may be related to some or all explanatory variables, implying that it is a multiplicative heteroskedastic model. The J-P model used in this study is in line with [22], which is as follows;

$Y_i = f(X_i, \beta) + g(X_i , \alpha)\varepsilon_i$ (4)

where Y_i is the yield or mean response output, and X_i is a vector of explanatory variables, β and α are parameter vectors, and ε_i is a random variable with zero mean. The mean output of production is a function of the explanatory variables and is given by the function $f(X_i, \beta)$. The variance of output is related to the explanatory variables by the function $g(X_i , \alpha)\varepsilon_i$. [19] proposed a three stage estimation method which include estimation of the mean output function with fixed effects, estimation of the risk function with fixed effects model; and re-estimation of the mean output function with the method of generalized non-linear OLS.

The general model is;

$Y_i = X'_i \beta + e_i$, where i = 1, 2, ...N (5)

$E(e_i^2) = \sigma_i^2 = \exp[Z'_i \alpha]$ (6)

where $Z'_i = (z_{1i}, z_{2i}, ... z_{ki})$ is a vector of observations for K explanatory variables, $\alpha = (\alpha_1\ \alpha_1\ \alpha_1 .....\alpha k)$ is a (K x 1) vector of unknown coefficients, and $E(e_i) = 0$, $E(e_i e_s) = 0$ for $i \neq s$.

Using the natural log transformation, equation (6) can be rewritten as In $\sigma_i^2 = Z'_i \alpha$. Since σ_i^2 is unknown, the least square residuals from equation (5) can be used to replace σ_i^2 in equation (6) which then becomes

$Ine_i^{*2} = Z'_i \alpha^* + u_i$ (7)

where $u_i = In(e_i^{*2}/ \sigma_i^2)$.

The u_i will be asymptotically independent with a mean of $E[u_i] = -1.2704$, and with an asymptotic covariance matrix $\Gamma = 4.9348\ (Z'Z)^{-1}$. This result is asymptotically valid in hypothesis tests for the risk effects. To obtain efficient coefficients the predicted values of equation (7) are used as weights for equation (4) [22].

In this study, quadratic functional form, being the best functional form using statistical and economic criteria, was used for the variance (risks effects) of the crop yield, and is given in equations 8. The relationship is as follows;

$lne_{mi}^2 = \alpha_1 X_1 + \alpha_2 X_1^2 + \alpha_3 X_2 + \alpha_4 X_2^2 + \alpha_5 X_3 + \alpha_6 X_3^2$ (8)

where; lne_{mi}^2 = Variance of maize yield, (X_1) = Amount of rainfall, $(X_1)^2$ = Amount of rainfall squared, (X_2) = Temperature, $(X_2)^2$ = Temperature squared, (X_3) = Relative humidity and $(X_3)^2$ = Relative humidity squared.

Autoregressive Distributed Lag (ARDL) Co-integration Model

Autoregressive Distributed Lag (ARDL) is a recent but widely used approach to co-integration. The approach is not as popular as Vector Autoregressive (VAR) Model employed in co-integration studies to establish multivariate relationship. The bounds testing (Autoregressive Distributed Lag (ARDL) Model) co-integration procedure as used by [36]; [38]; [9] empirically analysed the long-run relationships and dynamic interactions among the variables of interest. It has some advantages compared to other co-integration procedures which include the following;

(a) Endogeneity problems and inability to test the hypothesis on the coefficients that are estimated in the long run with the method of Engel-Granger are solved using bounds approach [25].

(b) It is not compulsory that the variables of interest should be integrated of the same order in bounds approach unlike other techniques such as the Johansen co-integration approach. The ARDL bounds testing approach is applicable whether the variables (regressors in the model) are purely I(0), purely I(1), or mutually co-integrated.

(c) It is found that bounds approach is suitable for small sample which makes it more superior to that of multivariate co-integration [27] and [25].

(d) Using bounds test approach, co-integration relationship can be estimated by OLS once the lag order of the model is identified, which makes it simple.

(e)Long and short run parameters are estimated separately in a single model using bounds test approach.

(f)Different variables can be assigned different lag-lengths as they enter the model.

The presence of long-run relationship among variables of interest is tested using an F-test of the joint significance of the coefficients of the lagged levels of the variables. Two asymptotic critical values bounds provide a test for co-integration when the independent variables are I(d) (where 0≤d≤1): a lower value assuming the regressors are I(0), and an upper value assuming purely I(1) regressors. Once the upper critical value is less than the F-statistic, the null hypothesis of no long-run relationship can be rejected regardless of the orders of integration for the time series. Conversely, if the lower critical value is greater than the test statistic, the null hypothesis cannot be rejected. Lastly, if the statistic is between the lower and upper critical values, the result is inconclusive [39].

The null hypothesis of no co-integration (no long-run relationship) among variables of interest is given as:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_{5=0}$$

The alternate hypothesis (there is long-run relationship or co-integration exists) among variables of interest is given as:

$$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$$

This approach to co-integration procedure is used to empirically analyse the long-run relationships and dynamic interactions among maize production, annual temperature, annual rainfall and relative humidity. This study followed [41]and [12] who related crop yield with some climate variables such as temperature and rainfall.

The relationship between maize production and the selected climate variables are as follows;

$$\mathrm{MAIZ} = f(\ln\mathrm{Temp}, \ln\mathrm{Rain}, \ln\mathrm{Hum}) \qquad (9)$$

According to [39], the ARDL model specification of equation (9) is expressed as unrestricted error correction model (UECM) to test for co-integration between the variables under study:

$$\Delta\ln\mathrm{MAIZ}_t = \beta_0 + \sum_{i=1}^{q}\beta_1\,\Delta\ln\mathrm{MAIZ}_{t-i} + \sum_{i=0}^{q}\beta_2\,\Delta\ln\mathrm{Temp}_{t-i} + \sum_{i=0}^{q}\beta_3\,\Delta\ln\mathrm{Rain}_{t-i} + \sum_{i=0}^{q}\beta_4\,\Delta\ln\mathrm{Hum}_{t=i} + \omega_1\ln\mathrm{MAIZ}_{t-1} + \omega_2 ln\mathrm{Temp}_{t-1} + \omega_3\ln\mathrm{Rain}_{t-1} + \omega_4\ln\mathrm{Hum}_{t-1} + e_t \qquad 10$$

Once co-integration is established, the long run relationship is estimated using the conditional ARDL model specified as:

$$\ln\mathrm{MAIZ}_t = \beta_0 + \omega_1\ln\mathrm{MAIZ}_{t-1} + \omega_2 ln\mathrm{Temp}_{t-1} + \omega_3\ln\mathrm{Rain}_{t-1} + \omega_4\ln\mathrm{Hum}_{t-1} + e_t \qquad 11$$

The short run dynamic relationship is estimated using an error correction model specified as:

$$\Delta\mathrm{MAIZ}_t = \beta_0 + \sum_{i=1}^{q}\beta_1\,\Delta\ln\mathrm{MAIZ}_{t-i} + \sum_{i=0}^{q}\beta_2\,\Delta\ln\mathrm{Temp}_{t-i} + \sum_{i=0}^{q}\beta_3\,\Delta\ln\mathrm{Rain}_{t-i} + \sum_{i=0}^{q}\beta_4\,\Delta\ln\mathrm{Hum}_{t-i} + \delta\mathrm{ecm}_{t-1} + e_t \qquad 12$$

where:

MAIZ = Maize Output (kg), Temp = Temperature (degree celcius), Rain = Rainfall (mm), Hum= Relative humidity (%), β_0 = Constant term, et = White noise, $\beta_1 - \beta_4$ = Short run elasticities (coefficients of the first-differenced explanatory variables), $\omega_1 - \omega_4$ = long run elasticites (coefficients of the explanatory variables), ecm_{t-1} = Error correction term lagged for one period, δ = Speed of adjustment, Δ = First difference operator, $\ln$ = Natural logarithm and q = Lag length.

RESULTS AND DISCUSSIONS

Trend Analysis and Growth Rate of Maize Output (1980-2012)

The results of trend analysis and growth rate of maize output as presented in Table 1 shows that maize output had a positive trend. The coefficient of the trend variable in maize enterprise was positive and highly significant at 1% level of significance. The positive trend suggests a positive and increasing relationship between time and outputs in the enterprise in the period under study. This implies that maize output increase with time probably because of new technologies being introduced into the agricultural sector from time to time.

The growth rate of maize output as shown in Table 1 reveals that maize output had a positive growth rate of 7.6% in the period under consideration. This is an indication that various agricultural programmes of different governments have positively influenced maize enterprise. Findings from this study reveal that maize growth rate is higher than the average growth rate of 3.25% in maize between 1983 and 2008 in Nigeria as reported by [47].

Table 1. Estimated Trend Equations and Growth Rate for Maize Yield (1980-2012)

Dependent Variable (Yield)	b_0	b_1	R^2	Growth Rate (%)
Maize	-1.1037 (-5.9605)	0.0733*** (7.7077)	65.7	7.6

Source: Computed from ADP data of various years.
Figures in parenthesis represent t-value, *** = 1% significant levels.

Acceleration, Deceleration or Stagnation in the Movement of Growth Rate of Maize Yield.

Quadratic equations were estimated in time variables to determine whether there was acceleration, deceleration or stagnation in the movement in growth rates of maize outputs. Table 2 shows that the coefficients of t^2 for maize output were negative but significant at 1% indicating deceleration in the growth of maize yield during the period under consideration.

Table 2. Quadratic Equations in Time Variables for Maize Yield (1980-2012).

Dependent Variable (Yield)	b_0	b_1	b_2	R^2
Maize	-2.0195 (-10.2655)	0.2303*** (8.6308)	-0.0046*** (-6.0664)	84.6

Source: Computed from ADP data of various years.
Figures in parenthesis represent t-value, *** = 1% significant levels.

This implies that the movement in the growth of maize was not as fast as expected. This scenario could be attributed to poor implementation and monitoring of some of the agricultural programmes put in place by various governments in the study area. This is in conformity with the findings of [29] who reported deceleration in maize output between 1980 and 2010 when maize production in Nigeria as a whole was considered.

Estimated Results for the Variance Response Functions for Maize Yield Using Climate Variables (1980-2012).

The estimated coefficients for the variance of maize yield using climate variables are shown in Table 3.

Temperature and Relative Humidity had significant influence on the variance of maize yield in the study area. The direct relationship that existed between temperature and variance of the maize yield is an indication that climate change poses serious risk to the maize enterprise because of the reduction in the output. Also, the positive relationship between relative humidity and variance of maize yield could lead to disease infestation which could bring about reduction in the maize yield.

Table 3. Estimated Coefficients for the Variance of Maize Yield Using Climate Variables

Variable	Variance of Yield
Intercept	61.6331 (0.2922)
Rainfall	-0.3383 (-0.6459)
Rainfall Squared	0.0010 (0.4702)
Temperature	1.1064*** (-7.3122)
Temperature Squared	1.0605 (0.3939)
Relative Humidity	8.5103** (2.0053)
Relative Humidity Squared	-0.0622 (-0.9564)
R^2	40.4%
Number of Years	33

*Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level; Values in parenthesis represent t-value.
Source: Computed from Field Survey Data, 2015.

F-test Results of the Hypothesis for Maize Enterprise Using Climate Variables

The F-test that the coefficients of Temperature and Temperature squared were equal to zero ($b_3 = b_4 = 0$) was rejected (F-value of 2.90), indicating that Temperature affected the variance of maize yield (Table 4). This scenario shows that Temperature increased the production risk of the maize farmers in the study area. The results show that variability in maize yield may be adversely impacted by variability in Temperature. The F-tests for other climate variables were not rejected because they were not affecting the variance of maize yield and the risk of producing maize in the study area.

Table 4. The F-test results for Maize Using Climate Variables

Null Hypothesis	Parameter Restriction	F-Value	Remark
Variance is not influenced by Rainfall	$b_1 = b_2=0$	1.99	Accept H_0
Variance is not influenced by Temperature	$b_3 = b_4=0$	2.90**	Reject H_0
Variance is not influenced by Relative Humidity	$b_5 = b_6=0$	1.36	Accept H_0

*Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level
Source: Computed from Field Survey Data, 2015.

Relationship Among the Selected Climate Variables and Production of Maize for the Period of 1980 to 2012

Unit Root Tests Analysis

The standard Augmented Dickey-Fuller (ADF) unit root test was employed to check the order of integration of the variables included in the analysis. This is done in order to ensure that the assumption of ARDL stated by [39] is respected in spite of the fact that ARDL co-integration technique does not require pre-testing of variables included in the empirical model for the order of integration [31].

Table 5. Results of Unit Root (ADF) Test for Maize Enterprise

Variables	Level [I(0)]		First Differences [I(1)]	
	Constant	Constant and Trend	Constant	Constant and Trend
MAIZ	-0.5063 (0)	-1.7290(2)	-5.3127 (0)***	-2.3987 (1)
RHUM	-4.3682 (0)***	-4.2864 (0)***	-5.8029 (1)***	-4.1148 (8)***
TEMP	-1.6481 (2)	-6.0628(0)***	-7.5204 (1)***	-7.4396 (1)***
RAIN	-4.9149 (1)***	-4.8789 (1)***	-7.0084(2)***	-7.0692(2)***

Source: Computed from NIMET and ADP Data, 2015.
Notes:
***, **, * imply significance at 1%, 5%, 10% level respectively.
The figures in parentheses for the ADF (Dickey-Fuller, 1979) statistic represents the lag length of the dependent variable used to obtain white noise residuals.
The lag length for the ADF was selected using Automatic-based on AIC, max lag = 8

As shown in Table 5, the ADF test statistic revealed that Maize output was stationary at first difference *I(1)*, while Relative Humidity, Temperature and Rainfall were stationary at level *I(0)*. The combination of *I(0)* and *I(1)*can be used under ARDL unlike Johansen procedure and this is the justification for using bounds test approach in this study.

Co-integration Test Based on ARDL Bounds Testing Approach

OLS regression was estimated from equation (9) and then tested for the joint significance of the parameters of the lagged level variables when added to the regression analysis. The results from OLS regression are of "no direct interest" to the bounds testing approach to co-integration test. The F-statistic tests the joint null hypothesis that the coefficients of the lagged level variables are zero (i.e. no long-run relationship exists between the variables in question). Wald Test of coefficients in the ARDL-OLS egression was used to estimate the F-statistic. Table 6 reveals the value of calculated F-statistic for F_{MAIZ}(MAIZ | TEMP, RAIN, RHUM) to be 4.36. Since the value is higher than the upper bound critical value of 4.35 at the 5% level, the null hypothesis of no co-integration was rejected.

Table 6. Results of Co-integration Test Based on ARDL Bounds Test Approach

Critical Value	Critical value Bounds of the F-statistic	
	Lower bound I(0)	Upper bound I(1)
1%	4.29	5.61
5%	3.23	4.35
10%	2.72	3.77

Computed F – Statistic : F_{MAIZ}(MAIZ | TEMP, RAIN, RHUM) = 4.36
Note: Critical Values are cited from Pesaran *et al.* (2001), Table CI (iii), Case 111: Unrestricted intercept and no trend, Number of regressors (K) = 3.

This indicates that there is a long-run co-integration relationship among the variables when maize output was regressed against explanatory variables of average temperature, rainfall and relative humidity.
The result of this study is in conformity with the findings of [4] who reported a long run association between climatic variables (rainfall and temperature) and crop productivity in Nigeria using Johansen test of co-integration.

Analysis of Long Run Estimates

The long run coefficients of ARDL (1,0,0,0) are presented in Table 7. The results revealed temperature and rainfall had positive and negative significant influence, respectively, on maize output in the long run. The inverse relationship that existed between rainfall and maize output could be traced to excessive rainfall that resulted to erosion and leaching. Leaching makes nutrient unavailable for the maize plant and thus decreasing maize output. This is in conformity with the findings of [13] who reported inverse relationship between rainfall and maize yield. Also, findings from this study support [12] who reported that rainfall and agricultural output are inversely related. The direct relationship between maize output and temperature could be linked to the usefulness of temperature in the growth of maize plant but it would get to a stage where increase in temperature becomes hazardous to maize plants. This could be due to the fact that maize is seen as C4 and C3 pathway plant i.e sun-loving plant.

Table 7. Estimated Long Run Coefficients Using the ARDL Approach for Maize Enterprise

Regressor	Coefficient	T-Ratio
TEMP	0.21846**	3.55798
RAIN	-0.10057**	-2.21520
RHUM	-0.37258	-0.24191
INPUT	43.6582	1.97322

Note: *, **, ***, significant at 10%, 5%, 1% respectively.
Maize: ARDL(1,0,0,0) selected based on Schwarz Bayesian Criterion

Analysis of Short Run Estimates – Vector Error Correction Model (VECM)

The analysis of Error Correction Model (ECM) based on ARDL bounds test approach was used to obtain the short run dynamic coefficients associated with the long-run co-integration relationships. The results of the short run coefficients of ARDL (1,0,0,0) model are presented in Table 8. Both temperature and rainfall had direct and inverse relationships respectively with maize output in the short run. The statistically significant negative coefficient of ECM(-1) for maize enterprise verified the long run relationship among the variables in the enterprise. ECM measures how quickly the endogenous variable adjusts to the changes in the independent variables before the endogenous variable converges to the equilibrium level [52]. Negative and statistically significant ECM demonstrates that adjustment process is effective in restoring equilibrium. Negative and low ECM in absolute value points out a slow adjustment. It is, therefore, clear that ECM in this study is statistically significant at 1% level and had a value of -0.0238. The implication of this is that about 2.38% of disequilibrium in maize enterprise from the previous year's shock converge to the long-run equilibrium in the current year. The positive effect of temperature on maize output is when high temperature has not led to soil nutrient depletion and extreme heat that is unfavourable to maize production. Inverse relationship that existed between rainfall and maize output could be as a result of heavy rainfall that caused storm, erosion and leaching. This is in conformity with the findings of [4] who reported a negative and significant effect of rainfall on agricultural productivity.

Table 8. Results of the ARDL Short-run Relationship for Maize Enterprise

Regressor	Coefficient	T-value
ΔTEMP	0.005206***	5.721
ΔRAIN	-0.002397**	-3.751
ΔRHUM	-0.008879	-0.381
ΔINPUT	1.0404	0.194
ecm(-1)	-0.023831***	-2.954

R-Squared = 0.039890 R-Bar-Squared = -0.10782
S.E. of Regression = 0.33668 F-stat. = F(4, 26)2.27006[.058]
Residual Sum of Squares = 2.9471 Equation Log-likelihood = -7.5131
Akaike Info. Criterion = -12.5131 Schwarz Bayesian Criterion= -16.0981
DW-statistic = 1.9425
Note: **,***, significant at 5%, 1% respectively.

Analysis of ARDL Diagnostic Tests

Table 9 shows that the F-test failed to reject the null hypotheses of no serial correlation, homoscedasticity and normal distribution at 5% significant level. Also, stability tests using the cummulative sum of recursive residuals (CUSUM) and cummulative sum of squares of recursive residuals (CUSUMq) plots of Brown *et al.* (1975) [6] for the ARDL model as shown in Figures 1a, 1b, show the movement of the CUSUM or CUSUMq outside or within the critical lines of 5% significant level, which indicates parameter instability or stability. From the Figures, CUSUM statistic lies within the 5% critical lines, meaning that the model coefficients are stable in the short run. On the other hand, CUSUMq statistic for the model coefficients crosses the critical value line, indicating some instability in the ARDL model in the long run for the enterprise.

Table 9. Results of Diagnostic Tests

Test	χ^2 statistic	Probability
Breusch-Godfrey Serial Correlation Test	1.5767	0.2313
White Heteroskedasticity	1.1069	0.3959
Jarque-Bera test (Normality)	1.1845	0.3727

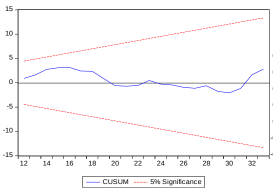


Figure 1a

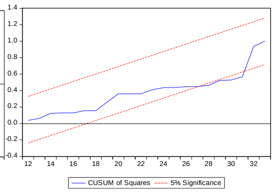


Figure 1b

Fig. 1. Plot of the Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Recursive Residuals of Square (CUSUMq) Tests for ARDL Model.

CONCLUSIONS

Based on the findings of this study, it can be concluded that the growth of maize output experienced deceleration in the period under consideration in the study area. Also, Temperature increased the production risk of the maize farmers in the study area. Temperature, rainfall and relative humidity were important climate factors that influenced the output of maize in the long and short run in the area. Therefore, individuals, government and non-governmental organizations should create more awareness on the need to always practice eco-friendly activities such as afforestation and put in place coping strategies against the menace of climate change on the production of food crops. Climate change issue can also be mitigated by encouraging carbon trading in Nigeria as it is in some advanced countries of the world. Agricultural insurance industry in Nigeria should be further strengthened and empowered to service risky farm businesses. The impact of Agricultural Insurance Industry still needs to be felt more in order to encourage farmers during the period of shocks. Policies that are geared towards the attainment of accelerated growth in maize output should be formulated in Nigeria such as making credit facilities available and accessible to the farmers.

REFERENCES

[1]Agboola, S.A., 1979, An Agricultural Atlas of Nigeria, Oxford University Press, Nigeria Pp.248.
[2]Akpaeti, A. J., Bassey, N. E., Okoro, U. S., Nkeme, K., 2014, Trends and Drivers of Agricultural Investments and Growth in Nigeria: The Pre and Financial Sector Reforms Experience. Asian Journal of Economic Modelling, 2(3): 115-127.
[3]Amos, T.T., 2004, Forecasting Sorghum Acreage in Nigeria Using Grafted Response Analysis. Journal of Arid Agriculture. 14: 15-21.
[4]Ayinde, E.O., Muchie, M., Olatunji, G. B., 2011, Effect of Climate Change on Agricultural Productivity in Nigeria: A Co-integration Model Approach. Journal of Human Ecology, 35(3): 189-194
[5]Battisti, D.S., Naylor, R.L., 2009, Historical warnings of future food security with unprecedented seasonal heat. Science, 323: 240–244.
[6]Brown, R.L., Durbin, J., Evans, J.M., 1975, Techniques for Testing the Constancy of Regression Relations Over Time. J.R. Stat. Soc. 3(37):149-192.
[7]CEEPA, 2011, Climate Change and Agriculture in Africa. Centre for Environmental Economics and Policy in Africa (CEEPA), University of Pretoria, South Africa.
[8]Farauta, B. K., Egbule, C. L., Idrisa, Y. L., Victoria, C. A., 2011, Climate Change and Adaptation Measures in Northern Nigeria: Empirical Situation and Policy Implications. African Technology Policy Studies Network, Working Paper Series No. 62.
[9]Fatuase, A.I., Ehinmowo, O.O. Oparinde, L.O., Omonijo, G.A., 2016, Effect of Agriculture and Health Expenditures on Economic Growth in Nigeria. Journal of Biology, Agriculture and Healthcare, 6(7) 48-57.
[10]Harvey, A.C., 1976, Estimating Regression Models with Multiplicative Heteroscedasticity. Econometrica 44: 461-65.
[11]Howden, S.M., Soussana, J.F., Tubiello, F.N., Chhetri, N., Dunlop, M., Meinke, M., 2007, Adapting agriculture to climate change. Proc. Natl. Acad. Sci. USA, 104(50): 19691–19696.
[12]Idumah, F.O., Mangodo, C., Ighodaro, U.B., Owombo, P.T., 2016, Climate Change and Food Production in Nigeria: Implication for Food Security in Nigeria. Journal of Agricultural Science, 8(2): 74-83.
[13]Igwe, K.C., Agu-Aguiyi, F.N., Uguru, J.O., 2013, Investigation of the Direction of Causality and Effect of Climate Change on Food Grain Output in Nigeria (1970-2010). The International Journal of engineering and Science, 2(3):49-54.

[14]Iken, J.E., Amusa, N.A., 2004, Maize research and production in Nigeria. African Journal of Biotechnology 3 (6):302-307 www.academicjournals.org/AJB.

[15]IPCC., 2001, Climate Change: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change". Houghton JT, Ding Y, Griggs DJ, Noguer M, van der Linden PJ, Dai X, Maskell K, Johnson CA (eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[16]IPCC., 2012, Summary for policy-makers. In C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor and P.M. Midgley, eds. Managing the risks of extreme events and disasters to advance climate change adaptation, pp. 1–19. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge, UK, and New York, USA, Cambridge University Press.

[17]Iwasaki, S., Razafindrabe, B.H.N., Shaw, R., 2009, Fishery livelihoods and adaptation to climate change: a case study of Chilika lagoon, India, Mitigation and Adaptation Strategies for Global Change, 14, pp.339-355.

[18]Judge, G.G., Griffiths, W.E., Hill, R.C. Lutkepohl, H., Lee, T., 1985, The Theory and Practice of Econometrics, 2nd ed. New York: John Wiley and Sons.

[19]Just, R. E., Pope, R. D., 1979, Production Function Estimation and Related Risk Considerations. American Journal of Agricultural Economics, 61(2): 276-284.

[20]Kudi, T. M., Bolaji, M., Akinola, M. O., Nasa, I. D. H., 2011, Analysis of adoption of improved maize varieties among farmers in Kwara State, Nigeria. International Journal of Peace and Development Studies. 1(3):8-12.

[21]Kurukulasuriya, P., Mendelsohn, R., 2008, A Ricardian analysis of the impact of climate change on African cropland, African Journal of Agricultural and Resource Economics, 2(1), pp.1-23

[22]Ligeon, C., Jolly, C., Bencheva, N., Delikostadinov, S., Puppala, N., 2008, Production Risks in Bulgarian Peanut Production, Agricultural Economics Review 9(1):103-110.

[23]Mavi, H.S., Tupper, G.T., 2004, Agrometeorology: principles and applications of climate studies in agriculture, The Haworth Press, Inc., New York, 364 pp.

[24]Mkpado, M., Nweze, J.N., Igbokwe, E.M., 2012, Income and energy sources among agrarian households in Nigeria: Implications for low carbon energy development in less developed countries, Russ J Agric Socio-Econ Scie 7: 32-39.

[25]Mohamed, A., Sahbi, F., Muhammad, S., Frederic, T., 2014, The Role of Natural Gas Consumption and Trade in Tunisia's Output. Working Paper Series, IPAG Business School, 2014 – 057. Available at http://www.ipag.fr/fr/accueil/la-recherche/publications-WP.html, Accessed on Dec.1, 2015

[26]Molua, E.L., Lambi, C.M., 2006, Climate, hydrology and water resources in Cameroon, CEEPA Discussion Paper No. 33, 37pp.

[27]Narayan, P.K., 2005, The Saving and Investment Nexus for China: Evidence from Cointegration Tests, Applied Economics, 37: 1979-1990.

[28]National Bureau of Statistics (NBS), 2011, Annual Abstract of Statistics, Federal Republic of Nigeria. Available on www.nigerianstat.gov.ng, Accessed on Sept.10, 2012.

[29]Obasi, I.O., Uwanekwu, G.A., 2015, Effect of Climate Change on Maize Production in Nigeria. Journal of Agricultural Economics and Rural Development, 2(1): 22-25.

[30]Obioha, E., 2009, Climate variability, environmental change and food security nexus in Nigeria. Journal of Human Ecology, 26(2):107-121.

[31]Okodua, H., Ewetan, O.O., 2013, Stock Market Performance and Sustainable Economic Growth in Nigeria: A Bounds Testing Co-integration Approach, Journal of Sustainable Development, 6(8):84–92. Doi:10.5539/jsd.v6n8p84.

[32]Okoye, B.C., Asumugha G.N., Okezie, C.A., Tanko, L., Onyenweaku, C.E., 2006, Econometric Assessment of the Trend in Cocoyam Production in Nigeria, 1960/61-2003/2006, MPRA Paper No. 17460, http://mpra.ub.uni-muenchen.de/17460/, Accessed on June 15, 2016.

[33]Omotosho, J.B., 2009, Pre-rainy Season Moisture Build-up and Storm Precipitation Delivery in the West Africa Sahel, International Journal of Climatology. DOC:10.1002/joc.1548.

[34]Onuk, E. G., Ogara, I. M., Yahaya, H., Nannim, N., 2010, Economic Analysis of Maize Production in Mangu Local Government Area of Plateau State, Nigeria, Production Agriculture and Technology 6 (1): 1-11, www.patnsukjournal.net/currentissue, Accessed on May 20, 2014.

[35]Onyenweaku, C.E., Okoye, B.E., 2005, Trends in cassava output, area and productivity in Nigeria, 1960/61-2003/04. Proceedings of the 39th Conference of the Agricultural Society of Nigeria, Benin.

[36]Oteng-Abayie, E. F., Frimpong, J. M., 2006, Bounds Testing Approach to Cointegration: An Examination of Foreign Direct Investment Trade and Growth Relationships, American Journal of Applied Sciences 3 (11): 2079-2085.

[37]Oyekale, A.S., 2009, The Effect of Climate Change on Cocoa Production and Vulnerability Assessment in Nigeria, Medwell Agriculture Journal, 4(2):77-85.

[38]Oyinbo, O., Rekwot, G.Z., 2014, Agricultural Production and Economic Growth in Nigeria: Implication for Rural Poverty Alleviation, Quarterly Journal of International Agriculture, 53 (3) 207-223.

[39]Pesaran, M.H., Shin, Y., Smith, R.J., 2001, Bounds Testing Approaches to the Analysis of Level Relationships, Journal of Applied Econometrics, 16, 289-326.

[40]Quattara, B., 2004, Foreign Aid and Fiscal Policy in Senegal. Mimeo University of Manchester.

[41]Saravanakumar, V., 2015, Impact of Climate Change on yield of Major Food Crops in Tamil Nadu, India, SANDEE Working Paper No. 91-15.
[42]Sawant, S.D., 1983, Investigation of the hypothesis of deceleration in Indian Agriculture, Indian Journal of Agricultural Economics. 38(4): 475-496
[43]Selvaraju, R, Gommes, R., Bernardi, M., 2011, Climate science in support of sustainable agriculture and food security, Clim Res., 47: 95–110.
[44]Shannon, H.D., Motha, R.P., 2015, Managing weather and climate risks to agriculture in North America, Central America and the Caribbean. Weather and Climate Extremes 10: 50–56.
[45]Shewmake, S., 2008, Vulnerability and the impact of Climate Change in South Africa’s Limpopo River Basin, IFPRI Discussion Paper 00804, 33pp.
[46]Slater, R., Peskett, L., Ludi, E., Brown, D., 2007, Climate change, agricultural policy and poverty reduction – how much do we know? ODI Natural Resource Perspectives 109, September 2007
[47]Tahir, H.M., 2014, Trend Analysis of Some Selected Cereal Crops in Nigeria: 1983-2008. Research on Humanities and Social Sciences, 4(8): 110-116.
[48]Tingem, M., Rivington, M., 2009, Adaptation for crop agriculture to climate change in Cameroon: Turning on the heat, Mitigation and Adaptation Strategies for Global Change, 14, pp.153-168
[49]Traxler, G., Falck-Zepeda, J., Ortiz-Monasterio, J.I., Sayre, K., 1995, Production risk and the evolution of the varietal technology, American Journal Agricultural Economics. *77*: 1-7.
[50]Turral H, Burke J., Faurés, J., 2011, Climate change, water and food security, FAO Water Report 36, Food and Agriculture Organization of the United Nations (FAO), Viale delle Terme di Caracalla, Rome, Italy.
[51]Tveterås, R., 1999, Production Risk and Productivity Growth: Some Findings for Norwegian Salmon Aquaculture, Journal of Productivity Analysis 12:161–79.
[52]Yilmaz, B., 2014, Effects of Foreign Direct Investment Inflows and Domestic Investment on Economic Growth: Evidence from Turkey. International Journal of Economics and Finance, 6(4): 69 – 78.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IMPLICATIONS OF AGRICULTURAL PRACTICES ON LAND PRODUCTIVITY OF FARMING HOUSEHOLDS IN IMO STATE, NIGERIA

Emeka OSUJI[1], Uchechi ANYANWU[2], Melissa OKWARA[2], Akunna TIM-ASHAMA[3]

[1]Michael Okpara University of Agriculture Umudike, Department of Agricultural Economics, P.M.B, 5267, Abia State, Nigeria. Phone; +2348037351597, Email: osujiemeka2@yahoo.com
[2]Federal University of Technology Owerri, Department of Agricultural Economics, P.M.B, 1526, Imo State, Nigeria. Phone;+234803900536, +2348035245770,
Emails: uchechigerarda@gmail.com, melissa.okwara@gmail.com
[3]Alvan Ikoku Federal College of Education Owerri, Department of Agricultural Science, P.M.B, 1020, Imo State, Nigeria. Phone; +2347034773356, Email: timashama5@gmail.com

Corresponding author: osujiemeka2@yahoo.com

Abstract

The use of variant agricultural practices has marred the productivity of the farmers to an immeasurable extent. Hence the study evaluated the implications of agricultural practices on land productivity of the farming households in Imo State, Nigeria. Multi-stage sampling technique was used to select 120 crop farmers from the three agricultural zones of the State. Data were analyzed using descriptive statistics and ordinary least squares multiple regression technique. Results showed that farmers have a mean household size of 7 persons, 19 years farming experience with a net income of ₦84, 000 per cropping season. Result further showed farmers completed their post primary education and cultivated less than 2.0 hectares per unit area of land. The use of agricultural practices such as crop rotation, continuous cropping, bush burning, mixed cropping and mulching are significant at various levels and therefore have strong implications on land productivity of the farmers. Farmers are faced with series of constraints' such as capital, technical known-how, land tenure difficulties, etc. which limits land productivity and adoption capacity of the farmers. Hence farmers are encouraged to drop agricultural practices that are concomitant to land productivity and embrace improved ones that are technically appropriate, socially acceptable, environmentally friendly and economically suitable.

Key words: *implications, agricultural practices, land, productivity, farming households*

INTRODUCTION

Agricultural production accounts for about 30 percent of gross domestic product (GDP) in Nigeria as well as offers employment opportunities to a large number of people in the country. Agriculture provides the basic needs of individuals in form of food, clothing, shelters, medicine, recreation, etc. Hence, agriculture is viewed as a thriving enterprise in the World [2]. It is a productive sector where the free gifts of nature namely land; water, etc. are effectively utilized.

Agricultural development in Nigeria is multifaceted having spread rapidly with respect to time and space. The introduction of green revolution and operation feed the nation by past governments brought about the use of improved agricultural practices and inputs to enhance the production potential per unit of agricultural land, time and output [1]. In recent times, there has been a global trend towards the intensification of agricultural land-use practices and changes in farming techniques have been collimated by recent agricultural technologies. This has resulted in the production of large quantity of inorganic manure in order to meet increasing demands for food and other agricultural products [3]. Furthermore, through modern advances in technology, there has been a tremendous expansion of agriculture regardless of the suitability of the land, and thus the development of improved crop varieties has made it possible to cultivate under marginal environmental conditions.

New agricultural techniques are very efficient and produce high crop yields but can also have adverse effect on the environment [9].

The relevance of the agricultural sector as a veritable tool for poverty reduction has been greatly undermined by less attention by the governments, cum inadequate plant-nutrient supply, depletion of soil organic matter, soil erosion, etc. In an effort to overcome these challenges, farmers have engaged in the use of variant agricultural practices to drive high production and output irrespective of its adverse consequences. Furthermore, the land productivity of the farmers has remained low due to the type of agricultural practices of the farmers coupled with unfavorable climatic conditions. As such erratic rainfall patterns present serious challenges to food production in the State. More importantly, government measures to promote agricultural technologies lack a clear picture of the role of agro-ecology [1]. As such the distribution and amount of rainfall varies both in spatial and temporal terms across and within Nigeria. This connotes that it is vital to consider the distribution of rainfall when formulating policies that promote the adoption of productivity-enhancing technologies, such as inorganic manures and other conservation tillage practices. However, the key to tackling these issues in the State lies not only in the adoption of agricultural technologies that enhance water retention capacities of soils, but also in the adoption of farming technologies that rely mainly on inexhaustible farm resources which reduce production costs and risks. An example of such technology is the use of improved agricultural practices that are technically appropriate, environmentally friendly, and are economically and socially acceptable [5]. Consequently, this study seeks to evaluate the implications of agricultural practices of farmers on land productivity in Imo State, Nigeria.

MATERIALS AND METHODS

This research was conducted in Imo State, which is located in the South Eastern part of Nigeria with a land area of 5,530 sq km. The State lies between latitudes $4^0 45^I$N and $7^0 15^I$N and Longitudes $6^0 50^I$E and $7^0 25^I$E. The State shares boundaries with Abia and Cross Rivers State to the East, Delta State to the West, Rivers State to the South and Enugu and Anambra State to the North. The State is made up of 27, Local Government Areas which are grouped into three agricultural zones namely; Owerri, Orlu and Okigwe. Farming is the predominant occupation of the rural inhabitants. Almost all the families in the area engaged in farming either as a primary or secondary occupation. Multi-stage sampling technique was used for this study. In the first stage, two local government areas (LGAs) were randomly selected from each of the three agricultural zones of the State. The second stage involved a random selection of 2 communities from each of the LGAs. From these communities, 3 villages were randomly selected and thus, 5 crop farmers were picked from each of these villages giving a total sample of 180 farmers but from the questionnaire collected only 120 farmers were found useful for data analysis. The zonal ADP’s provided the sample frame for this selection. Data were analyzed using descriptive statistics and ordinary least squares multiple regression technique.

The model is presented as follows:

$$LP_f = (\beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5+\beta_6X_6 + \beta_7X_7 + e) \quad (1)$$

where:

LP_f = Land productivity of the farmers (Kg/Naira)

$\beta_{O-}\beta_7$ = Parameter estimates

X_1 = Crop rotation (Area of land used)

X_2 = Continuous cropping (Area of land used)

X_3 = Bush fallowing (No. of years of fallow period)

X_4 = Bush burning (Area of land used)

X_5 = Mixed cropping (Area of land used)

X_6 = Mulching (Area of land used)

X_7 = Inorganic fertilizer (No. of bags used)

e = Error term.

RESULTS AND DISCUSSIONS

Socio-economic Characteristics of the Farmers

Table 1 shows the socio-economic characteristics of the farmers.

The mean age of 54 years implies that farmers are in their productive age and therefore could maximize available resources for increased production and outputs. This corresponds with [10].

Table 1. Socio-economic characteristics of the farmers

Variable	Mean
Age	54
Education	13
Farming Experience	19
Extension Contacts	14
Household Size	7
Farm Size	1.6
Net Income	84,000

Source: Field Survey, 2017.

The mean level of education was 13 years. This implies that almost all the farmers completed secondary school. This further indicates that the farmers could at least read and write and also evaluate new farming innovative technologies [9]. Farming experience shows a mean of 19 years. This implies that the farmers are well experienced in farming business and this could lead to increase in efficiency of production. Extension contacts reveal a mean of 14. This indicates that the extension agents visited the farmers 14 times per cropping season. Extension services expose farmers to new innovations and modern ways of farming which enhances productivity of the farmers. This is in conformity with [8].

The mean household size was 7. This implies that the farmers have a large family size which could be utilized in farm production activities and this agrees with [4]. Farm size has a mean of 1.6 hectares, which indicates subsistence farming. The net income reveals a mean of ₦84, 000. This implies that the farmers are economically efficient in farm production.

Types of Agricultural Practices Used by the Farmers

Table 2 below shows the types of agricultural practices used by the farmers in the area.

About 53% of the farmers practiced crop rotation. Efficient management of the soil using crop rotation enhances soil fertility as well as the productivity of the land. This agrees with [9].

Continuous cropping is practiced by 85% of the farmers. This farming method is largely practiced due to unavailability of lands and land tenure patterns in an area. About 6% of the farmers practiced bush fallowing. This is an old farming technique used by rural farmers to enhance the fertility of the soil and replenish lost soil nutrients. Though its' mainly practiced where land is sufficient.

Again, 83% of the farmers practiced bush burning. Bush burning is also an old traditional system which satisfies the immediate needs of the farmers in a short period and exacerbates the land in the long-run.

Mixed cropping is practiced by 95% of the farmers. In this type of farming, farmers' cultivates more than one type of crops in a bid to maximize available lands.

Mulching accounted for 66% of the farmers and is used to support the soil against erosion and degradations.

More than 87% of the farmers used inorganic manure as means to increase the productivity of the soil. This soil technique has the potential to increase yield per unit area of land with its attendant adverse consequences.

Table 2. Types of Agricultural Practices Used by the Farmers

Agricultural Practices	*No. of Farmers	Percentage of Farmers
Crop rotation	63	52.5
Continuous cropping	102	85.0
Bush fallowing	7	5.8
Bush burning	99	82.5
Mixed cropping	114	95.0
Mulching	79	65.8
Inorganic fertilizer	106	88.3

Source: Field survey, 2017. *Multiple Responses Recorded

Implications of Agricultural Practices on Land Productivity of Farmers

Table 3 below shows the estimated regression analysis on the implications of agricultural practices on land productivity of the farmers.

Four functional forms were fitted in with the Cobb-Douglas function chosen as the lead equation based on the highest coefficient of multiple determination, highest F-value, lowest standard error and highest number of significance levels of the independent variables. The F-value was significant at 1% level as this confirms the fitness of the model. The R^2 shows a value of 0.8021 which implies that about 80.2% of variations in the dependent variable was explained by the independent variables investigated. The coefficient of crop rotation is significant at 1% level and has a positive relationship with the land productivity of the farmers. This implies that increase in the use of crop rotation by the farmers increases land productivity. Good management of the soil through crop rotation ensures adequate nutrient availability through-out the cropping season and maintain balanced soil ecosystem [7]. Continuous cropping has an inverse relationship with land productivity and is significant at 1% level. This implies that a 1% increase in the use of continuous cropping would bring about 7.69% decreases in land productivity of the farmers. The use of continuous cropping pattern is widely practiced due to unavailability of lands cum land tenure systems prevalent in an area [10]. The coefficient of bush burning is significant at 5% level and negatively related to land productivity. This implies that a step-up in the use of bush burning by the farmers decreases the productivity of the land. The burning of the bush exacerbates soil leading to erosion, water run-off and degradation [4]. Mixed cropping is significant at 5% and positively related with land productivity. This indicates that a 1% increase in the use of mixed cropping by the farmers will bring about 9.93% increases in the productivity of the land. Mixed cropping is usually practiced to avert the risks of total crop failure.

Table 3. Implications of Agricultural Practices on Land Productivity of Farmers

Variables	**Coefficients**	**T-values**	**Significant levels**
Constant	108.321	1.0441	Ns
Crop rotation (X_1)	0.0654	3.2042	**
Continuous cropping (X_2)	-0.0769	-3.4107	**
Bush fallowing (X_3)	0.0843	1.0021	Ns
Bush burning (X_4)	-0.0904	-2.3720	*
Mixed cropping (X_5)	0.0993	1.9924	*
Mulching (X_6)	0.4763	2.7092	**
Inorganic fertilizer (X_7)	-0.9341	1.2056	Ns
R^2	0.8021		
F-value	45.443		**
N	120		

Source: Field survey, 2017.

The coefficient of mulching is significant at 1% level and has a positive relationship with land productivity. This implies that as the farmers engaged in the use of mulching; the productivity of the land is automatically increased [9]. However, the coefficients of bush fallowing and inorganic manure are not significant even at 5% level. These might be due to the long period of fallow and chemical deposits of inorganic fertilizers.

Constraints to Agricultural Practices in Imo State

Table 4 below shows the constraints to agricultural practices in the area. More than 98% of the farmers indicated lack of capital as a serious constraints to them. Capital is a very vital tool in agriculture as it helps farmers to expand their farm production and purchase other important inputs such as improved seedlings, manures, chemicals, etc. This agrees with [6]. About 97% and 94.2% of the farmers indicated technical known-how and land tenure difficulties as most challenging to them. Land tenure patterns destabilize farmers from adopting improved farming practices cum inability to practice improved farming techniques. Problem of continuity and climatic challenges accounted for 91% and 89.2% of the farmers. There is always the tendency of farmers to withdraw the use of a particular farming technique when faced with difficulties. At such scenario farmers tends to discontinue the use of such technique and this poses a threat to agricultural productivity [5]. Also changes in climate tend to distort rainfall and temperature patterns in agriculture. However, other identified constraints to agricultural practices in the State include; pests and diseases (87%), conservational attitudes of the farmers (79.2%) and poor innovation exposures (73.3%). These constraints limit the productivity of the land as well as adoption potentials of the farmers at large.

Table 4. Constraints to Agricultural Practices in Imo State

Constraints	*Frequency	Percentage
Technical known-how	116	96.7
Problem of continuity	109	90.8
Poor innovation exposure	88	73.3
Conservational attitudes	95	79.2
Land tenure difficulties	113	94.2
Pests and diseases	104	86.7
Climatic challenges	107	89.2
Lack of capital	119	99.2

Source: Field survey; 2017 *Multiple Responses Recorded

CONCLUSIONS

The findings of the study showed the mean age of the farmers to be 54 years. This implies that farmers are in their productive age and therefore could maximize available resources for increased production and outputs.

Farmers in the area used variant agricultural practices ranging from crop rotation to inorganic manure.

About 6% of the farmers practiced bush fallowing which is an old farming technique used by rural farmers to enhance the fertility of the soil and replenish lost soil nutrients. Variables such as crop rotation, continuous cropping, bush burning, mixed cropping and mulching are significant at various levels and therefore have strong implications on land productivity of the farmers.

Over 98% of the farmers indicated lack of capital and technical known-how as a major constraint impeding land productivity and adoption of agricultural practices.

Hence farmers are encouraged to drop agricultural practices that are concomitant to land productivity and embrace improved ones.

REFERENCES

[1]Altieri, M., 2011, Applying agro-ecology to enhance the productivity of peasant farming systems in Latin America. Reducing poverty through sustainable agriculture. University of Essex, London. 36-38.

[2]Anon, O., 2007, Soil and surface water protection using conservation tillage in northern and central Europe (SOWAP). Technical Final Report. LIFE03 ENV/UK/000617 2007.

[3]Benites, J., Vaneph, S., 2001, Conservation agriculture: for a better environment. 1st World Congress on Conservation Agriculture, Volumes I and II. Published by XUL, Córdoba, Spain for FAO (Food and Agriculture Organization of the United Nations) and ECAF (European Conservation Agriculture Federation), EU Life Project 99/E/308.

[4]Ebewore, S.O., Emuh, F. N., Obiebi, E., 2014, Effects of small scale farming practices on land degradation in Ethiope East Local Government Area, Delta State. Int'l Journal of Agriculture and Rural Development. 17(1):1572-1578.

[5]FAO, 2008, Food security and agricultural mitigation in developing countries. Options for capturing synergies, Rome, Food and Agriculture Organization of the United Nations, Rome Italy.

[6]Nwaru, J.C., 2004, Rural credit markets and resources use in arable crop production in Imo State, Nigeria. An Unpublished Ph.D Thesis, Micheal Okpara University of Agriculture, Umudike, Nigeria.

[7]Onasanya, A.S., 2007, Crop farmers' use of environmentally sustainable agricultural practices in Ogun State, Nigeria. Journal of Environmental

Extension, 6(1):75-78.

[8]Osuji, E.E., Anyanwu, U.G., Ehirim, N.C., Eze, E.U., Tim-Ashama, A., 2017, Economics of processed cassava products in Imo State, Nigeria. Journal of Research in Business and Management, India, 5(3):09-19

[9]Osuji, E. E., 2017, Impacts of sustainable soil management techniques on land productivity and poverty levels of arable crop farmers in Imo State, Nigeria. Unpublished PhD dissertation. Department of Agricultural Economics, Michael Okpara University of Agriculture Umudike, Nigeria

[10]Osuji, E.E., Ohajianya, D.O., Ehirim, N.C., and Eze, E.U., 2012, Effect of land use patterns on agricultural productivity in Imo State, Nigeria. International Journal of Food and Agricultural Research. 9(1): 81-89.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ASSESSMENT OF FACTORS INFLUENCING THE USE INTENSITY OF IMPROVED SOIL MANAGEMENT PRACTICES IN IMO STATE, NIGERIA

Emeka Emmanuel OSUJI

Michael Okpara University of Agriculture Umudike, Department of Agricultural Economics, P.M.B, 5267, Abia State, Nigeria. Phone: +2348037351597, Email: osujiemeka2@yahoo.com

Corresponding author: osujiemeka2@yahoo.com

Abstract

The study evaluated the factors influencing the use intensity of improved soil management practices in Imo State, Nigeria. Data were obtained from 209 farmers with the aid of structured questionnaire. Data were analyzed using descriptive statistical tools such as the mean, frequency and percentages. The findings revealed that age, education, farming experience, household size, occupation and farm size etc are important factors influencing the use intensity of improved agricultural practices in the area. These factors probably could either mar or enhance the use intensity of improved agricultural practices. The study revealed that extension contacts are very vital in exposing the farmers to new innovations and modern farming technologies which improves the farm productivity and income of the farmers. Therefore, there is the need for increased extension services and technological education of the rural farmers via both the government and private enterprises to enhance farmers' perception and dispositions to socio-economic factors.

Key words: *assessment, factors, use intensity, soil management, agricultural practices*

INTRODUCTION

In recent times, farmers' productivity has been on decrease due to the use intensity of improved soil management practices occasioned by farmers' dispositions to certain socio-economic factors. Empirical studies have showed certain factors influencing the use intensity of farmers as regards to improved soil management practices in Nigeria [2]. These factors greatly influence the farmers' perception and attitude in using these enhanced techniques. Factors such as gender, household size, age of the household head, farmer's income, farm size, farming experience, livestock ownership, extension contacts etc affects farmers' use of improved soil management practices [3]. Age of the farmer's could either mar or build farmers perception towards the usage of enhanced soil techniques. This means that often times farmers could be conservative in the application and use of improved soil management practices. Farming experience and access to extension services exposes farmers to a wide range of enhanced soil practices which improves the productivity of the land. Credit facilities cum small size nature of farm lands that characterized rural farmers in Nigeria are obviously important factors influencing farmers' attitudes in usage of enhanced soil packages [7].

Intensification of enhanced soil management practices encourages the growth of macro and micro nutrients in the soil and prepares the soil for maximum plant growth. The use of soil management practices such as organic manuring and mulching often improve the productivity of soils and the nutritional value of crops grown thereon. Plants and animal wastes are added to the soil and upon decomposition, increase the nutrient content of the soil thus facilitating crop yields. Increase use intensity of crop rotation mitigates the build-up of pathogens and pests that often occurs when crop specie is continuously cropped and can also improve soil structure and fertility by alternating deep-rooted and shallow-rooted plants. Appropriate crop rotation increases organic matter in the soil, improves soil aeration, reduce soil degradation, and can result in higher yields and greater farm profitability in the long-term. Leguminous crops in the rotation fix

atmospheric nitrogen and bind it in the soil thus, increasing fertility and reducing the need for synthetic fertilizers [5]. High use intensity of mulching improves root growth, increases water infiltration, and minimizes soil loss/run-off. As these mulches slowly decompose, they provide organic matter which adds nutrients to the soil and ultimately enhances the growth and yield of crops. Furthermore, combined effect of livestock production and agricultural soil management systems according to [4] demonstrated that crops and livestock's have the potential to sustain the soil and help prevent soil structures from becoming too brittle by promoting greater biodiversity, and thus increased capability of the soil to absorb shocks of the natural resource base. Also mixed farming systems maintain soil fertility by recycling soil nutrients and allowing the introduction and use of rotations between various crops and forage legumes. Apart from mixed farming, the use of vetiver grass as a sustainable technique used for erosion control can further sustain the soil physical properties and biodiversity. It is most effective in preventing soil and moisture loss, particularly in crop lands. Use of organic fertilizers, cover crops, multiple cropping, fallowing and other agro-forestry practices pose a positive impact on the productivity of the farmland [6].
Hence this study seeks to evaluate the factors influencing the use intensity of improved soil management practices in Imo State, Nigeria which has not been documented.

MATERIALS AND METHODS

This research was conducted in Imo State, located in the South Eastern part of Nigeria with a land area of 5,530 sq km. The State lies between latitudes $4^0 45^I$N and $7^0 15^I$N and Longitudes $6^0 50^I$E and $7^0 25^I$E. The State shares boundaries with Abia, Delta, Rivers, Enugu and Anambra State. The State is made up of 27 Local Government Areas grouped into three agricultural zones. Two-stage sampling technique was use to select the sample. In the first stage, two local government areas (LGAs) were purposively selected from each of the three agricultural zones of the State. The selection of these LGAs was based on their predominant agricultural activities and use of enhanced soil management practices. The second stage involved a random selection of farmers from the list of registered farmers kept with the zonal ADP's. However, the farmers' picked were administered with structured questionnaires, of which only 209 questionnaires were valid and used for data analysis using descriptive statistical tools.

RESULTS AND DISCUSSIONS

Factors Influencing the Use Intensity of Improved Soil Management Practices

Age. The distribution of the farmers based on age is shown in Table 1 which shows that 45.9 percent of the farmers fell within the age range of 50–59 years. The mean age of the farmers was 53 years. This implies that 25.8% of the farmers are over 60 years and thus, were ageing. This might have a tremendous influence on the use intensity of improved soil management practices. This is in line with [9], who reported that the more a farmer advances in age, the more conservative he becomes in usage of new technologies.

Table 1. The distribution of respondents by age

Age Range (years)	Frequency	Percentage
20 – 29	7	3.3
30 – 39	16	7.7
40 – 49	36	17.2
50 – 59	96	45.9
60 – 69	49	23.4
70 – 79	5	2.4
Total	**209**	**100**
Mean	**53**	

Source: Field survey data, 2015.

Gender. The distribution of the farmers based on gender is shown in Table 2 which shows that 64.1 percent of the farmers were males while 35.9% were females. This implies that Nigeria agriculture is still male dominated, due to the fact that men take full responsibility in providing for their families at every given time and may probably use more of the improved soil practices.

Table 2. The distribution of respondents by gender

Gender	Frequency	Percentage
Male	134	64.1
Female	75	35.9
Total	**209**	**100**

Source: Field Survey data, 2015.

Marital Status.The distribution of the farmers based on marital status is shown in Table 3. From this table, majority of the farmers, 88.0 percent were married with children which are significant indication of high family labour availability utilized in the farming business. This is true because marriage tends to provide farmers with the required family labour. This result further implies that majority of the farm households are stable and this stability could create conducive environment for good usage of enhanced soil techniques.

Table 3. The distribution of respondents by marital status

Marital status	Frequency	Percentage
Married	184	88.0
Single	6	2.9
Separated	2	1.0
Divorced	3	1.4
Widow/Widower	14	6.7
Total	**209**	**100**

Source: Field Survey data, 2015.

Household Size. The household size of the farmers is shown in Table 4. It shows that majority, 53.6 percent of the farmers had household size of 6-10 persons, while 42.6 percent and 3.8 percent had household sizes ranging from 1-5 and 11-15 persons respectively. The mean household size was 6 persons.

Table 4. The distribution of respondents by household size

Household size (No. of persons)	Frequency	Percentage
1 – 5	89	42.6
6 – 10	112	53.6
11 – 15	8	3.8
Total	**209**	**100**
Mean	6	

Source: Field Survey data, 2015.

This implies that the household size in the area was relatively large and therefore could enhance the usage of improved soil management practices since rural households rely more on members of their households than hired labourers.

Educational Status. Table 5 shows the distribution of the farmers based on years of formal education. About 5.3 percent of the farmers had no formal education while 54.1 percent, 33.0 percent and 7.6 percent had primary, secondary and tertiary education respectively. The mean years of formal education of the farm households were 6 years. Thus, majority of the farmers had primary education which depicts a low educational background and may mar the intense usage of improved soil management practices in the area. Low educational levels retard farmers' ability to understand and evaluate new production techniques. Education has an important implication particularly for farm management, participation in economic activities, dissemination and adoption of new technology and practice [1].

Table 5. The distribution of respondents by educational status

Educational status (No. of years spent in school)	Frequency	Percentage
0 (No Formal Education)	11	5.3
1 – 6 (Primary School)	113	54.1
7 – 12 (Secondary School)	69	33.0
13-18 (Tertiary)	16	7.6
Total	**209**	**100**
Mean	6	

Source: Field Survey data, 2015.

Farming Experience. Table 6 shows the distribution of the farmers based on farming experience. According to the Table, majority that is 78.0 percent of the farmers had farming experience ranging from 11-20 years. The mean farming experience of the farmers was 17 years. This means that majority of the farmers are well experienced in the farming enterprise which might considerably reduce inefficiency in usage of improved soil management practices [10].

Table 6. The distribution of respondents by farming experience

Farming experience	Frequency	Percentage
1 – 10	18	8.6
11 – 20	163	78.0
21 – 30	14	6.7
31 – 40	10	4.8
41 – 50	4	1.9
Total	**209**	**100**
Mean	17	

Source: Field Survey data, 2015.

Extension Contacts. The distribution of farmers based on extension contact is shown in Table 7. The Table reveals that about 96.2 percent of the farmers had contact with extension agents during the cropping season while 3.8 percent had no contact with extension agents. This implies that, on the average most of the household farmers were exposed to a wide range of improved soil management packages and other technical innovations from the extension agents, thus the utilization of these packages tends to increase the land productivity and net income of the crop farmers. Extension contacts enhance information dissemination amongst farm households [8].

Table 7. The distribution of respondents by extension contacts

Extension contacts	Frequency	Percentage
Contacts	201	96.2
No contacts	8	3.8
Total	**209**	**100**

Source: Field Survey data, 2015.

Sources of Fund. The distribution of farmers based on their sources of fund for their farm work is shown in Table 8.

According to this Table, the major sources of funds for farm households were from co-operative societies and local money lenders which accounted for 89.0 percent and 81.8 percent respectively. This implies that farm households in the study area relied more on co-operative societies and local money lenders for funds due to the little or no interest charges placed on such funds. Thus, this helps to improve the usage of improved soil management practices in the area.

Table 8. The distribution of respondents by sources of fund

Sources of fund	*Frequency	Percentage
Friends and Relatives	54	25.8
Local Money Lenders	171	81.8
Age Grade	49	23.4
Co-operative Societies	189	89.0
Banks	12	5.7
Personal savings	16	**7.7**

Source: Field Survey data, 2015.
* Multiple responses

Sources of Labour. Table 9 shows the distribution of the farmers based on sources of labour. The Table reveals that majority 66.0 percent of the farmers made use of family labour compared to 21.1 percent of the farmers who used hired labour in their farm operations. This finding shows that a greater percentage of the respondents used family labour. Thus, this could either enhance or mar the use of improved soil management practices if the family labour were not fully utilized [8].

Table 9. The distribution of respondents by sources of labour

Sources of labour	Frequency	Percentage
Family Labour	138	66.0
Hired Labour	44	21.1
Both Labours	27	12.9
Total	**209**	**100**

Source: Field Survey data, 2015.

Sources of Farm Land. The distribution of farmers based on sources of farmland is shown in Table 10. The Table showed that the major source of farmland for farm households in the area was inheritance which accounted for 95.0 percent.

This implies that majority of the farmers in the area obtained their land through inheritance. This could be true because the cultivation of most arable crops in Nigeria is carried out on inherited farm lands. Furthermore, land hereditary is a common practice in Nigeria agriculture where land is passed on from one generation to another.

This method of land ownership tends to accommodate increased usage of enhanced soil techniques.

Table 10. The distribution of respondents by sources of farm land

Sources of farm land	*Frequency	Percentage
Inheritance	198	95.0
Gift	34	16.3
Lease/Rent	14	6.7
Outright Purchase	12	5.7
Pledge	28	13.4
Communal	36	17.2

Source: Field Survey data, 2015.
*Multiple responses.

Farm Size. The distribution of farmers based on their farm size is shown in Table 11. According to the Table, majority of the farmers, 60.3 percent had farm sizes ranging from 0.01 – 1.00 hectares. However, the mean farm size was 1.0 hectares. This implies that majority of the farmers in the area operated on small-scale bases (cultivating less than 2.0 hectares). This supports the findings [9] who reported that rural farm lands are characterized by small-sized holdings, fragmented and scattered which poses a great threat to land productivity and mechanization. Rural farmers cultivate arable crops operate on small scale bases probably due to the land tenure system available to them. Thus, this small size nature of the farm lands distorts the use of improved soil management practices. However, the mean farm size in the area is typical subsistence farming where a farmer majorly provides for himself and his family.

Table 11. The distribution of respondents by farm size

Farm size (ha)	Frequency	Percentage
0.01-1.00	126	60.3
1.01 – 2.00	73	34.9
2.01 – 3.00	8	3.8
3.01 – 4.00	2	1.0
Total	**209**	**100.0**
Mean	**1.0**	

Source: Field Survey data, 2015.

Occupation. Table 12 shows the distribution of the farmers based on occupation status. The Table shows that majority, 96.7 percent of the farm households had farming as their major occupation as well as engaged in other forms of occupation such as fishing, 22.0 percent; trading, 29.2 percent; artisans, 9.1 percent, etc. This implies that, apart from farming, farmers in the area also engaged in other forms of occupation to earn a living, improve their living standard and also raise off-farm income to enhance the use of improved farming practices.

Table 12. The distribution of respondents by occupation

Farm size (ha)	*Frequency	Percentage
Farming	202	96.7
Fishing	46	22.0
Trading	61	29.2
Artisans	19	9.1
Civil Service	39	18.7
Hunting	8	3.8
Apprenticeship	2	1.0

Source: Field Survey data, 2015.
*Multiple responses.

CONCLUSIONS

Over the years farmers have witnessed a dwindling output and yield due to the influence of certain factors. Thus, the findings of the study showed that the use of improved farming practices is dependent upon some socio-economic factors which by disposition of the farmers affect their output, yield and income.

Use of improved agricultural practices is a prerequisite to increased output and productivity of the farmers. For farmers to increase their output and yield, the use of improved farming practices is not negotiable. Furthermore, the use of extension contacts is very vital in exposing the farmers to new innovations and modern farming technologies which improves farm productivity of the farmers.

The findings further revealed that age, education, farming experience and farm size etc are essential factors influencing the usage of improved agricultural practices in the area. Therefore, there is the need for increased extension services and technological education of the rural farmers via both the government and private enterprises to enhance farmers' perception and depositions to socio-economic factors.

REFERENCES

[1] Akinbile, L. A., Ndaghu, A. A. T., 2000, Poverty level and poverty alleviation strategies of farm families; Michika Local Government Areas of Adamawa State, Nigeria. Journal of Economic and Rural Development. 14(2):101-109

[2] Apata, T. G., Samuel, K. D., Adeola, A. O., 2009, Analysis of climate change perception and adaptation among arable food crop farmers in South Western Nigeria. Contributed Paper prepared for presentation at the International Association ofAgricultural Economists' 2009 Conference, Beijing, China, August 16-22.

[3] Egeru, A., 2012, Role of Indigenous Knowledge in Climate Change Adaptation. Indian Journal of Traditional Knowledge, 11(2): 217 - 219.

[4] FAO, 2010, Sustainable crop production intensification through ecosystem approach and an enabling environment: Capturing efficiency through ecosystem services and management, FAO, Committee on Agriculture, Rome, Food And Agriculture Organization of the United Nations, Rome Italy. 10-14.

[5] FAO, 2011, Mitigation of climate change in agriculture, series 3. MICCA, Agriculture and Food Security, Food and Agriculture Organization. 11-16.

[6] Lawson, D. A. 2007, The effect of crop type, crop rotation and tillage practices on run-off and soil loss on a vertisol in central queen land. Australian Journal of Soil Research. 35(1): 329-332.

[7] Osuji, E. E. 2017, Impacts of sustainable soil management techniques on land productivity and poverty levels of arable crop farmers in Imo State, Nigeria. Unpublished PhD dissertation. Department of Agricultural Economics, Michael Okpara University of Agriculture Umudike, Nigeria.

[8] Osuji, E.E., Ehirim, N.C., Eze, E.U., and Osuji, M.N. 2013, Analysis of socio-economic variables on agricultural productivity of some selected arable crops in Imo State, Nigeria. Int'l. Journal of Agriculture and Rural Development. 16(1): 1390-1396.

[9] Osuji, E.E., Ohajianya, D.O., Ehirim, N.C., Eze, E.U., 2012, Effect of land use patterns on agricultural productivity in Imo State, Nigeria. International Journal of Food and Agricultural Research. 9(1):81-89.

[10] Ukoha, O.O., Okoye, B.C., Emetu, J., 2010, Analysis of the determinants of total factor productivity among small holder cassava farmers in Ohafia Local Government Area of Abia State. International Journal of Agriculture and Rural Development, 1(4): 97-187.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

STATISTICAL EVALUATION OF ENVIRONMENTAL FACTORS AND SOIL FERTILIZERS EFFECTS ON GARDEN PEA (*Pisum sativum*) PRODUCTION PARAMETERS

Sergiu Erich PALCU[1], Claudia MUREŞAN[1], Radiana-Maria TAMBA-BEREHOIU[2], Ciprian Nicolae POPA[3]

[1]Aurel Vlaicu University of Arad, Faculty of Food Engineering, Tourism and Environmental Protection, 3 Elena Dragoi, Micalaca, Arad, Romania, 310330, Phone/Fax:40257219331/ +40257219242; E-mail: palcusergiu@yahoo.com; muresanclaudette@yahoo.com
[2]University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti, District 1, 11464, Bucharest, Romania, Phone/Fax: 00 40 744 6474 10; Email: radianatamba@yahoo.com
[3]S.C. Farinsan S.A., Grădiştea vilage, Comana commune, Giurgiu district, Romania
Phone:+40 727 27 78 40, Fax: +40318156038, Email: cipnpopa@yahoo.com

Corresponding author: muresanclaudette@yahoo.com

Abstract

The aim of the paper was to determine the effects of environmental factors and soil fertilizers (Universol Blue and Ferticare I, applied for 3 weeks), upon production parameters of garden pea (Pisum sativum). In this regard, there were analysed: soil pH and soil temperature at the moment of sowing. The garden pea, Bördi variety, was randomly sown in early April, on 18 plots, which formed 6 experimental variants (three plots on variant). First variant V1 was the control. Variants V2, V3 and V4 have been fertilised with Universol Blue (337.5g; 421.875g; 506.25 g/variant), and V5, V6 have been fertilised with Ferticare I (540g; 607.5g/variant). After harvesting, there were determined the statistical estimates of the peashells number/variant, estimates of total peashells weight/variant and individual peashells weight/variant. The results showed that soil pH values were in the weak acid range, pH of variants V2, V3 and V4 being slightly more acidic (6.59) than pH of V5 and V6. Soil temperatures was between 6^0 and 7^0 C all over the plots. The number of peashells was increased in all variants, relative to the control (control and V3 exhibited a high variability 26.12%, respectively 21.77%). Ferticare I fertilizer was more effective than Universol Blue (938.17 vs. 907.89 peashells). The t values were insignificant between variants, concerning most parameters. The evolution of pH to alkaline domain and the increase in soil temperature, favored the increase in the total weight of peashells (r=0.789, respectively r=0.882*). Fertilization have reduced the variability, caused by environmental conditions. The application of fertilizers did not increase the weight of peashells, but increased the total number of peashells.*

Key words**:** *fertilizers, pH, Pisum sativum, statistical evaluation, temperature*

INTRODUCTION

Environmental factors have a decisive influence on the growth and development of open-culture crops. It is rather complicated to control the variability of these factors. At the same time, there are some interdependences between factors, that affect the evolution of plants and field crops.
External factors, important and more difficult to control, are: light, radiation types, temperature, composition of the air (i.e. the percentage of carbon dioxide and oxygen), the amount of water (rain).
Also, the composition and soil structure, decisively influence the plant growth rate.
The content of the macro (N, P, K) and microelements (S, Mg, Mn, Fe, Mo, Cu, Co, V, etc.) of the soil, determines the field crop performances, plants health, necessary substances production (ie. vitamins, phytohormones etc) [26].
Gonzalez et all. (1996), studied the influence of UV radiation (280-315 nm) on the growth process of garden pea and observed that the height of plants fell by 24-38% and the leaf area decreased by 5-30%, compared to plants grown in natural light [14].
Light affects the development of pea, so that this plant should be sown earlier, considering that the vegetal mass develops in low light conditions (short days), and fructification

takes place under wider illumination conditions (long days).

The amount of water used by plants during development depends on many factors, including: temperature, sweat coefficient and perspiration productivity, water balance and the usage efficiency of the consumed water.

The sowing season, which is directly related to soil temperature, is considered to be a significant factor in cultures technology. The moment of sowing sets the climatic conditions in which the plants arise and develop and in particular, when the fruits mature [5, 15]. Some studies have shown that in the case of pea spring crops, sowing in early April, instead of March, causes a decrease in the content of alcohol-insoluble substances and an increase in chlorophyll content [22, 27]. Sowing of pea in June causes an increase in protein content compared to sowing the plant in May [2, 3].

The effect of soil temperature on nodulation and nitrogen fixation should not be neglected in this context. The *Rhizobium* species involved in this process are specific to the host, but are also conditioned by optimal temperatures, for the symbiosis processes required, such as: root formation, survival of rhizomes in the soil, exchange of molecular signals between the two symbionts etc. [25].

Nodulation and nitrogen fixation takes place at optimal temperatures between 20 and 30^0 C. There have been observed specific adaptations of the plant root microbiome to the climate they are in (tropical, temperate or arctic) [6].

Wrinkled pea type is a plant whose arise requires relatively low temperatures of $2\text{-}3^0$ C. Smooth pea type requires slightly higher arise temperatures, i.e. $4\text{-}5^0$ C. If the temperature conditions are satisfied, the pea will emerge within 8 to 10 days [23].

The influence of soil reaction on the growth and development of plants (vegetables, fruits, cereals) has been studied, under experimental conditions, in the acidic, neutral and alkaline pH zone [8].

In nutritional solutions, at a high concentration in hydrogen ions (H^+), plants develope much better than in soils with the same hydrogen ion concentration.

Consequently, it can be said that in acidic soils, besides the high concentration of H^+, there are other factors that hinder plant growth and development.

The unfavorable effect (which will influence the biosynthesis of amino acids, vitamins, pigments etc.) is due to the compounds that are solubilizing in acid soils and their solubility increases in proportion to soil acidity (compounds of iron, aluminum, manganese, zinc etc.) [20]. Thus, at soil pH values of 6.8-7.5, the best yields (e.g. corn and wheat) were obtained. For example, at pH values of 4.7 the pea beans production was the lowest 65%, versus 100% at pH 6.8 [32]. Acidic soils (pH<4) frequently contain lower levels of phosphorus, calcium and molybdenum, and alkaline soils (pH>8) contain higher concentrations of NaCl, bicarbonates and borates [29].

In the case of plants which are associated with nitrogen fixative bacteria (*Rhizobium spp*.), soil pH can also influence the plants growth, due to the effects on the microbial population.

Reduced or too high pH values affect the formation of associations between plant and fixative bacteria, with effects on soil nitrogen uptake by plants [6, 21].

Fertilizers play an extremely important role in the cultivation of *Leguminosae* crops (pea, beans), from the nutritional point of view [10].

The microelements in fertilizers, in particular, stimulate the growth of plants foliage mass. Microelements have a catalytic role in plants growth and can be administered in very small amounts. The microelements metabolic role is important and complex and it is always necessary in plants fertilization, in particular, in the case of garden pea [4, 13].

The degree of the nutrients uptake for plants development, depends on the soil pH. Macroelements such as N, P, K are assimilated to pHs greater than 6, while Fe, Zn, Mn, Cu and Co are easily assimilated to pH=4-6.5.

It has been observed that in too acidic soils garden pea does not assimilate important nutrients such as macroelements. Garden pea prefers soils with a pH in the slightly acid or slightly alkaline range, between 6.0 and 7.5.

One of the essential elements for plant growth

and development is nitrogen. Apparently, in the case of **Leguminosae**, due to the symbiotic mechanisms involved in fixing and assimilating nitrogen in the soil, crops fertilization with nitrogen could be considered as of secondary importance.
However, some studies have shown that the application of low-dose nitrogen fertilizers could have favorable effects on nodulation and nitrogen fixation, while high doses have adverse effects [11, 12, 19, 31].
Nitrogen fixation is catalysed by nitrogenase, an enzyme made up of two metalproteins: one containing the Fe-Mo pair, and the other only Fe. Jongruaysup et al. (1993) showed that the development of symbiosis with rhizobi increases the need for Mo of pea crops [16]. This was subsequently confirmed by numerous studies [7, 28].
Application of fertilizers with P and K stimulates vegetative growth and pea beans production [1, 9, 17, 18, 30]. Some studies have shown that the lack of K and P leads to the accumulation of legumina in pea beans, while the lack of S leads to a significant reduction of this globulin in pea beans [24].
Other studies suggested that seed treatment with a series of microelements such as Mn, Cu, Co, have a positive influence on chlorophyll synthesis, and besides these, Mo and V cause the increase of N content of the leaves. Applied to soil, vanadium has a positive influence on the protein content of the pea beans [5].
The objective of the research was to highlight the influence of environmental factors and fertilizers treatments on the production parameters of garden pea (*Pisum sativum*).

MATERIALS AND METHODS

There were sown with garden pea, variety *Bördi*, 18 plots, the characteristics of which are shown in Table 1. Sowing was done in early April, in a temperate climate zone (46 ° 10 'N; 21 ° 18' E).
We mention that the *Bördi* variety of pea is semi-early.

Table 1. Experimental plots

Experimental plot	Size/unit measure
The length of the plot	2.50 m
The width of the plot	1.50 m
The surface of the plot	3.75 m^2

Source: Own experiment.

The 18 plots were randomly grouped into 6 variants, three on variant, depending on how the fertilizer treatments, with microelements, were applied (Table 2).

Table 2. Randomized plots pattern

Control V1	V2	V3
V4	V5	V6
V3	Control V1	V2
V6	V4	V5
V2	V3	Control V1
V5	V6	V4

Source: Own experiment.

Variant 1 was the unfertilized control. Variants 2, 3 and 4 were fertilized with Universol Blue. Variants 5 and 6 were fertilized with Ferticare I. The composition of the fertilizers used is shown in Table 3.

Table 3. Fertilizers composition (%)

Composition	Universol Blue	Ferticare I
Total nitrogen (N)	18.000	14.000
Phosphates (P_2O_5)	11.000	11.000
Potassium (K_2O)	18.000	25.000
Magnesium (MgO)	2.500	2.800
Iron (Fe) EDTA	0.100	0.100
Bore (B)	0.010	0.020
Copper (Cu) EDTA	0.010	0.010
Manganese (Mn) EDTA	0.040	0.030
Molybdenum (Mo)	0.001	0.001
Zinc (Zn) EDTA	0.010	0.020

Source: Specifications on the fertilizers package.

Fertilization was applied for 3 weeks, with progressive fertilizer amounts, as shown in Table 4. The mode of administration was extraroot to all variants. The fertilization model has been chosen to comply with the maximum application limits.
The pH of the soil was determined before the first fertilization, with a portable pH meter Testo 205, to see if it is suitable for pea sowing. At the same time, the soil temperature was measured with a soil thermometer.

Table 4. Fertilizers application model

No. plot	Fertilizer	g/m^2 / week	Total fertilizer/ parcel (g)	Total fertilizer/ variant (g)
Control 1	-	-	-	-
2	Universol	10.0	112.50	337.500
3	Universol	12.5	140.62	421.875
4	Universol	15.0	168.75	506.250
5	Ferticare I	16.0	180.00	540.000
6	Ferticare I	18.0	202.50	607.500

Source: Own experiment.

We mention that the soil was chernozem type. Pea arising occurred in the second half of April and was harvested in mid-June on all plots. Production parameters were determined, namely the number of peashells and their weight, on each plot.
These parameters were subjected to computer-assisted statistical calculation, using the professional IBM SPSS Statistics Program.

RESULTS AND DISCUSSIONS

The soil pH values for the control and the other variants are shown in Table 5.

Table 5. Estimates of soil pH variability (n=3)

Variant	Mean (X)	Stand. dev. (s_x)	s (variance)	Variab. coeff. (CV, %)
V1 (Control)	6.567	0.208	0.043	3.160
V2	6.533	0.058	0.003	0.880
V3	6.533	0.153	0.023	2.340
V4	6.733	0.058	0.003	0.860
V5	6.667	0.153	0.023	2.290
V6	6.733	0.153	0.023	2.270

Source: Own calculation based on the experiment results.

Soil pH values were in the weak acid range, which favors plants growth. Variability was higher for variants V3, V5 and V6, but within normal limits, and lower than to the control. V4 and V6 exhibited less acidic pH values. At the same time, the average pH of variants V2, V3 and V4 was slightly more acidic (6.59) than variants V5 and V6 (6.70), without reaching the significance level (t=1.1209). Table 6 shows the soil temperature values when sowing garden pea.

Table 6. Estimates of soil temperature variability (^{0}C, n=3)

Variant	Mean (X)	Stand. dev. (s_x)	s (variance)	Variab. coeff. (CV, %)
V1 (Control)	6.533	0.058	0.003	0.880
V2	6.700	0.100	0.010	1.490
V3	6.533	0.115	0.013	1.760
V4	6.633	0.153	0.023	2.300
V5	6.600	0.100	0.010	1.515
V6	6.633	0.208	0.043	3.135

Source: Own calculation based on the experiment results.

Temperatures were placed on average between 6^0 and 7^0 C all over the plots, with slightly higher variations at V4 and V6. Last but not least, we mention that the average soil temperature of V2+V3+V4 variants, was 6.622^0 C, comparable to the average soil temperature of V5+V6 variants (6.616^0 C). After the pea harvest, the peashells were counted on each plot and the mean was calculated per each variant (Table 7).

Table 7. Estimates of the number of peashells/variant variability (n=3)

Variant	Mean (X)	Stand. dev. (s_x)	s (variance)	Variab. coeff. (CV, %)
V1 (Control)	828.330	216.380	46820.304	26.122
V2	904.000	85.860	7371.939	9.490
V3	916.000	199.480	39792.270	21.770
V4	903.670	52.990	2807.940	5.860
V5	884.670	63.720	4060.238	7.202
V6	991.670	47.080	2216.526	4.747

Source: Own calculation based on the experiment results.

The average number of peashells was increased in all variants, relative to the control. The best-performing variant was V6, with the lowest variability (4.74%). In V5, the number of peashells was lower, closest to the control. Variant V3, although having an appreciable average number of peashells, showed increased variability (21.77%).
The control variant V1 showed a lower productivity and a considerable high variability (26.12%), compared to fertilized variants. It can be deduced that fertilization, besides increasing productive performances,

homogenizes the conditions of plant growth and reduces the variability induced by environmental conditions.

In variants fertilized with Universol Blue (V2+V3+V4) the average number of peashells was 907.89. This average was exceeded by the average of V5+V6 variants, fertilized with Ferticare I, which was 938.17 peashells.

There were no significant differences between statistical averages (t=0.7529). However, it is possible that Ferticare I fertilizer was still more effective than Universol Blue.

The mean of harvested peashells total weight, per each variant is shown in Table 8.

Table 8. Estimates of total peashells weight/variant (g, n=3)

Variant	Mean (X)	Stand. dev. (s_x)	s (variance)	Variab. coeff. (CV, %)
V1 (Control)	5380.000	1405.840	1976386.100	26.130
V2	5646.670	535.290	286535.380	9.470
V3	5396.670	1173.560	137724.300	21.760
V4	5846.670	343.120	117731.330	5.860
V5	5646.670	408.080	166529.280	7.222
V6	6110.000	289.310	83700.276	4.735

Source: Own calculation based on the experiment results.

Compared to the control, all variants showed higher peashells total weight. The V3 variant was closest to the control, including the variability values, quite large, on the other hand (21.76% and 26.13% respectively).

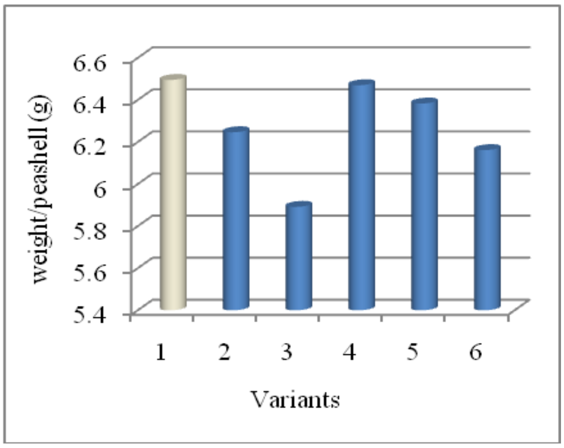


Fig. 1. Average weight of a peashell/variant
Source: Own design based on the experiment results.

The weight of a peashell was calculated by the formula: the total weight of the peashells/the number of peashells. In Figure 1 we can see the average weight of a peashell, belonging to the control (V1) and to each of the fertilized variants (V2, V3, V4, V5, V6).Variants V4 and V5 showed the highest average values of the peashell weight, but smaller than the control. Compared with the other variants, V3 showed a higher number of peashells, but the peashells had the smallest weight. Interestingly, the application of fertilizers did not increase the weight of a peashell, but increased the total number of peashells.

Table 9. The significance of the mean difference between the variants

Variants pairs	Mean difference	t
The significance of soil pH difference		
V2-V4	6.533-6.733	4.223*
V2-V6	6.533-6.733	2.117
V3-V4	6.533-6.733	2.117
The significance of soil temperature difference		
V1-V2	6.533-6.700	2.502
The significance of the difference between the number of peashells/variant		
V4-V6	903.670-991.670	2.150
V5-V6	884.670-991.670	2.339
The significance of the peashells total weight difference/variant		
V2-V6	5646.670-6110.000	1.318
V5-V6	5646.670-6110.000	1.604

*p < 0,05; **p < 0,01; ***p < 0,001
Source: Own calculation based on the experiment results.

Concerning the control (V1), it was observed that fewer peashells have been formed, but the average weight of a peashell exceeded the average weight of a peashell in the fertilized variants.

The t test, between the variants, regarding all the analyzed parameters, is shown in Table 9. Only values of t higher than 1.3 have been shown.

Generally, the t values were small, insignificant. Only soil pH differed significantly between V2-V4 (4.223*). It is noted that V6 had distinguished most from the other variants. However, differences between V6 and V1 (control) were not significant, concerning the number of peashells (t=1.277), nor their weight (t=0.880).

The regressions calculation revealed the

significant dependence of the total peashells weight on soil pH, where the determination coefficient R^2 reached 0.624 (r=0.789*).
Figure 2 shows the linear regression between the total peashells weight, for all variants and the soil pH for the same variants.

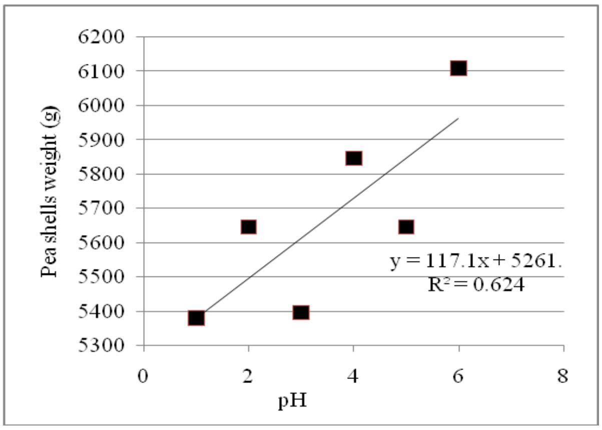


Fig. 2. Peashell total weight - soil pH regression
Source: Own design based on the experiment results.

The peashells total weight correlated positive significant with the soil temperature (r=0.882*).
Figure 3 shows the polynomial regression total peashells weight - soil temperature.
The pH variation, in the sense of its alkalinization, influenced 77% the increase in the weight of the peashells. The individual weight of the peashells was significant negative correlated (r=-0.784 *) with the total number of peashells.

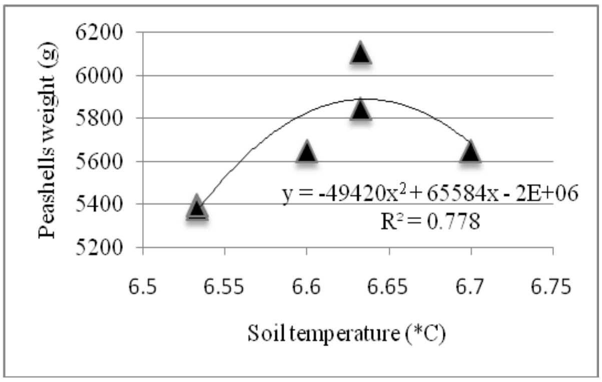


Fig. 3. Total peashells weight - soil temperature regression
Source: Own design based on the experiment results.

Figure 4 shows the polynomial regression between these parameters and a good coefficient of determination was recorded (R^2=0.615).

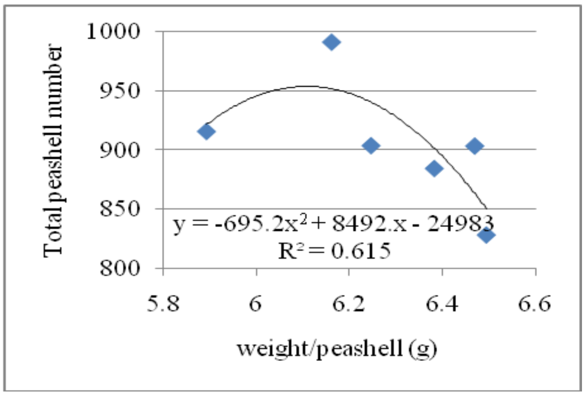


Fig. 4. Regression between the total number of peashells and the average weight of a peashell
Source: Own calculation based on the experiment results.

Practically, as the weight of a peashell increased, the decrease in the total number of peashells was influenced in a proportion of 61%.

CONCLUSIONS

The randomized plots (in the number of 18), which formed the 6 experimental variants (3 plots/ variant), did not present homogeneous characteristics of the soil parameters. There was even a significant difference between V2-V4 concerning soil pH (t=4.223 *).
Control (V1) and V3 had low variability coefficients of soil pH and soil temperature, but increased compared to other variants.
At the same time, variability of V1 and V3, concerning production parameters, namely: the number of peashells (26.122% and 21.77% respectively) and the weight of peashells (26.130% and 21.760% respectively), was the highest, compared to other variants.
Fertilizer treatments have increased production parameters, but insignificant in most cases. It is possible that the insignificant differences, were mainly due to insufficient differences between the quantities of fertilizers applied progressively.
Fertilization, in addition to productive performances increase, have homogenized plant development conditions and reduced variability, caused by environmental conditions. It was also noticed that application of fertilizers did not increase the weight of peashells, but increased the total number of

peashells. Between these two parameters a significant negative correlation has been established (r=-0.784*).

Soil temperature and soil pH are important factors that can influence the productive parameters of garden pea. It had been found that the evolution of pH to alkaline domain, as well as the increase in soil temperature, had favored the increase in the total weight of peashells (r=0.789*, respectively r=0.882*).

REFERENCES

[1]Akhtar, N., Amjad, M., Anjum, M. A., 2003, Growth and yield response of pea (Pisum sativum I.) crop to phosphorus and potassium application, Pakistan Journal of Agricultural Sciences, 40:217-222.

[2]Ali-Khan, S. T., Snoad, B., 1977, Root and shoot development in peas. Annals of Applied Biology, 85(1):131-136.

[3] Ali-Khan, S. T., Youngs, C. G., 1973, Variation in protein content of field peas, Canadian Journal of Plant Science, 53(1):37-41.

[4] Andrews, M., Sprent, J.I., Raven, J.A., Eady, P.E., 1999, Relationships between shoot to root ratio, growth and leaf soluble protein concentration of Pisum sativum, Phaseolus vulgaris and Triticum aestivum under different nutrient deficiencies, Plant, Cell and Environment, 22:949-958.

[5] Bordea C. et al., 1984, Tratat de biochimie vegetala. Partea a II-a: compozitia chimica a principalelor plante de cultura, Ed. Academiei RSR, Bucuresti, pp: 318 - 324.

[6]Bordeleau, L. M., Prévost, D., 1994, Nodulation and nitrogen fixation in extreme environments, Plant and soil, 161(1):115-125.

[7]Brkić, S., Milaković, Z., Kristek, A., Antunović, M., 2004, Pea yield and its quality depending on inoculation, nitrogen and molybdenum fertilization, Plant Soil Environ, 50(1):39-45.

[8]Chis S., Ciutina V., 2006, Agriculture, Editura Universităţii Aurel Vlaicu, Arad.

[9]Cutcliffe, J. A., Munro, D. C., 1980, Effects of nitrogen, phosphorus, potassium, and lime on yield and maturity of green peas, Canadian Journal of Plant Science, 60(2):599-604.

[10]Dumitrescu, H., Milu, C., 1997, Controlul fizico-chimic al alimentelor, Editura Medicală, Bucureşti, p. 75-78

[11] El Behidi, M. A., Gad A. A., El Sawah, M. H., El Hady, H. M., 1985, Effect of inoculation with Rhizobium leguminosarum and nitrogen fertilization on pea plants. I. Growth and plant chemical composition. Zöldségterm. Kut. Intéz. Bull., 18:17–25.

[12]Ergorov, V. J., 1985, Symbiotic nitrogen fixation in cultivated podzolic soils of the Kola Peninsula. Microbiology, 54:388–391.

[13] Gherghi, A., Burzo, I., Bibicu, M., Mărgineanu, L., Bădulescu, L., 2001, Fruits and vegetable biochemistry and physiology, Editura Academiei Române, Bucureşti.

[14] Gonzalez, R., Paul, N. D., Percy, K., Ambrose, M., Mc Laughlin, C. K., Barnes, J. D., Areses, M., Wellburn, A. R., 1996, Responses to ultraviolet – B radiation (280-315 nm) of pea (Pisum sativum) lines differing in leaf surface wax, Physiologia Plantarum, 98:852-860.

[15]Indrea, D., Apahidean, S.Al., Apahidean, M., Măniuţiu, D. N., Sima, R., 2007, Vegetable cultivation, Editura Ceres, Bucureşti.

[16]Jongruaysup, S., Ohara, G. W., Dell, B., Bell, R. W., 1993, Effects of low molybdenum seed on nodule initiation, development and N2 fixation in black gran (Vigna mungo L), Plant Soil, 156:345 – 348.

[17]Kanaujia, S. P., Sharma, S. K., Rastogi, K. B., 1998, Effect of phosphorus, potassium and Rhizobium inoculation on growth and yield of pea (Pisum sativum L.), Ann. Agric. Res, 19(2):219-221.

[18] Kanaujia, S. P., Rastogi, K. B.,Sharma, S. K., 1997, Effect of phosphorus, potassium and Rhizobium inoculation on growth, yield and quality of pea cv. Lincoln, Vegetable Sci, 24(2):91-94.

[19]Milaković, Z., Brkić, S., Bukvić, Ž., Bogut, I., Horvat, D., 2000, Efficiency of inoculation and different nitrogen fertilization on small-grained bean quality and yield, Rostl. Výr., 46:361–366.

[20]Neamţu, G., 1996, Substanţe naturale biologic active, Editura Ceres, Bucureşti, vol.1, p. 228-243.

[21] Palcu, S. E., 2008, Cercetări privind tehnologia de extragere a vitaminelor hidrosolubile din complexul B utilizând ca materii prime unele plante de cultură horticole şi agricole,Teză de doctorat, Arad

[22]Perez-Ruiz, T., Martinez-Lozano, C., Sanz, A., Guillen, A., 2004, Spectrophotometric and titrimetric analysis of phytoascorbate, Biomed.Anal., 34:551-557.

[23]Popescu, V., Atanasiu, N., 2001, Legumicultură, Vol.3, Editura Ceres, Bucureşti.

[24] Randall, P. J., Thomson, J. A., Schroeder, H. E., 1979, Cotyledonary storage proteins in Pisum sativum. IV. Effects of sulfur, phosphorus, potassium and magnesium deficiencies, Functional Plant Biology, 6(1):11-24.

[25]Sadowsky, M. J., 2005, Soil stress factors influencing symbiotic nitrogen fixation, in Werner D., Newton W. E. (Eds.) Nitrogen fixation in agriculture, forestry, ecology, and the environment Springer, Dordrecht, 89-112.

[26]Scurtu, I., 1980, Corelaţii între elementele potenţialului biologic de producţie la mazăre, Analele I.C.L.F., vol.VII:158-167.

[27]Smittle, D., Bradley, G., 1966, The effects of irrigation, planting and harvest dates on yield and quality of peas, Proc. Amer. Soc. Hort. Sci, 88:441-446.

[28]Srivastava, T.K., Ahlawat I.P.S., 1995, Response of pea (Pisum sativum) to phosphorus, molybdenum and biofertilizers, Ind. J. Agron., 40:630–635.

[29]Tang, C., Unkovich, M.J., Bowden, J.W., 1999, Factors affecting soil acidification under legumes.III.

Acid production by N_2-fixing legumes as influenced by nitrate supply, New Phytol.,143:513-521 .
[30]Vorob'ev, V. A., 2000, Effective inoculation of leguminous plants in relation to provision of phosphorus and potassium and dependence on rhizosphere temperature, Agrokhimiya, 2:42-44.
[31] Waterer, J. G., Vessey, J. K., Raper, C. D., 1992, Stimulation of nodulation in field peas (Pisum sativum) by low concentrations of ammonium in hydroponic culture, Physiol. Plant., 86:215–220.
[32]Yenane, A., Skjelvag, A.O., 2003, Effects of Fertilizer Phosphorus on Yield Traits of Dekoko (Pisum sativum var. abyssinicum) Under Field Conditions, Journal Agronomy and Crop Science, 189:14-20.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ROMANIA'S CEREAL EXTERNAL TRADE BETWEEN 2014 AND 2016

Radu Lucian PÂNZARU[1], Marius VLADU[1], Dragoș Mihai MEDELETE[1], Dan BODESCU[2]

[1]University of Craiova, Faculty of Agronomy, 19 Liberty, 200421, Craiova, Romania, Phone: +40 741 180 976 , Fax: + 40 251 418 475, rlp1967craiova@yahoo.com, medelete@yahoo.com
[2]University of Agricultural Sciences and Veterinary Medicine Iași, Faculty of Agriculture, 3 Mihail Sadoveanu, Iași, Romania, Phone:+40 744 708 173, Fax +40 232 219 175, Email: dbodescu@uasiasi.ro

Corresponding author: medelete@yahoo.com

Abstract

Through the content, the paper aims to highlight Romania's main export-import items from the cereal group for the period 2014-2016. In this respect, the situation for wheat, rice, barley, oats, maize, rye and sorghum is presented, both in terms of exports and imports. The value of foreign trade (thousands USD - FOB for export, thousands USD - CIF for import) is presented both structurally and in terms of the evolution over time, based on the consideration that Romania is an important cereal producer, at least, at regional level. The dynamic series is also completed by presenting the average of the period. The export activity predominates compared to imports (2,390,399.33 versus 546,557.33 thousand $), which leads to the recording of a surplus trade balance for the Romanian external trade with cereals. This situation is present for most of the products marketed, except for rice and rye, for which the trade balance is deficient.

Key words*: *trade balance, grain, dynamic, export, import, structure

INTRODUCTION

Foreign trade exerts an important influence on economic growth [4]. In this context, we considered it necessary to review the foreign trade operations of Romania with cereals, given that Romania is - at least at European level - an important producer in the field.
The export represents all the transactions of selling or investing abroad of some goods or values, the import is a commercial transaction for the purchase of goods and/or services from abroad and involves the passage by them the customs frontier of the importing State [8].
The trade balance is a component of the balance of current transactions. The state of trade balance will have an impact on the balance of payments, to a greater or lesser extent, depending on the share of trade operations in relation to other country's exchange operations [2]. The foreign trade balance or, more simply, the trade balance represents a statistic-economic picture in which, according to established order, all the foreign trade operations performed by a country are reflected in a given period [5]. Each country must aim at achieving a balanced external trade. A passive, unbalanced trade balance due to export surpluses by imports may result in a decrease in currency earnings. The more foreign country's dependence on foreign trade is, the more imperative the desire to balance its trade balance [6]. Over-the-counter trade balance has its limits, because no one wants to export as much as possible and import as little as possible [11].
Cereals have been a commodity since ancient times, and trade cereals have been confirmed since 6000-5500 BC [7]. Cereal grains are currently an important international trade item. Over the past decade, an average of about 100 million tons of wheat, 100 million tons of corn, up to 25 million tons of rice, 16 million tons of barley and 6 million tons of sorghum have been sold annually [10].
Corn is an important cereal for Romania with export potential. Corn crop in Romania also suffers from specific climatic conditions but also from pests [9]. Maize occupies the highest share in the cultivated area with cereals, 48%, taking into account the

importance of the maize grains for human and animal consumption, and for industry. Also, maize has an important share in the cultivated area of Romania, being about 32 % [12].

It is worth noting that the 2014-2016 period differs from the previous situations. From 1990 until 1995, Romania's trade balance for cereals was deficient; an offensive of grain exports, especially wheat exports, began in 1995, which lasted until 1999; two years (2000 and 2001) with exports below the level of cereal imports followed by a new trend towards the recovery of the trade balance for cereals; in the agricultural year 2003-2004, the balance of cereals is imbalanced as a result of the increase in wheat imports of more than 1.5 million tons [13]. In 2008, due to the favorable world situation Romania became a net export country of wheat [14]. Romania will in the future become a major wheat exporting country, thus contributing to balancing the trade balance of foreign payments [3].

MATERIALS AND METHODS

For the elaboration of the paper, the database of the National Institute of Statistics was consulted, from where were extracted the data related to the value of exports and imports of Romanian cereal products. As indicators were used the value of exports and the value of imports, as well as the level of trade balance (difference between imports value and value of exports), expressed in thousand $.

As a method of analysis, the comparison was used. The comparison method appreciates the results obtained and reports them to some bases of reference. Comparisons are done in time, space, and mixed [1].

The paper used indices analysis, comparison over time being highlighted through the mobile base index, calculated by formula: $I_{vb} = (y_n/y_{n-1})100$, in which: y_n- the level of indicator for each component of the dynamic series; y_{n-1}- the level of temporal sequence indicator considered as a basis for comparison or reference period .

At the same time, to highlight the importance of each traded product, the annual and multiannual export and import structures made by Romania (by calculating the structural indices) were used, considering the traded products: wheat, rice, barley, oats, corn, rye and sorghum.

In order to determine export and import dependence, the correlation coefficient r was calculated according to the formula:

$$Correl(X,Y) = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

where $\bar{x}$ and $\bar{y}$ - are the averages for samples, average (matrix1) and average (matrix2).

RESULTS AND DISCUSSIONS

The information used, refers to the evolution of the export value level [15] and is presented in Table 1.

For the year 2014, the highest value of exports was of 161,287,349 thousand $ for wheat (48.957% of the total) followed by: corn with 1,013,648 thousand $ (38.548%), barley 305,992 thousand $ (11.636%), rice 16,110 thousand $ (0.613%), sorghum 5,794 thousand $ (0.220%), oat 611 thousand $ (0.023%) and rye 67 thousand $ (0.003%). The sequential values determined a level of $ 2,629,571 thousand $ for the total Romanian export of cereals.

In the case of 2015, a total export value of 2,221,541 thousand $ was established, which consisted of: 19 thousand $ rye (0.001%), 365 thousand $ oats (0.016%), 4,180 thousand $ sorghum (0.188%), 11,555 thousand $ rice (0.520%), 334,437 thousand $ barley (15.054%), 778,659 thousand $ wheat (35.051%), 1,092,326 thousand $ corn (49.170%).

At the level of 2016, export variation limits were 73 thousand $ for rye (0.003%) and 1,248,059 thousand $ for wheat (55.346%) respectively.

The rest of the products have levels of: 802,319 thousand $ corn (34.581%), 215,416 thousand $ barley (9.285%), 14,216 thousand $ rice (0.613%), 2,728 thousand $ sorghum (0.118%), 1,275 thousand $ oats (0.054%). The overall export level reached 2,320,086 thousand $.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 1. Export of grain (2014–2016)

Specification	2014		2015			2016			Average **		
	Th. $*	Str. %**	Th. $*	Str. %**	2015/ 2014**	Th. $*	Str. %**	2016/ 2015**	Th. $	Str. %	Average/ 2016
Wheat	1,287,349	48.957	778,659	35.051	60.48	1,284,059	55.346	164.91	1,116,689.00	46.716	86.97
Rice	16,110	0.613	11,555	0.520	71.72	14,216	0.613	123.03	13,960.33	0.584	98.20
Barley	305,992	11.636	334,437	15.054	109.29	215,416	9.285	64.41	285,281.67	11.934	132.43
Oat	611	0.023	365	0.016	59.74	1,275	0.054	349.32	750.33	0.031	58.85
Maize	1,013,648	38.548	1,092,326	49.170	107.76	802,319	34.581	73.45	969,431.00	40.556	120.83
Rye	67	0.003	19	0.001	28.36	73	0.003	384.21	53.00	0.002	72.60
Sorghum	5,794	0.220	4,180	0.188	72.14	2,728	0.118	65.26	4,234.00	0.177	155.21
Total	2,629,571	100	2,221,541	100	84.48	2,320,086	100	104.43	2,390,399.33	100	103.03

*http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=EXP101F (05.09.2017)
**own calculation

The average of the analyzed period shows a total value of exports of 2,390,399.33 thousand $, in which the export items contributed as follows: 53 thousand $ rye (0.002%), 753.33 thousand $ oats (0.031%), 4,234 thousand $ sorghum (0.177%), 13.960.33 thousand $ rice (0.584%), 285.281.67 thousand $ barley (11.934%), 969.431 thousand $ corn (40.556%), 1.116.689 thousand $ wheat (46.716%) - Figure 1.

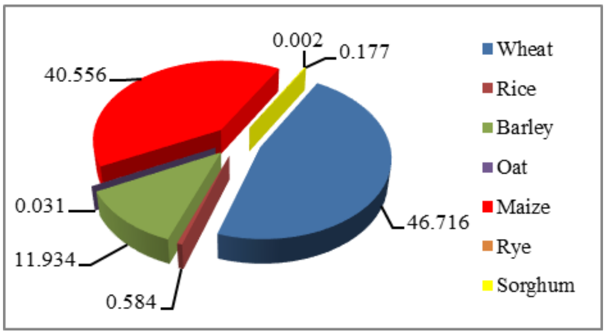


Fig. 1. Export of grain - structure (%), period average (2014-2016)

For wheat, the indicator dynamics was fluctuating, characterized by year-to-year declines and increases (-39.52% in 2015 compared to 2014, +64.91% in 2016 compared to 2015). The same situation is also characteristic for rice (-28.28 and +23.03%), oats (-40.26 and 249.32%, respectively) and rye (-71.64 and +284.21%). In the case of barley, 2015 exceeds 1.09 times the specific situation in 2014, and in 2016 there is a decrease in exports by 35.59%.

For maize, the evolution is somewhat similar to the one presented above (+7.76 and -26.55%). Sorghum shows a strictly downward trend of exports (annual successive declines of 27.86 and 34.74% in 2015 and 2016 respectively compared to the terms of comparison). Overall, there is a 15.52% decrease in 2015 and a 4.43% increase in 2016.

Table 2, presents data on cereal imports made by Romania [15].

At the level of 2014, the highest import value was 165,949 thousand $ for maize (42.52% of the total), followed by wheat by 159,042 thousand $ (40.75%), rice 37,612 thousand $ (9.52% %), barley 26,196 thousand $ (6.71%), sorghum 1.357 thousand $ (0.35%), oats 410 thousand $ (0.11%) and rye 172 thousand $ (0.04%).

These values led to a total of 390,288 thousand dollars for the total Romanian grain imports.

The specific situation for the year 2015 is characterized by a total import value of 593,108 thousand $, which consisted of: 180 thousand $ rye (0.03%), 359 thousand $ oats (0.06%), 1,176 thousand $ sorghum (0.20%), 34,629 thousand $ rice (5.85%), 92,776 thousand $ barley (15.64%), 133,703 thousand $ wheat (22.54%), 330,222 thousand $ corn (55.68%).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 2. Import of grain (2014–2016)

Specification	2014		2015			2016			Average **		
	Th. $*	Str. %**	Th. $*	Str. %**	2015/ 2014**	Th. $*	Str. %**	2016/ 2015**	Th. $*	Str. %	Average/ 2016
Wheat	159,042	40.75	133,703	22.54	84.07	375,131	57.16	280.57	222,625.33	40.73	59.35
Rice	37,162	9.52	34,692	5.85	93.35	33,912	5.16	97.75	35,255.33	6.45	103.96
Barley	26,196	6.71	92,776	15.64	354.16	80,509	12.27	86.78	66,493.67	12.17	82.59
Oat	410	0.11	359	0.06	87.56	401	0.06	111.70	390.00	0.07	97.26
Maize	165,949	42.52	330,222	55.68	198.99	164,635	25.09	49.86	220,268.67	40.30	133.79
Rye	172	0.04	180	0.03	104.65	248	0.04	137.78	200.00	0.04	80.64
Sorghum	1,357	0.35	1,176	0.20	86.66	1,440	0.22	122.45	1,324.33	0.24	91.97
Total	390,288	100	593,108	100	151.97	656,276	100	110.65	546,557.33	100	83.28

*http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=EXP102F (05.09.2017)
**own calculation

In the case of 2016, the import variation limits were 248 thousand $ for rye (0.04%) and 375,131 thousand $ for wheat (57.16%) respectively. The rest of the products were placed at: 164,635 thousand $ corn (25.09%), 80,509 thousand $ barley (12.27%), 33,912 thousand $ rice (5.16%), 1,440 thousand $ sorghum (0.22%), 401 thousand $ oats (0.06%) and 248 thousand $ rye (0.04%). The total annual imports reached 656,276 thousand $.

The average of the analyzed period is characterized by a total import value of 546,557.33 thousand USD, which consisted of the following: 200 thousand $ for rye (0.04%), 390 thousand $ oats, 0.07%, 1,324.33 thousand $ sorghum (0.24%), 35,255.33 thousand $ rice (6.45%), 66.493,67 thousand $ for barley (12.17%), corn 220.268,67 thousand $ (40.30%), 222.625,33 thousand $ wheat (40.73%) - Figure 2.

Imports of rice are characterized by a strictly downward trend (-6.65 and -2.25% in 2015 and 2016 respectively compared to baselines).

At the level of reed, we are talking about a strict ascending trend (annual successive overruns of 1.04 and 1.37 of the terms of reference). For the rest of the products, the trend was fluctuating: increases in 2015 and declines in 2016 for barley and maize; decreases in 2015 and increases in 2016 for wheat, barley and sorghum respectively. On a general level, we are talking about a strictly upward trend of the indicator (1.51 and 1.10 times the baseline for 2015 and 2016.

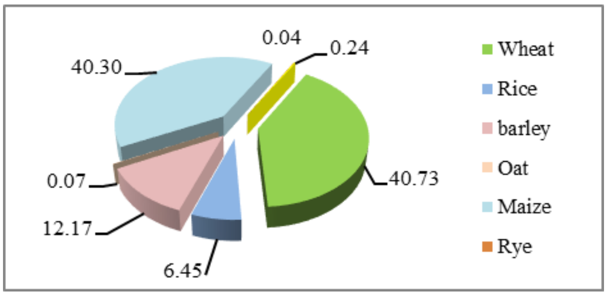


Fig. 2. Import of grain – structure (%), period average (2014-2016)
Source: Own design based on [15].

In 2014, the balance of trade balance is surplus. There is a surplus of +2,239,283 thousand USD, which is based on surpluses specific to the vast majority of crops (+201, +4,437, +279,796, +847,699 and +1,128,307 thousand $ for oats, sorghum, barley, corn and wheat). Deficits only appear for rye and rice (-105 and -21,052 thousand $).

The year 2015 is also characterized by a surplus of the trade balance (1,628,433 thousand $), perpetuating the state of things specific to 2014 (deficits are found only for rice and rye: -23,137 and -161 thousand dollars). There is, however, a decrease in surpluses for the rest of the products (from +6 thousand $ for oats to +762,104 thousand $ for maize).

At the level of 2016, the same trend of the trade balance is maintained (+1,663,810

thousand $ - general level), a trend dictated by crops of wheat, corn, barley, sorghum and oats (+908,928, +637,684, +134,907, +2,480 and +874 thousand $ respectively).
If we analyze the share of cereal products exported by Romania in the context of total Romanian exports and exports of vegetal.

Table 3. Balance of foreign trade in cereals - thousands $ (2014–2016) *

Specification	2014	2015	2016	Average
Wheat	+1,128,307	+644,956	+908,928	+894,063.67
Rice	-21,052	-23,137	-19,696	-21,295.00
Barley	+279,796	+241,661	+134,907	+218,788.00
Oats	+201	+6	+874	+360.33
Maize	+847,699	+762,104	+637,684	+749,162.33
Rye	-105	-161	-175	-147.00
Sorghum	+4,437	+3,004	+2,480	+2,909.67
Total	+2,239,283	+1,628,433	+1,663,810	+1,843,842.00

*own calculation.

The average of the period shows a surplus balance for Romania's international grain trade (+1,843,842 thousand $). Figure 3 shows the specific situation for each product.

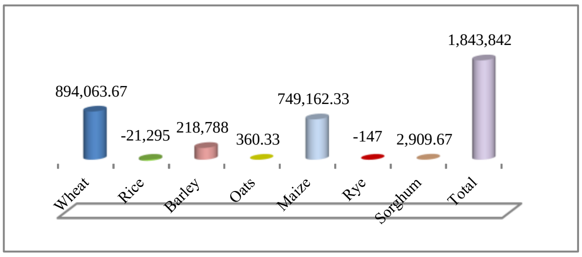


Fig. 3. The trade balance of foreign trade (thousands $), period average (2014-2016)
Source: Own calculation and design.

CONCLUSIONS

In Romania's external cereal trade, the main items are wheat and maize, with over 40% weight for both exports and imports. The rest of the products, except for barley, account for less than 10% (some even have very low weights - rye, oats, sorghum and rice in exports, rye, oats and sorghum in the case of imports - weighing less than 1%);
The evolution of exports is - in general - fluctuating, except for sorghum (downward trend).
The trends in imports are rising, with different trends for rice (descending trend), respectively for wheat, barley, oats, maize and sorghum (non-uniform trend). Only for rye, the evolution is similar to that recorded at the general level.
products (multi annual averages, 2014-2016, which were 64,690,295 and 3,764,189 thousand $), it is found that this represented 3.70 and 63.50%, it is confirmed the character of the exporting country of cereals for Romania.
In the case of imports, all wheat and maize (40.73 and 40.30%) are predominantly followed, at appreciable distances of barley and rice. The rest of the products hold weights below 0.25%.
The trend of total imports is an upward trend, a situation that also occurs for rye. With the exception of rice (downward trend), the rest of the products show a fluctuating variation.
If we analyze the share of cereal products imported by Romania in the context of total imports and imports of vegetal products (multi annual averages, 2014-2016, which were 74,121,167.33 and respectively 2,284,017 thousand $), it is found that they represented 0.74 and 23.93%, it is noted that for Romania the cereals are not an exponential export item.
The balance of trade balance is in surplus, which emphasizes the Romanian producers orientation towards cereal crops, which find favorable growth and development conditions in Romania (except for rice).
The correlation between exports and imports, determined by the value of the correlation coefficient r (-0.89471), is hardly inversely proportional (Fig. 4).

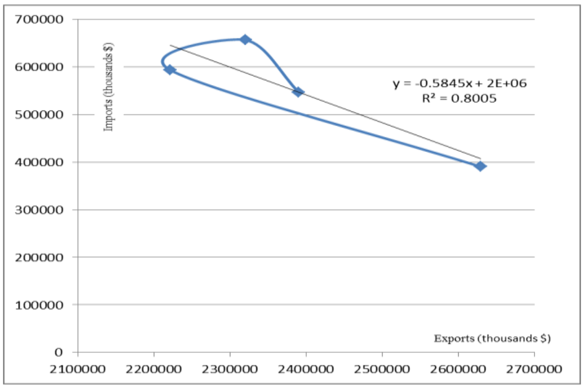


Fig. 4. Regression function between exports and imports (thousands $), period average (2014-2016)
Source: Own calculations and design.

It is worth mentioning that Romania suffers from the external market's point of view.

Import is often aimed at covering the need for seeds (the vast majority of situations), but also for filling the food needs of the population (rice) or for covering the forage needs.

REFERENCES

[1] Alecu, I., Merce, E., Pană, D., Sâmbotin, L., Ciurea, I., Bold, I., Dobrescu, N., 1997, Management in Agriculture, Bucharest, Ceres Publishing House, pp. 300 - 318

[2]Bari, I., 1997, The World Economy, Bucharest, Didactic and Pedagogical Publishing House, pp. 626 - 642

[3]Constantin, M., Chiran, A., Funar Sabina, Drăghici, M., Frone, F., Pânzaru, L., Peț Elena, Gîndu Elena, Alecu, I., Chihaia Anișoara, 2009, Marketing of food production, Bucharest, Agro Technical Publisher, pp. 298 - 323

[4] Crețoiu, G., Cornescu, V., Bucur, I., 1993, Political Economy, 2nd Ed., Bucharest, Publishing House and Press Chance L.L.C., pp. 401 - 428

[5]Crețoiu, G., Cornescu, V., Bucur, I., 2008, Economy, 2nd Ed, Bucharest, Publishing House C. H. Beck, pp. 426 - 461

[6]Dumitrescu, S., Dolgu, G., Gheorghiță, V., Marin, G., Bari, I., Comănescu, L., 1989, World Economy, Bucharest, Didactic and Pedagogical Publishing House, pp. 146 - 156

[7] Matei, G., 2014, Phytotechnics, cereals and pulses, vol. 1, Craiova, Sitech Publishing House, pp. 40 - 288.

[8]Mâlcomete, P., Merhidan, G., Munteanu, V., Adăscăliței, V., Anton, I., Constantinescu, A., Dijmărescu, E., Isărescu, M., Vainer, A., 1994, Internal and International Marketing Lexicon, Iasi, Junimea Publishing House, pp. 115 - 126.

[9] Popescu, Agatha, 2017, Maize culture - an intensive or extensive production system in Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 17, Issue 1, 2017, pp.351- 356.

[10]Roman, G. V., Tabără, V., Robu, T., Pîrșan P., Ștefan, M., Axinte, M., Morar, G., Cernea S., 2011, Phytotechnics, vol. I - Cereals and pulses for beans, Bucharest, University Publishing House, pp. 42 - 291

[11]Rosu Hamzescu, I., Zăvăleanu, M., 2002, Diplomacy, negotiation, protocol in international relations, Craiova, Universitaria Publishing House, pp. 33 – 66.

[12]Tudor, Valentina, Popa, Daniela, Gimbășanu, Gabriela Florentina, 2017, The analysis of the cultivated areas, the production and the selling price for maize crops during the pre and post-accession periods of Romania to the European Union and trends of evolution of these indicators, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 17, Issue 2, 2017, pp.387-394

[13]Zahiu Letiția, Arion, F., Berevoianu Rozi., Constatin, M., Dachin Anca, Dobre Iuliana, Drăghici, M., Ene Irina, Giurcă Daniela., Grodea Mariana, Iatan Elena, Ion Raluca, Lazăr, T., Oancea, Margareta, Popescu Angela, Turek , A., Turek Magdalena, Turek Antoaneta, 2006, Policies and Agricultural Markets, Reform and Integration, Bucharest, Ceres Publishing House, pp. 199 - 227.

[14]Zahiu Letiția, Toma Elena, Dachin Anca, Alexandri Cecilia (coordinators), Ailenei, D., Alboiu Cornelia, Angelescu Coralia, Molănescu Gabriela, Grodea Mariana, Huru, D., Iuliana, I., Luca, L., Moldovan Minodora, Socol Aura, Socol C., 2010, Agriculture in the Romanian economy, between expectations and realities, Bucharest, Ceres Publishing House, pp. 58 - 96.

[15]http://statistici.insse.ro/shop/, Accessed on Dec. 10, 2017.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE HERITAGE OF TRADITIONS AND TOURISM FACILITIES IN TRANSILVANIA, ROMANIA

Daniela-Mirela PLEȘOIANU[1], Edith GRECU[1], Agatha POPESCU[2]

[1]Ovidius University, 1, University Avenue, Campus, Building B, Constanta, Romania, Email: plesoianudaniela@hotmail.com
[2]University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest Romania, Phone: +40213182564, Fax: +40213182888, Email: agatha_popescu@yahoo.com

Corresponding author: plesoianudaniela@hotmail.com

Abstract

This paper is an analysis of the Transylvanian region in terms of customs and traditions in this area. Such characterization of an area involves studying the history of this area, which in this case has deepened its mark.Thus, the fact that Transylvania was occupied both by the Ottoman Empire and by the Austro-Hungarian Empire can be seen both in the traditions and customs, in the folk port, the only thing and the most obvious inheritance being the language, that is, the Hungarian language inherited by from one generation to another, studying even at school.The purpose of this paper is to illustrate the traditions and customs of the Transylvanian region by highlighting the folk port and habits that take place every season on different occasions, habits preserved from the estates, ancestors. In this paper we used methods such as cartographic description, analytical method and graphics. These methods helped to translate data into graphs, tables, and charts using EXCEL. The work has gone through three important stages in its development, namely: documentation, analysis of statistical and territorial data research, integration and complex interpretation of information.In the first stage, the documentary we consulted an extensive scientific bibliography which later served as a basis for the present study, providing in particular information regarding the physical-geographic characterization of the study area. The integration of all geographic information allowed, through complex interpretation and their transposition into representative maps, the knowledge and understanding of traditions and customs in Transylvania.As far as the traditions of the most important moments of life are concerned, each of them distinguishes itself from the rest of the regions at different times.As far as the accommodation base is concerned, Transylvania adds approximately 7,000 units with an accommodation capacity of approximately 25,442,084 seats. Although the base of accommodation is quite large, the index of utilization of the capacities in operation is only 23.6%, the region occupying the 4th place in the country.As in the case of the accommodation base, public catering amounts to about 4,000 authorized establishments where tourists can enjoy traditional cuisine specific to the area (Szekler spelled, curtoş kalacs, gulaş, papricaş s.a.). Touristic routes and means of transport are varied, highlighting special transports, namely cable cars, chairlifts, tele-skis.As far as tursim forms are concerned, mountain tourism, cultural-historical, religious, sports, rural, ecotourism, business tourism and conferences, recreation, treatment and weekend tourism are practiced.

Key words*: *traditions, customs, popular port, heritage, festivals

INTRODUCTION

Transylvania is one of the richest regions in terms of cultural heritage, here is a series of Romanian traditions combined with traditions of Hungarian nature.
So, in each season, there are a series of traditions and customs that attract tourists throughout the year [4].
As in every region of the country, and in Transylvania, a series of traditions take place in the most important moments of life, traditions that differentiate and highlight the area in relation to the rest of the Romanian regions.
On the territory of Transylvania itself there are nine counties: Alba, Bistrita-Nasaud, Brasov, Cluj, Covasna, Harghita, Hunedoara, Mures and Sibiu.
Besides these, there are also settlements in the counties of Bacau, Caraş-Severin, Maramureş, Neamţ, Sălaj and Vâlcea [5].

MATERIALS AND METHODS

To accomplish this work I used data provided by the regional develoment plan, 2014-2020, regional development plans and general development strategies of the counties: Harghita, Hunedoara, Covasna, Cluj, Bistrita-Năsăud, Sibiu, Alba, Brașov.

Methods such as cartographic description, analytical method and graphics have been used. These methods helped to translate data into charts, tables and charts using the EXCEL program. This paper has three important steps in its development, namely: documentation, analysis of statistical and territorial data research, integration and complex interpretation of information. In the first stage, the documentary we consulted an extensive scientific bibliography which later served as a basis for the present study, providing in particular information regarding the physical-geographic characterization of the study area. The integration of all geographic information allowed, through complex interpretation and their transposition into representative maps, the knowledge and understanding of traditions and customs in Transylvania.

RESULTS AND DISCUSSIONS

Traditions of the most important moments of life

The most important moments of life are captured in the habits of the area: baptism, wedding, funeral, but also the specific traditions of the area pertaining to each season.

Dominated by a high relief, the region is separated from the localities of the former Wallachian province of the Southern Carpathians, while Moldova separates the Eastern Carpathians [6]. The name of Transylvania comes from Latin, being known from ancient times for the beauty of the forests that covered the surrounding mountains [7] . Exquisite landscapes can be admired in the hilly areas and depressions that accompany the many watercourses. Even climate is another reason to visit this part of the country if we think summer days are much more enjoyable, while the winter snow turns the region into a true paradise for winter sports enthusiasts. Transylvania is one of the few areas of Romania where traditions have been preserved intact from their ancestral lands [8]. And now you can see on the streets of Maramureş people dressed in traditional clothes. At the work of the field, in the center of the village, at the holidays over the year, or at the church service, the Maramures boast the national port [9]. The traditions and customs here are as alive as a hundred years ago. In this part of Romania it seems that time has remained, people enjoying the holidays over the year, the important events in the family, as well as the work of the field. Christmas, Easter, Rusaliile, Sfânta Maria are occasions for feasting and hunting, but also for prayer and fasting.

Traditions of the spring season

"Mărţişorul" is a small object of ornamentation connected to a braided string made of a white and red thread, which appears in the tradition of Romanians and neighboring populations. Women and girls receive marches and wear them during March as a sign of spring arrival. Together with the marriage, spring flowers are often offered, the most representative of which is the snowdrop.

Currently, the marriage is worn throughout the month of March, after which it is caught by the branches of a fruit tree. It is believed that it will bring abundance in people's homes. It is said that if someone asks a desire while hanging the marriage of the tree, it will be fulfilled at once [1].

In the Transylvanian settlements marquises are hung by doors, windows, horns of domestic animals, as it is believed that they can scare the evil spirits.

The Daffodils festival "blooms" the Braşovian tradition in Şercaia commune, the village of Vad. The Narcissus Festival takes place every year in May in the Dumbrava Vadului Reserve, unique in Europe as a dimension. It lies right in the middle of the Făgăraș Mountains, an area where daffodils grow in large numbers. This reservation is also known as "Dumbrava with coprinas". In fact, the word "coprin" translates into "daffodils."

Easter is a holiday full of meaning and symbols, with beautiful traditions and customs, kept with holiness. One of the habits is that every man, however poor he may be, is taking a new coat [3].

For this holiday the villagers paint eggs, prepare pasta and other traditional dishes. On this occasion, chigala is prepared. "Chigala" is a traditional cake made from Easter, fluffy topped with plum jam and poppy.

Participating in the Resurrection service is an indispensable ritual of Transylvanian families. Children are used to going home from home and proclaiming the Lord's Resurrection. Instead they get red eggs. Also in these parts of the country there is the tradition that the men in the village can compete at the collision of the eggs.

In Cluj and Mureș, each farmer adorns his gates with fir branches gathered from the forests near the localities.

Also on Saturday before the Resurrection, the unmarried boys go to the unmarried girls' homes with their own trees, so as not to remain unmarried. Girls give them red eggs and money in exchange for these habits. It may happen that sometimes the young people like it and the knife's habit takes place [2].

Splashing with perfume is another custom made by the Catholic Easter. As a rule, every woman in the community is sprinkled with perfume to keep going all year round, staying so beautiful and giving birth to healthy babies. Initially, women were sprinkling with water.

The Junii Brașovului is one of the best known habits of the locality, held on the first Sunday after Easter, also known as "Tomii's Sunday". This habit, from the early hours of the morning, is a true parade. So we can admire the Young Juni, the Dorian Juniors, the Curcant Juniors, the Old Juniors, the Rosy Juni, the Albiori Juni or the Braşovecheni Juniors. They ride the most beautiful horses, anchoring national flags across the city, stopping for a few minutes in Council Square. Later on, he continued his journey to Solomon's Stones, where the habit of throwing his bucket is taking place.

During the scroll, the Junii Brașovului cried "Christ Risen!", The crowd answering them every time "True Risen!"

The Ascension Day, celebrated 40 days after the Resurrection, has a fairly large Orthodox significance, but also a series of traditions and customs respected by the inhabitants of the rural region. In the region of Transylvania, on the day of Ascension, men wear walnut leaves on the girdle, embodying the Christian image of the Savior Jesus Christ when he ascended to heaven. The women share freshly crumbling bread made of unleavened dough, onion and brandy, because those who have gone through eternal rest can be spoiled by the meridians sent by the earth to the world beyond. From a Christian point of view, it is said that those who cease to live on the holy day of Ascension reach heaven, regardless of the sins they have committed during their lives. Tradition also says that on the day of Ascension it is not advisable to borrow salt from the house, since those who have cows in the household will no longer enjoy plenty of milk. It is equally important that on the day of the Ascension of the Lord you will make red eggs, renewing the tradition of Easter again [3].

The habit of Căluşul is very common in the Transylvanian villages. This custom is related to the feast of Pentecost. This custom is to practice a traditional dance, imitating the walking and treading of a horse. Through the custom of Căluş, each person who participates celebrates the people who were close to the past, being practiced on the Saturday before the Rusalii, called the Summer Mothers.

Near them is the "Mutul", the symbol of Căluş, who is the god and the protector of the horses. They wear rags at the top of the pans, red ribbons are hung on them.

Traditions of the summer season

The traditions of St. Ilie take place with the Christian celebration of this holiday on July 20th. It is said that St. Ilie is a rain raid, thus increasing the harvests of the households.

However, traditions begin to be prepared on the eve of this holiday when households begin to get wet which more to call the rain. A series of popular sayings are said for St. Ilie to endure and to send the rain to the earth.

Inborn ox is a feast that takes place in the summer, usually very close to Sânziene or Rusalii [1] .

This tradition is preserved for rich crops in the agricultural year, the harvesting of storms and hail. Tradition embodies a very beautiful ox adorned with flowers, bells and fabrics made by village women. The ox was worn on every street in the village, accompanied by a rather large number, usually disguised with certain looks surprised by mythologies. According to the popular beliefs, the inbuilt ox shows a deity that helps every village farmer, protecting his crops and households [2].

In July, the Carta celebrates the "Harvest House". On this day, the oldest villagers teach the youngest to cut wheat spikes and to bind wheat sheaves. Women bind wheat sheaves in the form of a cross. They are placed one above the other, forming a bucket. The harvest house is a popular event in the Sibiu region, the entire Carta village being dressed in a feast, going through the village center to the homes of the households. The builder of women in wheat sheep is carried through a village of two little girls accompanied by a lot of people. The housewives sit at the gates, waiting for the glass to splash it with fresh water, fountains, a sign of welfare and freshness. Those attending the event are welcomed by the hosts who went to harvest wheat with traditional Romanian dishes. During the event, the song "Wheat Song" is rumored, and the two-eyed maid is left to the church.

Traditions of the autumn season

The wretched Sheep is one of the habits of the inhabitants of Bran, symbolizing the end of a pastoral year. The Shepherd of the Sheep takes place in Bran at the moment when each shepherd descends with his feet from the mountain to the village to leave every shepherd to his sheep with important pieces of cheese.

The Wailing Sheep is a joyful celebration that tells the arrival of the cold season. On this day, every shepherd is so glad to see his relatives and friends whom he has not seen for some good months. Each shepherd boasts the fruits of his labor, turning with fat males and chocolate cheeses made by traditional recipes.

The Shepherd of Sheep has become a true popular festival taking place in October every year.

The Halloween holiday at Bran Castle takes place on the night of October 30 and is becoming more and more a true tradition of the inhabitants and tourists. This takes about two days, during which tourists will be scared, Bran Castle becoming the perfect place for mystery seekers. The most foreign tourists are.

Traditions of the winter season

Cumulus of Romanian, Hungarian and Saxon beliefs and legends, Transylvania offers the traveler some of the most beautiful and animated traditions and customs of the year. Practiced to bring good luck, health and rich fruits to the entire community, these traditions are preserved with holiness from their ancestors and are unique in Romania and Europe. The casting of evil spirits, the revival of nature and life, survival and soul purification are some of the most important meanings of these traditions. Steaua is a winter habit, preserved from ancestors and held every year on December 25, Christmas. The chariots walk through the village with Star and proclaim the birth of the infant Jesus. Usually, the carols go in four, with the angel and three rays. For their carols, the children receive nuts, apples, or colognes.

The girls' call to juni. It's an annual custom, which takes place on Christmas Day, on December 25th [2] .

The goat is another winter habit that takes place on the Christmas holiday. The habit of this carol has a special significance: the goat brings abundance and health in the coming year. The carols get dressed and start dancing the goat all over the village, wishing the villagers wealth, work and health.

Butea Junilor. "This custom is specific to winter holidays, but preparations start as early as October. The "junkyard" is formed and hosts during the holidays. Then, a week before Christmas, sons of the village bring their homemade dishes for Christmas. On Christmas Day, the sons are dressed in holiday clothes and start walking around the village. After the caroling, the virgins head for the house of the host, where they will eat" (according to: www.turism-transilvania.ro).

Meteleaua. This habit is pagan, being celebrated each year at the winter solstice. On this occasion, the villagers fired fires to drive away the evil. Later the shots were replaced by a meteu (straw dolls). The fire of myth symbolized the rebirth of nature and life.

These shots are now associated with Christmas, in every village in Ardeal burning the moth in the center of the village. This feast takes place on December 28, and the bunch of sons have their thematic costumes [3] .

Boriţa. "It is a Christmas tradition specific to the Csango Hungarians in Transylvania. Borita is a mask carried by a virgin from the group of carolites who dance and play songs designed to cast out evil spirits. Dance is done only by the boys and it also signifies the cycle of life "(according to: www.turism-transilvania.ro).

Sumedru's fire takes place annually on October 26 by St. Dumitru. Both adults and children dress up in a popular harbor and dance around a fire. St. Demetrius is the protector of the shepherds and the rich fruits, and the coals of fire are taken by the villagers and used for the fertilization of fields and gardens.

Farsang is a spectacular custom, specific to the Saxon community. This custom takes place before Easter and is the last Easter party. It marks the beginning of a better year, full of fruit, wealth and health. The feast of the feast consists of the most colorful costumed sons and gets to the courtyards of all the villagers to rid the evil spirits of last year and bring freshness to a new year with luck.

The cock roar is a 400-year-old tradition specific to the Hungarian community in Transylvania. This habit takes place every year on the first Easter day and the participants are children and adolescents. The legend says that during the invasion of the Tatars, the inhabitants housed the Black Fortress, but they were discovered after the cock crow. Those who survived the slaughter decided to shoot the cock. This habit signifies survival.

Santilia takes place in the first week after St. Elijah and has a peculiar character, celebrating the fire and the sun. On this day, the sons are giving gifts to the girls with whom they will be married with torso and curls. This day was long awaited by the shepherds, who throughout the summer climbed to the hill with the sheep, from where they were no longer allowed to descend. However, by Santilie, the village goes up to the sheepfold. The Wheel in Flames. This habit takes place annually by Easter for Easter fasting. It takes place during the night, when rolled up by the village sons are rolled up in the valley. The wheels are for young girls who have not yet married. This custom announces the coming of the spring and the end of the marriage period.

In traditional culture, on the eve of the New Year or the New Year, a habit called "sowing" is practiced. When they come to the sowing, the sowers say that in the evening they walked with the plow and they looked, and now they must resemble the furrows. Those who participate are children, flames or men. The sowers have a handful of rice, wheat, rye or corn for sowing in their pockets. They tell the lyrics of a popular poem, hating the households to have health and abundance. The seeds are thrown into the house, over people, and after sowing the house is not matured anymore. There is the belief that if the first person to enter the door is a girl or a boy, the farmer will have the birth of female or male offspring in that year. Only cheerful and healthy ladies are allowed to married girls.

The Lole fleeing is a habit dating back to the Middle Ages in Agnita fortress in Sibiu County. The legend says that a young woman known as Ursula came out of Agnita's fortress from time to time, cracking whips, making deafening noises, thus banishing the frightened Turks. Until recently, the tradition of the Agnita lollies was related to the protection of the handicraft handbag, which had the role of protecting these boxes. "Run of Lollies" is a parade open to shoemakers. Lolls run on the streets to drive out bad spirits and protect guilds from parades. If they are recognized by the passers-by in the area, they offer as a reward a donut. The "Run of Lollies" custom takes place at the end of the cool season in February [1].

The Ionian Udine is one of the often used traditions of Tălmăcel, celebrated annually on Saint John the Baptist Day.

Each year, on the feast of St. John, dozens gather in church to celebrate this feast. The feasts dressed in the feast of the feast, specific

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

to the popular harbor, riding on white horses accompany a car with oxen adorned as a feast. Behind them there are several donkeys, the old man and the maid made of straw, but beautifully arranged and adorned. Everyone seems to be heading to the river to wet all those named "Ion". After being wet, all the Ions in Talmacel are served with coils, wine and brandy. The joy of this tradition is passed on to the inhabitants of the entire village, its origins being heard throughout the country.

The Feast of St. John the Baptist is celebrated on January 7, right after the new year.

The Turks from Holbav are one of the customs that have been preserved since the ancient times and made known the region of Transylvania both in the country and abroad. The Turks of Holbav are playing on St. Nicholas on December 6, wishing to announce the arrival of Christmas holidays.

Bear's Day is part of the traditions and customs of the Transylvanian people from the mountain peak. Bear's Day is celebrated 40 days after Christmas, exactly on February 2, when every Christian celebrates the Lord's Encounter. According to customs, Bear's Day coincides with this Orthodox ritual feast, also called Stretenie. According to the elders, on Winter's Bear Day he meets with the summer, and there is a real fight between the cold and the hot season. Also on Bear's Day people can make predictions about the weather look over the year. Following the bear, named Martin, people could know how it would be in the winter or summer.

The customs of Saint Basil in Hunedoara aim to find begging by unmarried girls. This habit in Hunedoara was called sanvasai. This habit consists in the fact that the girls and the boys gathered at the home of one of those present. In a dark room 9 or 12 plates were placed on the table with the bottom up. Under the plates were placed various items such as comb, spin, bread, basil, mirror, bread, knife, scissors, etc. The girls chose a plate, interpreting the nature and qualities of the future husband according to what was under the plate. Such a habit of Saint Basil takes place every year in the area of Orăștie, but also in the land of the Forestry.

Saint Nicholas' plaques. Just like the tradition of fasting, the tradition of St. Nicholas' pies (December 6) is preserved especially in the areas of the Transylvanian villages. The girls are all gathered on December 5 to knead the dough for the pies. In the evening all the boys in the village gather together with the girls and start to spend the next day. The traditions of the snakes trap. In the old days, when the Saxon population of Transylvania was still large, on December 12 a tradition was practiced that required the father to walk with a tray on his head, in which a few twigs were laid. He had to walk around the house to protect the house from all the bad things.

Tourism infrastructure

The tourism infrastructure of the region is very wide, the quality of services being different from one locality to another.

The tourist base of the Transilvania Region included in the year 2016 6,946 accommodation units, of which 1,748 hotels and motels, 266 hostels, 194 cottages, 923 villas and bungalows, 1530 boarding houses and 2028 boarding houses, the rest being other types of tourist units (Table 1. Fig.1.) [11].

Table 1. Transylvania Travel Receiving Structures in 2016

Type of structure	No.
Hotels	1,748
Hostels	266
Apartment hotels	21
Motels	218
Inns	3
Tourist villas	635
Tourist cottages	194
Bungalows	288
Holiday villages	7
Campgrounds	61
Tourist stops	38
Touristic houses	59
Camps for pupils and preschoolers	58
Tourist guesthouses	1,530
Agrotourist hostels	2,028
Accommodation spaces on river and sea vessels	10

Source: National Institute of Statistics, 2017

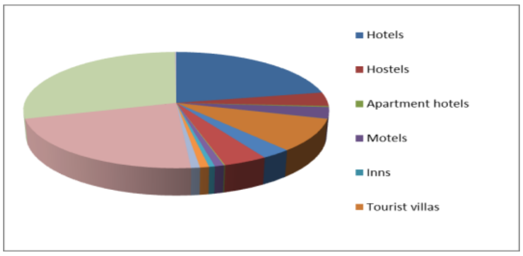


Fig.1.Transilvania Tourism Reception Structures in 2016

Source: Own determination.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The Transylvania Region holds 37.9% of Romania's agro-touristic pensions, 34.4% of the tourist boarding houses and 33.6% of the chalets. Braşov County is one of the six holiday villages of Romanian tourism.
However, it should be mentioned that the tourist base in the region is partially obsolete, the lack of modernization affecting the quality of services offered to tourists. The network of tourist accommodation units is unevenly distributed, the highest concentration being registered in Brasov County (881 units, representing 36% of the total number of tourist units in the region), the opposite is Covasna County, with only 97 units accounting for 4% of the total (Table 2, Fig.2.) [12].

Table 2. Distribution of tourist accommodation facilities in Transylvania in 2016

County	Number of structures
Alba	159
Bistrița-Năsăud	43
Braşov	881
Cluj	192
Covasna	97
Harghita	371
Hunedoara	125
Mureş	291
Sibiu	295

Source: National Institute of Statistics,2017

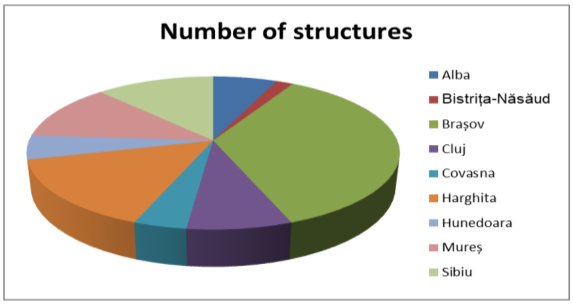


Fig.2. Distribution of tourist accommodation facilities in Transylvania in 2016
Source: Own determination.

Catering

In Transylvania, gastronomy characterized by Transylvanian and Hungarian dishes. From potato bread to meat and smoked food, from teleme to pies, the food in the heart of Transylvania is diversified and very tasty.
As for this sector, there is a conspicuous presence both in number and type, in Transylvania being found over 4,000 authorized units. Only the city of Cluj-Napoca owns approximately 660 authorized units and is distributed as follows: - Bar & Bistro - 1 unit; - Day Bar - 233 units; - Brasserie - 1 unit; - Buffet bar - 6 units; - Buffet-bistro - 1 unit; - Cafe bar - 71 units; - Cafe bar - café 5 units; - Cafe - 13 units; - Confectionery - 6 units; - Fast food - 47 units; - Summer Garden - 1 unit; - Pizzeria - 17 units; - Snack bar - 9 units; - Self-service restaurant: 8 units; - Classic restaurant: 153 units; - Restaurants with artistic program - 1 unit; - Restaurants with specifics: - national (Romanian) - 7 units; - local - 1 unit; - Austrian - 1 unit; - Irish - 1 unit - Italian - 3 units - Mexican - 1 unit; - Chinese - 1 unit; - Hungarian - 1 unit; - Family-friendly restaurant (hostel) - 1 unit in Mount Cold; - Restaurant - 3 units [13].

Travel routes and means of transport

One of the essential premises for the development of tourism is the provision of access to the objectives and areas of tourist importance. The areas with the highest intensity of tourism are the major cities of the region, the tourist resorts in the mountain areas and the spa resorts, the agrotourism areas (Mărginimea Sibiului, the Bran-Moeciu area, the Arieş valley, certain settlements in Szeklerland), most mountain areas and the areas with scattered cultural and tourist attractions (Saxon fortified churches, peasant castles, etc.)[14].
The main tourist areas in the Transylvanian region (except the cities of tourist importance) and the related road infrastructure:
- the Apuseni Mountains area, a tourist area in Alba County with various tourist resources (special karst phenomena, ski resort, agritourism, cultural tourism). Main roads: DN74, DN75, DJ762, DJ750 DJ108, DJ107K, DJ 750C, DJ107M.

In order to increase the accessibility to many mentioned tourist areas, which in turn will be felt in the economic development, it is necessary to develop and implement investment projects for the rehabilitation and modernization of some road sectors (especially county roads). At the level of the Center Region there is a relatively large number of road sectors that provide accessibility to areas or tourist attractions and require rehabilitation, upgrading or extension work. Regarding the special transport means, within Braşov County there is a good cable transport network. Here, there are 4 cable cars, 2 of them link foot and peak of Tâmpa mountain, and the other 2 are located in Brasov, one in Kanzel and the other two connects Capra Neagra to Mount Postavarul. Also in Braşov are telegondole and 6 tele-skis in Poiana Braşov and Predeal.

Another cable car is the one present in the Fagaras area connecting Balea Waterfall Balea Lake which stretches over 3700m. Within the Bucegi Mountains there are 3 cable cars, one connects Babele Buşteni, another connects Gura Ialomiţei Cave to Babele, and the other connects the 1400 share of 2000 Sinaia. The counties of Harghita and Covasna have a number of ski slopes for which tele-skis were placed on different routes, depending on the length and difficulty of the slope [15].

Facilities for treatment and recreation

In this respect, Transylvania has a number of resorts where mineral resources are used for both curative and recreational purposes. This type of tourism offers a wide range of options and addresses people of all ages. Sovata is one of the most important spa resorts in Romania Besides the complex treatment infrastructure, the Sovata resort has several possibilities for recreation, including in the cold season, where two ski slopes are arranged here.

In Covasna, the present resources make possible a series of procedures such as heated mineral water baths, mopeds, aerosols, inhalations, paraffin wraps, electrotherapy, galvanic baths, massage, medical gymnastics. Băile Tuşnad is a resort of national importance recommended for treatment of various diseases such as cardiovascular, digestive, endocrine. And here are a series of procedures such as paraffin wraps, herbal baths, galvanic baths, massage, internal mineral water therapy, magnetotherapy, medical physical culture, reflexology.

The Ocna Sibilului resort has a permanent character and is known for its salty waters with healing properties. In the resort there are procedures such as baths, underwater massage, whirlpools for upper and lower limbs, mud and paraffin treatments and contrast therapy (sauna), collective sprays, dry massage services and cervical and lumbar elongations, procedures with low-, medium- and high-frequency currents treat subacute and chronic inflammatory disorders of the annexes and sterility.

Praid is recommended for treating respiratory diseases.

Patients spend a number of hours as the doctor visits while visiting the mine. By the conditions in the saline the tonus of the neuro-vegetative system is restored. Inside the salt mine there is a museum, a church, a wine cellar [16].

Borsec, one of the oldest and most famous spa resorts in Central and Eastern Europe, located in the same name. Here are procedures like internal and external mineral water, electrotherapy,physiotherapy, electropuncture, ionization, balneophysiotherapy and medical recovery.

At Harghita Baths tourists have inhalations, internal and external cures with mineral waters, relaxing conditions and special rest.

The Homorod Spa has ski slopes.

At Balvanyos tourists can enjoy mofetes, electrotherapy, aerosols, thermotherapy (paraffin wraps), kinetotherapy, aeroheliotherapy, carbonated baths, medical gymnastics and maintenance in the gym. In-house treatments including underwater massage.

Malnaş, Vâlcele, Miercurea Sibiului, Bazna are spas of local importance.

The spa tourism is very likely to develop in the following years due to its strengths, and the existing baths are in competition with the well-equipped thermal baths in Hungary. In these potential resorts there is not yet special medical or balneo-therapeutic treatment, medical care being provided in school camps where it exists or in the medical cabinet of the locality. These resorts generally have open lagoons in degraded condition.

Auxiliary equipment

Concerning recreational means, they differ in typology and number in each county of the region. These consist of parks, cinemas, sports halls, summer gardens, horse riding, etc. In the county of Cluj there is a slight development and diversification, the county being represented by only a few classical products destined either for the summer season (ponds and swimming pools - Cluj-Napoca - Clujana, Sun, plus the Olympic basin, Iulius Mall, Hotel Belvedere, Dej - Toroc spa park, Gherla - Tehnomedical Complex, Turda - Durgauvalea Sărată from the Spa Complex Cojocna) or hibernal (the ski slopes from Băişoara, Dângău - Căpuş, Feleac and Mărişel) such as the theme parks, thematic festivals, business meetings and congresses or others, are also well below the level at which the resources can foster their development [17].

In 2012 in Bistrița-Năsăud county there were 183 cultural homes, increasing compared to 2001 when there were only 53 such units. There is only one cinema in the whole county, Dacia, but no films have been projected in recent years. In the county there are no amusement parks, botanical gardens or zoos. According to available information, the possibility of spending leisure time using the existing infrastructure is low.

In Harghita County for tourists who prefer sports-extreme activities, they have adventure and fun parks: Harghita Băi - Balu Park Adventure Park, Salt Praid Club Adventure Park, which was the first underground adventure park in Europe opened in 2012, Ciumani adventure parks with water slides, Club Aventura Park in Băile Tușnad.

In Harghita County there are more than 20 equestrian and hippie centers in Miercurea Ciuc, Gheorgheni and Odorheiu Secuiesc as well as in other localities such as Homorod Băi, Subcetate and Iacobeni. Bicaz Canyon and Red Lake provide the conditions for practicing more activities from climbing to boating. Canyoning can be practiced in the Seacă Valley and off-road turns can be made with off-road cars, motocross or enduro. Within Brasov County, recreational infrastructure has grown more and more. Swimming pools, cyclotourism trails, pistes, ski slopes built to the highest standards, tennis courts, mini-golf and paintball, horse riding, amusement parks, etc. were built. At the same time, a number of private sports halls appeared due to the increasing interest in martial arts, fitness and maintenance gymnastics.

Types and forms of tourism practicable in Transylvania

With an extremely generous natural potential and a valuable cultural heritage, the Transylvania region has a high and diversified tourist potential. Regional studies and studies show that tourism with the highest development potential is mountain tourism, spa tourism, cultural tourism and rural tourism.

Mountain tourism is most favored due to the existence of mountainous masses spread over large areas, the presence of mountain huts, the presence of marked trails and the promotion of these areas as perfect for practicing winter sports, mountaineering, hiking, speoturism. Transylvania is the first region of the country in terms of mountain tourism potential due to landscape diversity and numerous endemic flora and fauna species. Within the Transylvania region there are a number of locations such as Predeal, Poiana Braşov, Buşteni, Azuga, Sinaia locations that have a high tourist potential in both seasons.

Poiana Brasov ranks first in terms of shi resorts in the country. It has 12 slopes of varying degrees of difficulty, 17 km long slopes and cable cars. The Predeal locality includes 10 ski slopes on a 8 km long ski run. The counties of Covasna and Harghita have approximately 23 approved ski slopes and totally have a length of 13,583 m, the longest ski slope is 1,149 m and is located at Pasin Bucin, of which 19 are managed by commercial companies and 2 are managed by associations that are also equipped with cable transport installations.

Harghita County has a favorable context for practicing outdoor sports: mountain biking, cross-country cycling, nordic walking, caving, hiking, skiing, escalade, tyrolean, hippie, river-rafting, canoying, enduro, moto-cross etc.

Within Cluj County, the ski slopes are scarce and poorly diversified, the only place that has ski slopes is Băişoara, a medium-sized slope. The county of Cluj is highlighted due to the speoturistic potential given by the presence of a large underground cavities (about 160), including the second cave in Romania, the

Humpleu Cave (with over 40 km of development and some of the most grandiose halls in Romania European endocarst: 250-300 m long, 100-150 m wide, over 100 m high), respectively the Altar Cave, considered to be the most beautiful natural underground cavity in Europe [18].

Mountaineering is another form of mountain recreation that can be practiced in several areas of the Transylvanian mountain range, such as Cheile Turzii, Someşului Cald and Turenilor, which have a series of high-difficulty routes (IV-VI) but and some initiation routes (grade II-III). However, it is necessary to have an adequate endowment of the routes, the development of the climbing areas, the building of some tourist bases for hosting the practitioners. Hiking is primarily stimulated by the morpho-seismic value of the mountainous area where the spectacular and varied morphological landscape is a major attraction. The high and prolonged peaks of Mount Mare or Trascau, the pyramid dome of the Vlădeasa Massif, the key sectors and gorges (Turzii, Turenilor, Someşul Cald, Arieş, Hășdatelor, Crişul Repede) are frequent landmarks for those who follow such a depravity of tourism.

In the county of Harghita numerous tourist routes offer the possibility of hiking (eg the Maria Route) as well as cycling or equestrian tours: Giurgeu Mountains - 6 trails, Hasmas Mountains - 14 trails, Harghita Mountains - 10 trails, Gurghiu Mountains - 3 trails. In spite of the net advantage of the mountainous area from this point of view, even the depression area itself is not deprived of the hiking, on the contrary, especially as the mountain routes have as a starting point the localities located in the depression area or the contact with it.

Piscine leisure tourism has favorable conditions of affirmation due to the existence of a dense and mostly unpolluted hydrographic network, but with a drainage regime strongly affected by the massive deforestation in the last century and accentuated in the last two decades, which has a negative impact on the potential biological fish, much diminished. It can be practiced along the main rivers, Someşul Mic, Someşul Mare, Someş, Arieş, in the area of the Transylvanian Plain, Ţaga, Geaca, Cătina, Câmpeneşti, Mărtineşti, which are important areas for a great variety of species which can be harvested or accumulation lakes in Someşul Cald basin or Drăganului Valley.

Cultural and historical tourism is favored by the numerous architectural and historical monuments and, of course, the many customs and traditions. Most of the events are supported or even organized by local authorities. Relatively low distance between objectives favors their integration into different thematic circuits.

Religious tourism. In Braşov County this is especially practiced at Sâmbăta de Sus Monastery, where the religious services during the great holidays attract a great flow of people. Also within Braşov county there are 7 monastic complexes and a series of churches with special values.

In Cluj County this form of tourism is favored by the existence of important places of worship, the most representative objective of this type, the Nicula Monastery is celebrating its patrimony as an event that attracts visitors on August 15 not only from the county but also from the entire Transylvanian area and even from the extra-Carpathian regions (in 2015 the number of participating pilgrims was estimated at about 600,000) [19].

Sports tourism. In the counties of Braşov, Harghita, Covasna there are practiced alpine skiing, cross-country skiing, mountaineering, mountain biking, horseback riding, gliding and gliding, hunting and sport fishing in hilly and mountainous areas. The most effcetive solutions for harmonizing tourism requirements with the requirements of environmental protection and sustainable development are rural tourism and agro-tourism.

Transylvania has a rich and varied tourist potential, only partially capitalized. Rural tourism has witnessed spectacular dynamics in the last 20 years, the number of tourist and agrotourist guesthouses in Transylvania being over 1,000, and that of the offered accommodation places reaching almost 19 thousand. The Transylvanian region owns 37.9% of Romania's agro-tourism pensions and 34.4% of the tourist boarding houses. In Braşov County one of the six holiday villages of Romanian tourism is found. In Brasov county, agrotourism is practiced in Poiana Mare, Fundata, Moeciu, Bran, Sacele-Tarlungeni. In Cluj county agrotourism is practiced in many localities of Huedin Depression, Someşan Plateau and Transylvanian Plain.

The agrotouristic areas of Transylvania are: - Sibiu's border. -Areaş area superior (Albac - Gârda - Arieşeni - Avram Iancu - Vidra). - Rimetea. -Corund- Sovata. - Săcele area – Întorsura Buzăului.

Ecotourism is the form of tourism where the main interest of the tourist is nature, namely the observation and appreciation of all nature-related objectives that meet several conditions: educational character, conservation and nature protection, negative impact on the natural and socio-cultural environment. In the county of Brasov there are guest houses and eco-certified tours present in the Zărneşti area where tourism is in the most advanced stage in Romania, due both to the natural environment (Piatra Craiului National Park) and to the promotion and organization activity; the Vama Buzaului area; Buneşti-Viscri area; Făgăraş area [20].

Business and conference tourism has developed especially in major cities and several resorts that offer great accommodation comfort and have the necessary technical facilities. In Braşov County, this type of tourism is constantly growing, which is favored by the better facilities, namely well-equipped conference rooms. Recreational tourism is taking place in several resorts, namely Predeal, Bran-Moeciu-Fundata, Poiana Brasov, Covasna s.a. Traffic tourism is practiced in both forms of transit and traveling. Weekend tourism is also practicable in mountain and sub-Carpathian areas, with rare occasions when a tourist's stay exceeds the weekend. The treatment / spa tourism is favored by the existence of important mineral resources such as springs and mud with curative properties. Thus, in Transylvania there are a number of resorts where these resources are utilized such as Baile Turda, Someşeni, Băile Tuşnad, Sovata, Covasna, Harghita Băi s.a. This type of tourism attracts a large number of tourists of all ages. In some cases, lower investment in infrastructure has led to a decrease in the number of tourists.

CONCLUSIONS

Transylvania is the geographical region located within the Carpathian Arch being also one of the historical regions of Romania. On the territory of Transylvania itself there are nine counties: Alba, Bistrita-Nasaud, Brasov, Cluj, Covasna, Harghita, Hunedoara, Mures and Sibiu. Besides these, there are also settlements in the counties of Bacau, Caraş-Severin, Maramureş, Neamţ, Sălaj and Valcea.

As far as the traditions of the most important moments of life are concerned, each of them distinguishes itself from the rest of the regions at different times.

As far as the accommodation base is concerned, Transylvania adds approximately 7,000 units with an accommodation capacity of approximately 25,442,084 seats. Although the base of accommodation is quite large, the index of utilization of the capacities in operation is only 23.6%, the region occupying the 4th place in the country. As in the case of the accommodation base, public catering amounts to about 4,000 authorized establishments where tourists can enjoy traditional cuisine specific to the area (Szekler spelled, curtoş kalacs, gulaş, papricaş s.a.). Touristic routes and means of transport are varied, highlighting special transports, namely cable cars, chairlifts, tele-skis.

In terms of facilities for recreation and leisure, Transylvania dispose of a series of resorts (Sovata, Covasna, Băile Tuşnad, Borsec, Balvanyos s.a.) where natural resources (mineral waters, sapropelic sludge) are used for curative and recreational purposes.

In addition to the facilities, there are a number of recreational facilities such as parks, cinemas, botanical gardens, zoos, amusement parks, horseback riding, etc.

As far as turism forms are concerned, mountain tourism, cultural-historical, religious, sports, rural, ecotourism, business tourism and conferences, recreation, treatment and weekend tourism are practiced.

REFERENCES

[1]Analiza ADR Centru "Turism balnear-Domeniu economic cu potential de dezvoltare in regiunea Centru".

[2]Avramescu Elena, Florescu, F. B., 1959, Broderiile la români, State Publishing House for Publishers and Publications, București, pp.12

[3]Brancovici Lucreția, 1932, Artă românească din Banat, https://issuu.com/veafil/docs/lucretia_brancovici_-_arta_romaneasca. Accessed January 20, 2018.

[4]Bănățeanu, T., 1955, Portul din Țara Oașului, The State Publishing House for Literature and Art, București, pp.38

[5]Ghinea, D., 2002, Enciclopedia Geografică a României, Ediţia a III a, Encyclopedia Publishing House, Bucureşti, pp.49

[6]Ielenicz, M., 2000, Geografia României: Mică Enciclopedie, Corinth Publishing House, București, pp.39

[7]Mândruț, O., 2008, Geografia României, Corinth Publishing House, București, pp.51

[8]Planul de dezvoltare al regiunii Centru, 2014-2010, http://www.adrcentru.ro/Lista.aspx?t=ADElaborare%20PDR%202014-2020, Accessed January 10, 2018.

[9]Planul de dezvoltare regionala a judetului Hunedoara, 2014-2020, http://www.cjhunedoara.ro/documente/hotarari/2017/anexa%20hot%20131%20plan%20de%20dezv/SDJ_HD_rev_09.06_N.pdf, Accessed January 10, 2018.

[10]Posea, Gr., Popescu, N., Ielenicz, M., 1969, Zonarea județelor din România după potențialul turistic. Lucrările Colocviului Geografie Turism, București, pp.33

[11]Posea, Gr., Popescu, N., Ielenicz, M., 1974, Relieful Romaniei, Scientific Publishing House, București, pp.44

[12]Ștefănescu, A., 1984, Ghidul muzeelor, Sport-Tourism Publishing House, București, pp.52

[13]Strategia de dezvoltare generala a Judetului Harghita 2015-2020, Consiliul Judetean Harghita, http://hargitamegye.ro/upload/public/HMT/strategia/AnalizaStrategie_20160823.pdf , Accessed January 10, 2018.

[14]Strategia de dezvoltare a Orasului Covasna, 2016-2020, http://www.primariacovasna.ro/fileadmin/documents/ro/altele/strat2016-2020.pdf, Accessed January 10, 2018.

[15]Strategia de dezvoltare a judetului Cluj, 2014-2020, Consiliul Judetean Cluj, https://www.cjcluj.ro/centrul-de-marketing/, Accessed January 10, 2018.

[16]Strategia de dezvoltare a judetului Bistrita-Nasaud, 2014-2020, Consiliul Judetean Bistrita Nasaud, www.portalbn.ro, Accessed January 10, 2018

[17] Strategia de dezvoltare a judetului Sibiu, 2010-2013 si directiile de dezvoltare a judetului pentru perioada 2014-2020, Consiliul judetean Sibiu, http://www.cjsibiu.ro/wp-content/uploads/2015/10/Strategia-de-dezvoltare-a-judetului-Sibiu-pentru-perioada-2012-2020_finala.pdf, Accessed January 10, 2018.

[18] Strategia de dezvoltare a judetului Alba, 2014-2020, Consiliul Judetean Alba, http://www.cjalba.ro/wp-content/uploads/2014/08/Strategiadedezvoltare2014-2020.pdf, Accessed January 10, 2018

[19]Strategia de dezvoltare a judetului Brasov, orizonturi 2013-2020-2030. Consiliul Judetean Brasov, http://site.judbrasov.ro/page_Stategia-de-dezvoltare-durabil-a-jude-ului-Bra-ov_57.html, Accessed January 10, 2018.

[20]Voiculescu, C., Enache L., Teodoreanu, E., Dacos-Swoboda, M., 1984, Bioclima stațiunilor balneoclimaterice din România, Sport- Tourism Publishing House, București, pp.39

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

NATURAL AND ANTROPIC TOURIST POTENTIAL IN TRANSILVANIA

Daniela PLEȘOIANU, Edith GRECU

Ovidius University, 1, University Avenue, Campus, Building B, Constanta, Romania,
Email: plesoianudaniela@hotmail.com

Corresponding author: plesoianudaniela@hotmail.com

Abstract

This paper is an analysis of Transylvania regarding the natural and anthropic potential of the Transylvania region. In this paper we used methods such as cartographic description, analytical method and graphics. These methods helped to translate data into charts, tables and charts using the EXCEL program. The paper is based on documentation, analysis of statistical and territorial data research, integration and complex interpretation of information. The integration of all geographic information allowed, through complex interpretation and their transposition into representative maps, the knowledge and understanding of the natural and anthropic tourism potential in Transylvania. The data used were provided by the following institutions: Counties Councils, County Development Strategy 2007 - 2013, National Institute of Statistics, ADR Central analysis "Balnear tourism-economic domain with potential development in the Center Region". Regarding the natural tourist potential of the area within the region, there are natural and national parks (eg Cheile Bicazului-Hăşmaş National Park), nature reserves (eg Aiud Cheile, Cheile Râmeţului, Cheile Întregalde), winter resorts (eg: Predeal, Păltiniş) and spa resorts. The cultural and historical heritage is also complex and includes ancient vestiges (eg: The remains of the Roman castles Apulum), cities with a complex cultural heritage (eg Brasov, Sibiu), fortified churches and fortresses (eg Prejmer Church, Viscri, Saschiz, Rupea Fortress, Râşnov Fortress), castles and palaces (eg Bran Castle, Brukenthal Palace), monasteries (eg Sâmbăta de Sus).

Key words: *natural potential, anthropogenic potential, cultural value, edifices, gems*

INTRODUCTION

Transylvania has a lot of natural and anthropic attractions, due to the presence of numerous protected areas with a large number of endemic species and the presence of monuments of cultural and historical value (castles, churches, museums, etc.) [9]. Transylvania is the geographical region located within the Carpathian Arch being also one of the historical regions of Romania. On the territory of Transylvania itself there are nine counties: Alba, Bistrita-Nasaud, Brasov, Cluj, Covasna, Harghita, Hunedoara, Mures and Sibiu. Besides these, there are also settlements in the counties of Bacau, Caraş-Severin, Maramureş, Neamţ, Sălaj and Vâlcea.

MATERIALS AND METHODS

To accomplish this work we used various methods such as cartographic description, analytical method and graphics. These methods helped to translate data into graphs, tables, and charts using EXCEL.

To conduct this work was carried out a review of studies specialist who treated topics such as urban tourism, cultural tourism, heritage and tourism potential natural and human, infrastructure general and specific tourism sector, movement and tourism demand. Typology research work was used in qualitative and quantitative, where they were addressed several areas of tourism.

For example, if the qualitative research were applied the following research methods: the method of documenting the consultation literature that could be accessed and official documents and observation method, and the quantitative research used the following research methods: analysis method and data processing, graphic and cartographic method, the method of observation and interpretation.

The data used were provided by the following institutions: Counties Councils, County Development Strategy 2007 - 2013, National Institute of Statistics, Central ADR Center analysis "Balnear tourism-economic domain with potential development in the center

region".
The data were processed and converted into tables, graphs and then interpreted and analyzed. Data used in this study are part of the textbook on the desk.

RESULTS AND DISCUSSIONS

Natural attractions. Mountain resorts.
With a very generous nature and a cultural heritage of great value, the Transylvania Region has a high and diversified tourist potential. Without attempting a clear separation between the forms of tourism practiced in the Transylvanian Region, we consider a differentiated analysis useful. Regional research and studies show that tourism with the highest development potential is mountain tourism, spa tourism, cultural tourism and rural tourism [17].

National parks and natural parks
This includes the following: Bicazului-Hasamş National Park, Roşu Lake, Caliman National Park, Natural Park Mureşului Superior Park, Bucegi Natural Park, Piatra Craiului National Park, Apuseni Natural Park, Scărişoara Glacier.

Natural reservations
Representatives of: Sfânta Ana Lake, Reci Bastard, Daffodil Glade from Dumbrava Vadului, Emperor's Beech (Baia de Arieş), Detunata, Huda lui Papara, Gorges from Trascăului Mountains, Iezer Ighiel, Râpa Roşie, Mud Volcanoes, Reservation of steppe peony from Zau de Câmpie commune [3].

Winter resorts
In this category are included: Poiana Brasov, Predeal, Păltiniş, Bâlea, Arieşeni, Izvorul Mureşului, ski areas: Timişu de Sus, Pârâul Rece, Topliţa, Mădăraş, Bucin, Săcele, Ciumani, Luncile Prigoanei (Şureanu Mountains) [4].

Spa and spa resorts
In Transylvania there is the highest density of spa resorts in Romania. Mineral salt-rich mineral waters, former salt lakes, mofts, mud, peat, highly ozonized air (rich in resinous aerosols and negative ions) are the most important natural curative factors. Since the end of the nineteenth century several spa and spa resorts have been developed, the most important being Sovata, Covasna, Băile Tuşnad, Predeal, Balvanyos, Malnaş, Vâlcele, Praid, Borsec, Homorod, Harghita Băi, Izvoru Mureşului, Lacu Roşu, Ocna Sibiului, Bazna [5].

Cultural and historical heritage.
Cities with a complex cultural heritage
This category includes the following cities: Braşov, Sibiu, Tg. Mureş, Vauban Fortress from Alba Iulia, Sighişoara, Sfântu Gheorghe, Miercurea Ciuc.
Ancient vestiges - The remains of the Roman castles Apulum (Alba Iulia). -The Roman mines from Roşia Montană -Căpâlna. Dacian fortress, a site included in the UNESCO heritage list, along with 5 other Dacian fortresses in the Orăştie-Tilişca Mountains. The ruins of the Dacian fortress -Covasna. The vestiges of the Dacian fortress Valea Zânelor.
Fortified Churches, Fortresses. -The fortified churches in Transylvania, included in the UNESCO heritage. Seated 850 years ago, the Saxon population has made a significant contribution to the economic and social development of Transylvania. Of the approximately 150 fortified churches in Transylvania, UNESCO chose and included in the world heritage seven churches, all located in the Central Region (Biertan, Valea Viilor, Prejmer, Viscri, Saschiz, Câlnic, Dârju) considered by the experts as the most beautiful and more representative[8].
-The fortified churches of Alma, Moşna, Dealu Frumos, Merghindeal, Iacobeni (located in the northern part of Sibiu County) are among the most important fortified churches in Transylvania, built between the 13th and 15th centuries, being listed on the list of the national architectural patrimony .
-Harman, a fortified church in Barsa Country, built between the 13th and 15th centuries, a blend of Romantic and Gothic styles.
Church of Cisnadioara, Cârţa Monastery, Făgăraş Fortress, Mediaş, Rupea Fortress, Feldioara Fortress, Rasnov, Slimnic Fortress [2].

Castles and palaces
Bran Castle, Mureş County, Bethlen Castle and Kemeny Castle, Lăzarea (Harghita County), Boita (Sibiu County), Balta Fortress

(Alba County), Sânmiclăuş (Alba County), Racos (Brasov County),Avrig (Sibiu County).

Monasteries

The category of monasteries includes: Saturday Up, Râmeţ Monastery.

Other cities with cultural objectives of major tourist importance: Sebeş, Aiud, Blaj, Odorheiu Secuiesc, Târgu Secuiesc, Reghin, Dumbrăveni.

The economic importance of tourism is kept at a very low level, both at regional and national level, and in recent years there has even been a downward trend in the share of tourism in the Gross Domestic Product. Thus, the share of tourism in regional gross value added decreased from 3,6% in 2008 to 2,3% in 2015, while at national level the share of tourism in gross value added decreased during the same period from 2, 6% to 1.9% [16].

Capitalizing the tourism potential

The touristic potential of the Transylvania region is capitalized through a series of festivals, fairs, exhibitions taking place annually in different regions of the region throughout the year, holidays in this region being history and spectacle.

In the summer of Alba, the Festival of Dacian Fortresses in the Fortress of Balta, and in winter the Snow Festivities, held in February.

The only rural tourism fair in the country is hosted by the Albac commune, the Land of Moti, in September and offers tourists competitions for fishing, gastronomy, craft fairs.

In the summer of Alba, the Festival of Dacian Fortresses in Cetatea de Balta, and in winter the Snow Festivities, held in February.

The only rural tourism fair in the country is hosted by the Albac commune, Țara Moților, in September and offers tourists competitions for fishing, gastronomy, craft fairs.

In spring, the International Theater Festival, the largest festival of its kind in South-Eastern Europe, takes place in Sibiu. In addition, the National Festival of Folk Traditions in Dumbrava Sibiului aims at capitalizing on the national treasure of Romania.

The Easter Fair in Sibiu attracts merchants from all over Romania, offering unique gifts to visitors, such as handicrafts, sweets and flowers. In Covasna County, tourists can take part in unique traditional events. At the end of February, in Sfântu-Gheorghe, there is the international gourmet festival "Pomana Porcului", where you can enjoy the most delicious dishes.

In June, Bully Festival in Turia attracts thousands of gourmets every year, where bulz is prepared according to a local recipe. Participants at the Harghita Coal Festival can enjoy bean with bramble, calf at the prow and the desert kurac kalacs. Dozens of tourists from England, Norway, Ireland, Austria and Hungary have fun in September, when the Aldamas Village Cow and Feast Festival takes place. Another famous gastronomic festival is the Praid Festival of Sarmalele. In Brasov, the Jubilee Celebration takes place every year on Sunday after Easter. The Brasov Days and the Popular Craftsmen's Fair in Romania, organized in spring, are special attractions for the locals as well as for the tourists. The "cock shot" on the first Easter day is a traditional habit of the Hungarians, whereby a domestic bird is sacrificed on the basis of a legend. Another tradition is Sântilia, an ancient feast of shepherds shepherds. The event takes place in Poiana Anghelescu on July 20th [2].

In Cluj, unlike fairs and exhibitions, cultural festivals and events of various types represent artistic manifestations from various fields that address the segment of cultural tourism practitioners (film-cinema, classical music, theater, folklore, modern music - starting from jazz, electronic music, pop and rock, poetry, epigrams, humor, guitar, etc.) and may have a national or international character.

From the category of festivals stand UNTOLD which is the most famous music festival in Romania. It was named Best Major Festival at the European Festival Awards 2015. Although it is only at its third edition, Untold managed to raise 240,000 people in the first year, and in about 2016 about 300,000 [14].

Tourist flow The total number of tourists accommodated in 2016 is 3,322,548, which places Transylvania first in the country. Compared to 2000, 3 times more tourists arrived in 2016 (Table 1). According to the table (Table 1), all Transylvanian localities register an increase in the number of tourists annually [6].

Table 1. Arrivals in the period 2000-2016

Year	Number of incoming tourists
2000	1,149,884
2001	1,142,949
2002	1,083,557
2003	1,226,682
2004	1,399,867
2005	1,504,556
2006	1,641,565
2007	1,883,623
2008	1,854,864
2009	1,473,967
2010	1,494,191
2011	1,862,651
2012	2,106,814
2013	2,359,123
2014	2,489,308
2015	2,992,527
2016	3,322,548

Source: National Institute of Statistics,2017

According to Figure 1, the number of tourists increased year on year, except for 2009 and 2010 when there was a slight decrease in number. This is due to the growing interest of local authorities who have endeavored to promote the region, both by capitalizing on natural heritage and by creating festivals, fairs, competitions that attract thousands of tourists annually [15].

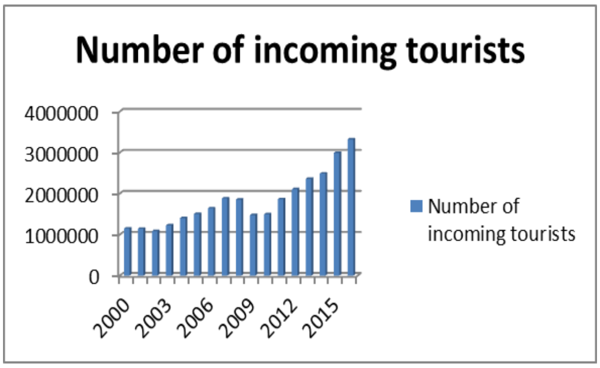


Fig.1. Number of incoming tourists
Source: Own determination.

Regarding the nationality of the tourists, the number of Romanian tourists is steadily increasing (Table 1 and Fig. 1). However, there are several numerical alternations between 2000-2010 and a considerable increase in the period 2010-2016, theory valid for all counties of Transylvania [10].

Table 2. Romanian tourists arrivals in the period 2000-2016

Year	Romanian tourists arrivals
2000	941,935
2001	906,628
2002	820,875
2003	924,038
2004	1,020,795
2005	1,134,495
2006	1,296,593
2007	1,484,291
2008	1,493,739
2009	1,194,352
2010	1,191,469
2011	1,507,850
2012	1,727,467
2013	1,950,649
2014	2,031,982
2015	2,448,062
2016	2,700,853

Source: National Institute of Statistics, 2017

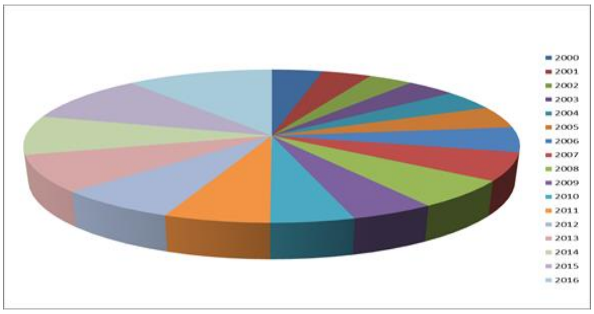


Fig.2. Arrivals of Romanian tourists in the period 2000-2016
Source: Own determination.

Regarding the flow of foreign tourists, there is an alternation in numbers, being at the same time increasing in all regions of Transylvania. Overall, in 2016 there were 608,603 foreign tourists, 50% more than in 2006 (Table 3 and Fig. 3) [7].

Table 3. Foreign tourists arrivals 2006-2016

Year	Foreign tourists arrivals
2006	329,305
2007	383,941
2008	349,184
2009	270,443
2010	293,347
2011	345,706
2012	370,344
2013	399,370
2014	447,656
2015	533,691
2016	608,603

Source: National Institute of Statistics,2017

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

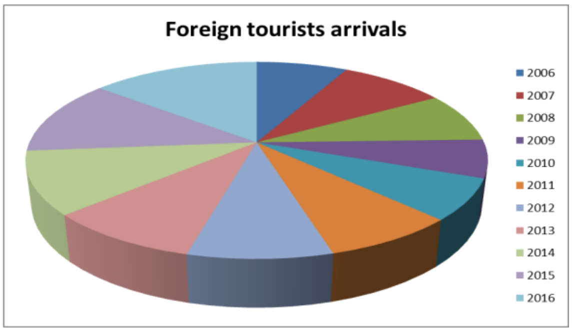


Fig. 3. Arrivals of foreign tourists in the period 2006-2016
Source: Own determination.

Compared to the two categories of tourists, Romanians are considerably above the numerical level, in 2016 being 4 times more Romanian tourists than foreign tourists (Fig. 4) [11].

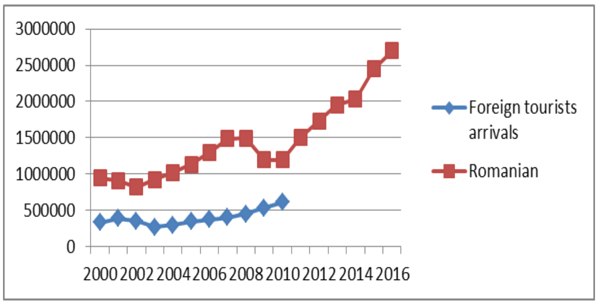


Fig. 4. Arrivals of Romanian and foreign tourists from 2000 to 2016
Source: Own determination.

Overall, at the level of the region, the number of overnight stays also shows an increase over the 15 years studied, with the exception of 2009 and 2010 when the number of arrivals was lower compared to the rest of the analyzed period (Fig.5 and Table 4) [1].

Table 4. Overnight stays in the period 2001-2016

Year	Overnight stays
2001	3,474,414
2002	3,174,152
2003	3,449,053
2004	3,613,916
2005	3,828,655
2006	4,024,893
2007	4,446,282
2008	4,405,702
2009	3,579,594
2010	3,507,824
2011	4,184,375
2012	4,584,499
2013	4,998,502
2014	5,305,651
2015	6,437,992
2016	6,857,453

Source: National Institute of Statistics, 2017

In 2009 and 2010 the number of overnight stays decreases by approximately 1 million if compared to 2008 when there were 4,405,702 [13].

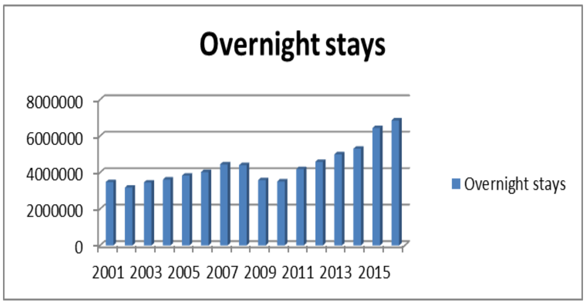


Fig.5. Overnight stays in the period 2001-2016
Source: Own determination.

In conclusion, the increase of the conditions regarding the accommodation base, the increasing capitalization of the natural and cultural-historical heritage has led and continues to increase the flow of tourists, attracting also tourists from other countries [12].

CONCLUSIONS

Transylvania is the geographical region located within the Carpathian Arch being also one of the historical regions of Romania.
Regarding the natural tourist potential of the area within the region, there are natural and national parks (eg Cheile Bicazului-Hăşmaş National Park), nature reserves (eg Aiud Cheile, Cheile Râmeţului, Cheile Întregalde), winter resorts (eg: Predeal, Păltiniş) and spa resorts. The cultural and historical heritage is also complex and includes ancient vestiges (eg: The vestiges of the Roman castles Apulum), cities with a complex cultural heritage (eg Brasov, Sibiu), fortified churches and fortresses (eg Prejmer Church, Viscri, Saschiz, Rupea Fortress, Râşnov Fortress), castles and palaces (eg Bran Castle, Brukenthal Palace), monasteries (eg Sâmbăta de Sus). The tourist potential is redeemed through a series of festivals that take place annually, festivals that can bring together up to 300,000 people (eg Untold). As far as the tourist flow is concerned, it is constantly increasing from one year to the next, as it is at regional and local level.

REFERENCES

[1]Analiza ADR Centru “Turismul balnear-domeniu economic cu potențial de dezvoltare în Regiunea Centru”
[2]Cucu,V., Ştefan, M., 1974, România. Ghid- atlas al monumentelor istorice, Scientific Publishing House, Bucureşti, pp.27
[3]Ghinea,D.,2002, Enciclopedia Geografică a Românie,Ediţia a III a, Encyclopedia Publishing House,Bucureşti
[4]Ielenicz, M., 2000, Geografia României: Mică Enciclopedie, Corinth Publishing House, București, pp.17
[5]Mândruț,O., 2008, Geografia României, Corinth Publishing House, București, pp.29-30
[6] Planul de dezvoltare a Regiunii Centru 2014-2020, http://www.adrcentru.ro/Lista.aspx?t=ADElaborare%20PDR%202014-2020, Accessed January 10, 2018.
[7]Planul de dezvoltare regională a județului Hunedoara 2014-2020, http://www.cjhunedoara.ro/documente/hotarari/2017/anexa%20hot%20131%20plan%20de%20dezv/SDJ_HD_rev_09.06_N.pdf, Accessed January 10, 2018.
[8]Posea,Gr., Popescu,N., Ielenicz,M., 1969, Zonarea județelor din România după potențialul turistic, Lucrările Colocviului Geografie Turism, București.
[9]Ștefănescu, A., 1984, Ghidul muzeelor, Sport-Tourism Publishing House, București, pp.24
[10]Strategia de dezvoltare generală a județului Harghita 2015-2020, Consiliul Judetean Harghita, http://hargitamegye.ro/upload/public/HMT/strategia/AnalizaStrategie_20160823.pdf, Accessed January 10, 2018.
[11]Strategia de dezvoltare a județului Covasna 2016-2020, http://www.primariacovasna.ro/fileadmin/documents/ro/altele/strat2016-2020.pdf, Accessed January 10, 2018.
[12]Strategia de dezvoltare a județului Cluj 2014-2020, Consiliul Judetean Cluj, https://www.cjcluj.ro/centrul-de-marketing/, Accessed January 10, 2018.
[13]Strategia de dezvoltare a județului Bistrița-Năsăud 2014-2020, Consiliul Judetean Bistrita Nasaud, www.portalbn.ro, Accessed January 10, 2018.
[14]Strategia de dezvoltare a județului Sibiu 2010-2013 și direcțiilede dezvoltare ale județului pentru perioada 2014-2020, Consiliul judetean Sibiu, http://www.cjsibiu.ro/wp-content/uploads/2015/10/Strategia-de-dezvoltare-a-judetului-Sibiu-pentru-perioada-2012-2020_finala.pdf, Accessed January 10, 2018.
[15]Strategia de dezvoltare a județului Alba 2014-2020, Consiliul Judetean Alba, http://www.cjalba.ro/wp-content/uploads/2014/08/Strategiadedezvoltare2014-2020.pdf, Accessed January 10, 2018.
[16]Strategia de dezvoltare a județului Brașov, orizonturi 2013-2020-2030, Consiliul Judetean Brasov, http://site.judbrasov.ro/page_Stategia-de-dezvoltare-durabil-a-jude-ului-Bra-ov_57.html, Accessed January 10, 2018.
[17]Voiculescu,C., Enache,L., Teodoreanu,E., Dacos-Swoboda,M., 1984, Bioclima stațiunilor balneoclimaterice din România, Sport- Tourism Publishing House, București, pp.64

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

QUALITY OF SERVICES IN HOTEL INDUSTRY - THE VOILA CARAIMAN COMPLEX, MAMAIA RESORT, ROMANIA

Daniela-Mirela PLEȘOIANU, Andreea URZICEANU

Ovidius University, 1, University Avenue, Campus, Building B, Constanta, Romania,
Email: plesoianudaniela@hotmail.com

Corresponding author: plesoianudaniela@hotmail.com

Abstract

The present study is a study on the organization of tourist services in the hotel industry. The study refers to the Voila-Caraiman Complex in the resort of Mamaia, addressing the economic and tourist situation as well as the services offered to the tourists within this complex. The data used were provided by the following institutions: Constanța County Council, the Constanța County Development Strategy 2007 - 2013, National Institute of Statistics, Constanța. The data were processed and converted into tables, graphs and then interpreted and analyzed.Data used in this study are part of the textbook on the desk. The Voila-Caraiman Complex has a favorable location, especially for young people, located in the northern part of Mamaia resort, the entire complex having 316 accommodation rooms. The Voila-Caraiman Complex, from year to year, has met with more and more Romanian and foreign tourists. This resort offers accommodation offers, offering the possibility to accommodate all types of tourists.

Key words: *hotel, tourists, favorable, conditions, facilities*

INTRODUCTION

The Voila-Caraiman Complex is located in the northernmost part of Mamaia resort in Constanta County, about 13 kilometers from the railway station and Constanta city center and 200 meters from the Black Sea's sandy beach.

The Aqua Magic Park Aqua Park is 3 km away, the Dolphinarium is 7.5 km away and the Ovidiu Island Pier for departures is 3.8 km away [1].

The unit is composed of three building bodies, being very close. They are classified into a 3-star system.

Being located in Mamaia Resort and benefiting from a favorable natural environment with moderate continental temperate climate with maritime influences, the Voila-Caraiman Complex presents all the auspices favorable to the development of a prolific tourist activity [2].

The purpose of the paper was to analyze the hotel services quality in Romania's tourism industry in a case study in Mamaia, the most beautiful seashore at the Black Sea.

MATERIALS AND METHODS

Consultation of the specialized bibliography was the starting point for research conducted with simpler or more elaborate scientific papers, statistical information and data, some data requiring careful filtering.

Tourism is analyzed and tracked through a system of specific indicators based on a methodology of calculation recognized and used worldwide (tourist capacity, tourist demand).

Thus, in order to obtain data on accommodation and tourist movements, we consulted the data sources provided by the Ministry of Tourism, the County Statistics Department of Constanţa, the National Statistical Institute and the consultation of non-official sources of data.

The data used were provided by the following institutions: Constanta County Council, Constanta County Development Strategy 2007 - 2013, National Institute of Statistics, Constanta.

The data were processed and converted into tables, graphs and then interpreted and analyzed. The data used in this study is part of the textbook on the desk.

RESULTS AND DISCUSSIONS

Tourism development influences the hotel industry. This is evolving due to a complex of socio-economic factors and phenomena where tourism has an important place. The services offered by the hotel units are diversified to address all categories of tourists [4].

Several factors that influence tourism demand include accommodation, transport, food and leisure. These services are determined by the fact that the place of accommodation fulfills the role of temporary residence for tourists and must provide complex services [5].

In order to meet the demands of the tourists and to satisfy their maximum degree of comfort, there are created several services present in the tourist resorts: initial accommodation, nutrition, agreement activities, information services regarding: the means of transport, the program of the restaurants in the area , the location of shops, ATMs and foreign exchange units in the surroundings.

Accommodation is the main service offered by hotel units, this means the existence of a space that ensures all conditions of rest and hygiene.

The rest of the tourists in the accommodation places is their location in relation to the distance to the high-traffic areas, such as: stairs, lifts, spaces with intense movement of the staff. Hygiene conditions depend on the quality of the sanitary equipment and its maintenance, but also on personal hygiene items. In addition to the two services provided, it is necessary to have spaces for social relations, so there is a need for a special space for the reception of tourists, as well as for business meetings (conference rooms).

Other complex services for completing the accommodation function could be: foreign exchange service, keeping of valuables, clothes cleaning, luggage handling, car parking.

The public catering service is not compulsory in all accommodation units. Where it is present, it must satisfy all the tastes of tourists. The organization of the space for the provision of this service must take into account the location and functionality in order not to affect the qualities of the other services offered [5].

Another service that can be offered by the accommodation but is not compulsory is the pleasure, it ensures during the stay the amusement of the guests, organizing entertainment evenings such as: dance nights, carnivals, competitions, etc. Provides space for satisfying passions (billiards, table tennis, pool and more) [9].

The Voila-Caraiman Complex is made up of three bodies, Voila Hotel, Caraiman Hotel and Luminiţa Villa. In 1995, there were Caraiman I and II, a nautical base and a disco.

The Voila-Caraiman Mamaia Complex is part of the New-Hotels group, which owns the hotels: Chalet Three Hera, Hera, Comfort Suites and Belvedere in Predeal, also the Florida Hotel in Mamaia.

Hotel Caraiman I, now the Voila Hotel, was built in 1970 and Caraiman II, currently the Caraiman Hotel, in 1975, both on an area of 13,452 m². Concrete and brick were used to build it.

Hotel Caraiman is built on a smaller area than the Voila. It is built on 4 levels (ground floor+ 3).

Hotel Voila is built on the largest area here. It is divided into several bodies (A, B, C, D), but it has only two or three floors, depending on the bodies. Corpses A and C have 3 floors (P + 2), and B and D have 2 floors (P + 1).

Villa Luminiţa is built on the smallest area of 13,452 m². It has 2 floors (P + 1) [8].

The accommodation capacity of the complex varies from one body to another. The complex was provided with spacious rooms and hallways, but being buildings of different sizes, and the number of rooms is different.

Hotel Caraiman has 99 rooms, Voila hotel of 200 rooms, and Luminiţa villa of 16 rooms.

Hotel Voila has 78 rooms with 2 separate beds, 104 rooms with matrimonial beds and 18 connecting rooms, all of which have their own bathroom.

Hotel Caraiman has 50 rooms with separate beds, 45 rooms with matrimonial beds and 4 suites, all of which have their own bathroom.

Villa Luminiţa has 16 double rooms with matrimonial bed, all of which have their own bathroom.

The complex has a total of 315 rooms [10].

Restaurant and car service

The restaurant at Voila Caraiman Mamaia is a place that combines three important groups of food in the same space. The preparations are made from fresh beef, but also matured from 14 days to 40 days, prepared from fish and fruits, but also sushi. The menu presents Romanian, Lebanese, Chinese and Italian specifics [3].

Compared to the restaurant, the self-service of the complex offers only Romanian dishes, according to the same recipes of the restaurant.

Organization of departments

The Voila-Caraiman Mamaia complex is made up of 6 departments: managerial, economic, accommodation, sales, food and technical.

The management department is headed by the general manager.

The economic department consists of 5 employees: a chief accountant, an accountant, a cashier, and two people dealing with the supply of the complex.

The accommodation department is made up of two compartments: front office and housekeeping. In these compartments are hired: a receptionist, eight receptionists, two governors, a launcher and 20 maids.

The sales department consists of 2 booking managers.

The food department is composed of: a head of the hall, two chefs, eight cook chefs, three bartenders, eight waiters, two self-service cashiers, 6 staff assigned to the line, 8 picots and 4 people hired for cleaning.

There are 2 plumbers, 2 electricians and one engineer in the technical department.

Categories of tourists

Categories of tourists accommodated in the complex

The Voila-Caraiman Complex, from year to year, has met with more and more Romanian and foreign tourists.

Table 1 represents the percentage of Romanian tourists but also of those coming from other countries during 2013-2015 within the complex [6].

Table 1. Percentage of Romanian and foreign tourists accommodated in the Voila-Caraiman complex between 2013-2015

Name of hotel space	Romanians 2013	Foreigners 2013	Romanians 2014	Foreigners 2014	Romanians 2015	Foreigners 2015
Voila Hotel	85 %	15%	88%	12%	81%	19%
Caraiman Hotel	92%	8%	95%	5%	88%	12%
Luminiţa Villa	97%	3%	99%	1%	95%	5%

Source: National Institute of Statistics, Constanța, 2015 [7].

According to Table 1, between 2013 and 2015, the percentage of foreign tourists increased from year to year in each hotel space in this complex and due to the location of the complex near the nightclubs, but also near the venues where festivals are organized of music.

According to Figure 1 , it is noticed that the percentage of Romanian tourists is higher in 2014, and the percentage of foreign tourists arriving in the complex is more pronounced in 2015 [6].

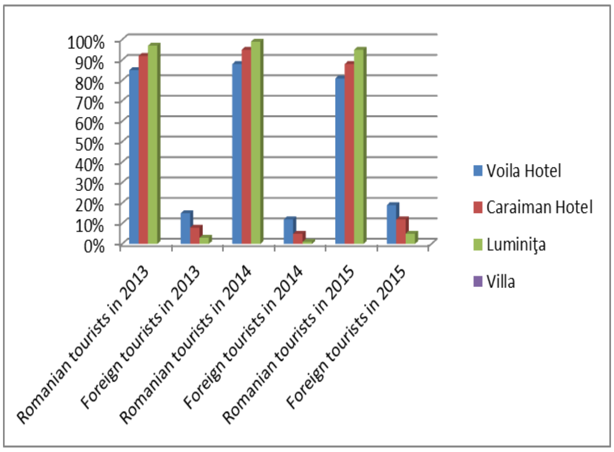


Fig.1. Average number of Romanian tourists arriving in the Voila-Caraiman complex between 2013-2015
Source: Own determination.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

In Table 2, after a detailed study of the information taken from the fact sheets of the complex, complemented by tourists accommodated between 1 June 2016 and 30 August 2016, we analyzed an average of tourists coming from all regions of the country, but also from outside the country.

Table 2.The structure Romanian tourists by the region of origin, arrived in 2016

Regions in Romania	Percentages
București	27%
Muntenia	28%
Dobrogea	1%
Moldova	18%
Maramureș	2%
Transilvania	14%
Banat	3%
Oltenia	7%

Source: National Institute of Statistics, Constanța, 2015 [7].

According to Table 2, the percentage of Romanian tourists arriving at the Voila-Caraiman Complex varies according to the area they come from. The regions in Romania where most of them come from have the higher average wages [6].

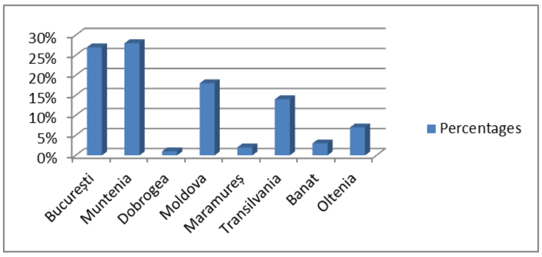


Fig.2. The structure of tourists arriving from Romania in 2016
Source: Own determination.

As can be seen in Figure 2, the percentage of tourists coming from Bucharest and Muntenia was the highest accounting for 55% in 2016.

Table 3. The share of foreign tourists by continent of origin in 2016

Continents	Percentages
Europa	88%
America de Nord	5%
America de Sud	2%
Asia	3%
Africa	2%

Source: National Institute of Statistics, Constanța, 2015

According to Table 3, the highest percentage is that of tourists coming from Europe, 88%, because those in Europe have easier access to Romania.

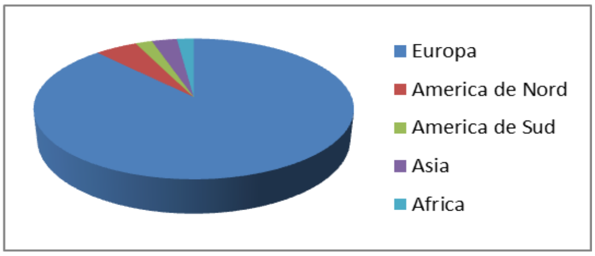


Fig.3. Structure of tourists by continent of origin, accommodated in 2016
Source: Own determination.

The resort has been welcoming tourists since early May, when the three bodies are fully occupied. At this time, most tourists are young people and couples who come to this part of Mamaia resort for nightclubs and music festivals.

In the following period, 3 May-24 June, and 30 August-20 September, is the off-season, also called "The Seaside for All", a program aimed at families with a low budget. During this time, the tourists passing the threshold of the complex are the families, but also the older ones. These days, the complex is not as populated as in the mini-holiday of May 1 and full season, with the possibility that one of the hotels is closed.

Beginning with the busiest season from June 15th to August 31st, the resort becomes the relaxation spot for many tourists, with even the possibility to have more requests for accommodation than the seats in the rooms offered by the 3 bodies. This period is chosen not only by young people who come for fun, but also for families, the elderly and those attending the professional courses organized here by different training agencies.

Next we will analyze the average of nights spent by tourists in the complex during 3 seasons, 2013-2015 [7].

Table 4. Average overnight stays of tourists in the Voila-Caraiman complex during 2013-2015

Year	Voila Hotel	Caraiman Hotel	Luminița Villa
2013	5	5	5
2014	4	4	4
2015	4	5	4

Source: National Institute of Statistics, Constanța, 2015 [7].

As can be seen in Figure 4, the difference between the nights of accommodation in each body is approximately equal.

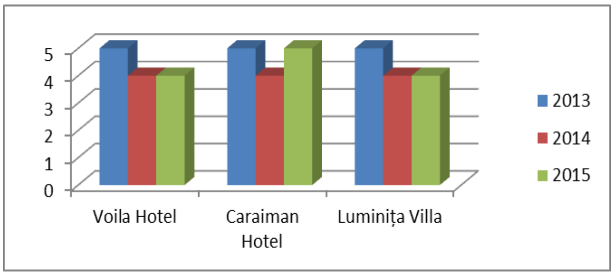


Fig.4. Average overnight stays of tourists in the Voila-Caraiman complex during 2013-2015
Source: Own determination.

Accommodation offers. Advantages.
Accommodation rates start at 70 RON / night with breakfast included (in extra season) up to 450 RON / night without breakfast (during the full season) or approximately 600 RON / night with full board included. All the above mentioned prices include swimming pool, terrace, garden, barbecue and children's playground.
The best price offers are found by those who reserve a room in the complex several months before the time they want to spend time here.
The complex offers are also available on its website (www.voilamamaia.ro), enabling potential tourists to consult the available offers.
Offer typology differentiates: Summer Love offer for couples; "Pentecost at Mamaia", "The seaside for all", with price variations according to the number of meals.
For each of the above offers, there is free access to the pool, sun loungers by the pool, playground and parking (within the limits of available seats).
The profit of the complex is based on all the services offered, against cost. Depending on the offers made available to tourists, as well as the flow of tourists, profit may increase from year to year or from month to month if the services offered are of good quality. In the period under review, 2013-2015, the profit was also high due to the modernization investments of the complex in 2014, thus 2015 having a high profit [6] .
The SWOT analysis.
Strengths:
- Location of the complex near the clubs in the northern resort of Mamaia;
-Provides many facilities, including: children's playground, swimming pool, parking;
- The existence of a restaurant and self-service in the establishment;
- Has many conference rooms;
- Snack bar on the shore of Lake Siutghiol;
- Managed by highly trained people;
- Wireless access to the entire complex.

Weaknesses:
- The complex does not have employees on bellboys;
- One of the two receptions does not have a safe;
- Does not have a fitness room and a sauna;

Opportunities:
- High potential of the tourist market;
- Various events can be organized;
- Improving customer service;
- Increase in number of tourists

Threats:
-The risk of competition in the field, especially of the Black Sea, Commandor and Savoy hotels.

CONCLUSIONS

The Voila-Caraiman Complex has a favorable location, especially for young people, located in the north of Mamaia resort.
The entire complex has 316 accommodation rooms.
The restaurant is a place on the Romanian seashore that combines preparations from several corners of the world.
Voila-Caraiman Mamaia Complex is made up of 6 departments: managerial, economic, accommodation, sales, food and technical.
The complex fulfills 95% of the requirements imposed by the Ministry of Tourism for holding 3 stars.
From year to year, the complex has encountered more and more Romanian and foreign tourists.
This resort offers accommodation offers, offering accommodation for all types of tourists.

REFERENCES

[1]Andronic, Ghe., Neațu, M, Rădulescu, A., Lascu, S., 1988, Litoralul românesc al Mării Negre, Sport Turism Publishing House, București, pp.15
[2] Cioroiu, C., Moise, M., 2001, Litoralul Românesc la 1900, Europolis Publishing House, Constanța, pp.23
[3]Constanta in imagini vechi, http://constanta-imagini-vechi.blogspot.ro/2012/08/mamaia-la-90-partea-iii-a.html, Accessed January 18, 2018.
[4]Geografia României II, Geografia Umana si Economica, 1984, Academy of the Socialist Republic of Romania Publishing House, Bucureşti, pp.28-29
[5] Glăvan, V., 2000, Turismul în România, Economic Publishing House, Bucureşti, pp.39
[6] INSSE, 2010-2016, Consiliul Judeţean Constanța
[7] National Institute of Statistics, Constanța, 2015.
[8]Organizarea hotelurilor, Management hotelier, http://www.stiucum.com/management/management-hotelier/Organizarea-hotelului75178.php, Accessed January 18, 2018.
[9]Stănciulescu, D.A., 2002, Tehnologia hotelieră,Gemma Print, București, pp.42-44
[10]Strategia de dezvoltare a judeţului Constanța 2004-2020, Consiliul Judeţean Constanța.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

VALORISATION OF THE TOURISM AND TRADITIONS POTENTIAL OF BUCOVINA, ROMANIA

Daniela-Mirela PLEȘOIANU[1], Diana CĂRĂUȘ[1], Agatha POPESCU[2]

[1]Ovidius University, 1, University Avenue, Campus, Building B, Constanta, Romania, Email: plesoianudaniela@hotmail.com
[2]University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest Romania, Phone: +40213182564, Fax: +40213182888, Email: agatha_popescu@yahoo.com

Corresponding author: plesoianudaniela@hotmail.com

Abstract

This paper highlights the traditions and customs of the Bucovinians from Romania, especially from Suceava County, but also the ways in which they use them.These data were provided by the following institutions: Countys Councils, Countys Development Strategys 2007 - 2013, National Institute of Statistics. The data were processed and converted into tables, graphs and then interpreted and analyzed.Data used in this study are part of the textbook on the desk. Bucovina is a spring of traditions and customs well preserved by its inhabitants who send them with love to future generations. The accommodation capacity registered fluctuations, after the 1990s followed a fall, which was later recovered in 2005, followed by a huge increase until 2015, having a double accommodation capacity compared to the year 2000. The index of accommodation capacity utilization during the period 2010-2015 did not suffer drastic changes. An improvement was noted in July-January in 2015, the most significant increase being in the summer months of July and August.

Key words: *traditions, customs, ancient, spring, future, Bucovine, Romania*

INTRODUCTION

Bukovina, known in German under the name Buchenland", i.e. "country of beans", and which became the Duchy of Bukovina during the period of the Austrian Empire, represents the historical region comprising an area of 10,440 km^2, covering the area adjacent to the overlapping cities on the territory of Romania: Rădăuţi, Suceava, Gura Humorului, Câmpullung Moldovenesc, Vatra Dornei, Siret and Vicovu de Sus; as well as on the territory of Ukraine Chernivtsi, Cozmeni, Zastavna, Viscauti on Ceremus, Vijniţa, Sadagura and Storojineţ [3].
It moves in the Northeastern part of Romania, with a North-Eastern part of Ukraine, having coordinates of 48 ° N 26 ° E [8].
The name officially entered into use with the annexation of the territory by the Habsburg Empire in 1774. The name is one of influence beech glory ("buk"), thus translating "Bucovina" - "The land of beans" of the beech forest, appears for the first time in a document issued by the Moldavian emperor, Roman I Muşat, on March 30, 1392, by which he gives to Ionaş Viteazul three villages on the Siret water "up to the great Bucovina, on where the road from Dobrinauți ... ".
The purpose of the paper was the analysis of the touristic potential of Bucovina and its valorification by its inhabitants.

MATERIALS AND METHODS

The specialized bibliography was used to collect information, as a starting point of this research work. In order to set up this article, the research was carried out using also the statistical information and data, some data requiring careful filtering.
Tourism is analyzed and tracked through a system of specific indicators, based on a methodology of calculation recognized and used worldwide (accommodation capacity, tourist traffic, tourist demand).
Thus, in order to obtain data on accommodation and tourist movements, we consulted the data sources provided by the Ministry of Tourism, the County Statistics

Department of Suceava, the National Statistics Institute and the consultation of unofficial data sources (specialized sites).
The data used were provided by the following institutions: Suceava County Council, the Suceava County Development Strategy 2007 - 2013, National Institute of Statistics Suceava.
The data were processed and the results were tabled and graphically illustrated and analyzed.

RESULTS AND DISCUSSIONS

Aspects related to the natural environment are favorable both for living and for developing tourist activities.
Tourism is an important element in the development of the Bucovina area. Due to its favorable conditions, the beauty of the places, the purity of the air, the waters, the mountain areas in the Bucovina area, as well as the picturesque region, the well-known hospitality, the folk traditions, the customs, the Moldovan gastronomy, give local color to attract tourists. Along with these special attractions, agritourism has an offer of accommodation and special food, ranging from cottages and rustic guesthouses to the three star standards. Agrotourism can be practiced throughout the year and complemented by fishing and hunting, mountain hiking [4].

Important events of the area - festivals and celebrations

Due to the passion that the Bucovines have for ancient traditions and customs, there are a series of events taking place annually in the area. For the most important inhabitants are the religious holidays (Christmas, Easter but also the days of important saints), these being the first ones to be celebrated, the second place is the ethno-folklore festivals, especially related to the agrarian rituals, besides which there are numerous cultural events and fairs.
In February, in Păltinoasa, "The Stagers' Time" takes place, this event celebrating the folk music festival [6]. According to the Romanian explanatory dictionary, it means: a small gathering in the villages during the winter evenings, where the participants work and spend the same time, telling stories, jokes, riddles.
In March, in Fundu Moldovei, the Festival of Musical Music "Bunavestire" takes place at Vatra Moldoviţei - "Flowers of Bucovina", at Cornu Luncii - "Hora Gospodarilor", this being a local celebration of folk music and dance.
The month of May had numerous festivals in Rădăuți – “Rock Music Festival” at Marginea – “The Black Ceramics Fair", at Dărmănești – The Minorities Festival “Cohabitations" which celebrates the ethnic minorities from Bucovina; at Gura Humorului, it runs the " National Festival of Caricatures, Epigrams and Hunour".
In June, the "Wedding Traditions Festival" takes place in Straja; at Sadova - "Strunga Oilor" at Hornodnic - "Silvestru Lungoci" Folk Instrument Festival; Traditional Dance Festival; in Balca - "The Elders' Festival" the locals who passed their first youth sing traditional songs and dance.
In July, in Suceava, the classical music competition "Ciprian Porumbescu" takes place, in Rădăuţi - The Olarilor "Ochi de Păun", in Fălticeni - "Evening seated", demonstrations of folk dance and folklore, Campulung Moldovenesc - "Bukovinen Meetings".
In August, in the city of Suceava, the Olari Craftsmen Fair is being held; Old costume festival (costumes and traditions); "Hora Prislop" National Dance Festival in Rădăuţi - "Arcanul" International Folklore Festival, Fundu Moldovei - Arcanum Feast, folk festival, Balca - Feast of St. Mary.
In September, at Vama - Hora la Vama, traditional dance festival in Suceava - ethnographic and folkloric festival "Simeon Florea Marian", in Straja - Romanian Soul Treasures, folk and folk music festival in Volovăţ - The Souls Treasures at Vololaţ, Gura Humorului - "Autumn at Voroneţ" Film and Diaporama Festival are presented short films and documentaries of young directors [7].
In October, at Suceava - Poetry Competition "Nicolae Labiş", candidates compete for the title of the best recipe, or the best creation, and the "Voroneţana" Plastic Art Competition.
In November, the Fair of Children Craftsmen

takes place in Suceava with the sale of objects created by craftsmen, at Moldoviţa - the Dance and Music Festival "Song of the Obcinii".

In December, the "Bucovina 2003" National Photography Art Salon is being held in Suceava. The annual competition for the best exhibition, but also the best photographer, at Marginea - Dates and Customs, at Partestii de Jos - Dates and Customs, at Zvorîştea - Dates and Customs, Dorna Arini - Dates and Customs.

All these events and tourist attractions are highly appreciated by tourists, as the number of tourists arriving in this region, as provided by the National Institute of Statistics.

The number of tourists visiting Bucovina

Table 1. Number of Romanian tourists visiting Bucovina

Months	2010	2015
January	13,349	17,959
February	11,996	18,375
March	10415	15,765
April	13,770	20,887
May	16,503	26,756
June	17351	28,422
July	18,860	37,559
August	25,005	43,873
September	19,687	31,143
October	16,302	24,211
November	13,304	19,815
December	16,804	24,327
Total	193,346	309,092

Source: National Institute of Statistics, Constanța, 2015, [2]

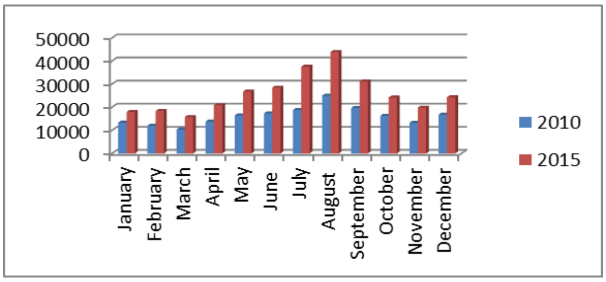


Fig.1. Number of tourists arrived in Bucovina
Source: Own determination.

The increase in the number of tourists visiting Bucovina is significant. From 2010 to 2015, the number of tourists increased by over 50%. The months with the largest number of tourists are the summer ones both in 2010 and in 2015, but in July and August of 2015, the number of tourists almost doubled compared to 2010. One of the factors that led to this increase , is the desire to escape from urban to rural areas.

Traditional cultural patrimony

Nothing can better define the spirit of Bucovina than its ancient customs and traditions.

This is the place that abounds in legends, myths and traditions kept for centuries. From religious holidays to important agricultural calendar days, Bucovines celebrate them with great joy through seating, festivals and celebrations.

For centuries, they have proudly kept their tradition, the Bucovins transfigure through moments and games the special moments but also the daily activities.

They are said to have a finesse to iron out the stupidity and the ugly.

The main events of life, birth, baptism, wedding, burial are captured and preserved by the inhabitants of the area.

Creating a popular costume is a true art, stitching, embroidery can be considered a source of inspiration for all generations to come. These creations of great value have been noticed over the centuries, due to the skill and skill that women have created.

Traditional Romanian embroideries are differentiated according to the region they come from. Popular costumes are different from each other in shape, the way they are ornamented, and the colors that are used.

The traditional Romanian costume is recognized throughout the world, having a surprising evolution, being re-interpreted today by many famous fashion houses.

The main holidays, Christmas and Easter are traditionally celebrated, keeping the customs of the ancestors, which attracts many tourists.

Tourism infrastructure assessment in Bucovina zone

Tourism accommodation infrastructure

According to the most famous site that tourists visit in search of accommodation www.booking.com, in May 2017 in May, there are 262 accommodation units in Bucovina, of which 1 hotel category 1 star, 14 category 2 stars, 73 category 3 stars, 55 category 4 stars and 3 category 5 stars; but also 32 holiday homes [10].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Table 2. The number of accommodation units by category in Bucovina area in 2015

Unit type	Number
Guest house	156
Hotels	41
Holiday House	16
Agrotourist hostels	11
Hostels	6
Apartments	6
Villas	6
Chalets	4
Cottages	4
B&B	3
Country houses	2
Complexes	2
Hosts / Rooms for rent	2
Holiday parks	2
Campgrounds	1

Source: www.booking.com [10]

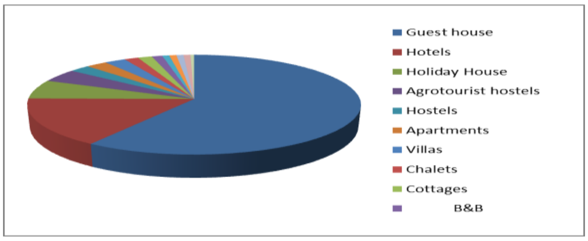


Fig.2. The structure of accommodation units by category from Bucovina in 2015
Source: Own determination.

Almost all accommodation units offer WiFI internet access, parking, some of them, some 80, also offer a shuttle service to the airport; 10 accommodation units have a swimming pool and a fitness room, 114 accommodation units accept pets, only 12 accommodation units are equipped with spa and wellness center, 10% of accommodation units facilitate the accommodation of persons with reduced mobility.

Another platform very used by tourists is: www.tripadvisor.com, here are 90 restaurants in Bucovina. The most popular restaurant is the Latino Restaurant in Suceava, followed by Q'uisine from Câmpulung Moldovenesc, and the third place is the Hilde's Restaurant in Gura Humorului.

These restaurants offer a menu of international variety, specific European food, but in the top 10 restaurants in Bucovina, we also find traditional Romanian food establishments: Bucovina Restaurant in Campulung Moldovenesc, The National Restaurant in Rădăuţi and Popasul Domnesc from Voroneţ.

Access infrastructure is in the process of development. Access to the area is via the Salcea airport, located 15 km from Suceava, 75 km from Campulung Moldovensc and 105 km from Vatra Dornei; trains or cars on European, national or county roads. (E 85, DN 17A, DN 18, DN 29, DN 2).

Table 3. Evolution of the number of accommodation units in the period 1990-2015 in Bucovina

Crt.No.	Year	Number of accommodation units
1	1990	63
2	1995	53
3	2000	93
4	2005	179
5	2010	245
6	2015	310

Source: National Institute of Statistics Constanța, [2]

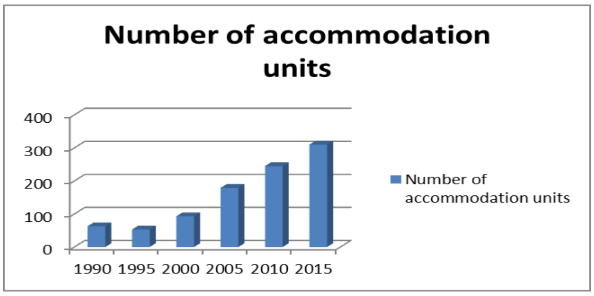


Fig.3. The evolution of the accommodation units in Bucovina, 1990-2015
Source: Own determination.

The tourist infrastructure of Bucovina is on the rise, one of the main reasons being the development of agrotourism, rural tourism, ie the desire to escape from the urban menu and to spend free time in communion with nature.

After the communist era, Bucovina inherited more than 60 units of accommodation, following a period of decline in 1995, then a huge increase, more than 50 new accommodation units every 5 years. Another influence seems to have been its accession to the European Union since after 2005 and until 2010 the region experienced the largest development of the accommodation base.

Between 2005 and 2015 there are a number of accommodation units in the Bucovina region, such as hotels, hostels, inns, motels, villas, cottages, bungalows, campings, stops, classical hostels and campers [5].

But the main ones, according to the number of units (in ascending order) are - hotels, boarding houses, tourist pensions, tourist villas, chalets, campings and hostels.

Table 4. Number of hotels in Bucovina, 1990-2015

Crt. No.	Year	Number of hotels
1	1990	20
2	1995	18
3	2000	20
4	2005	24
5	2010	30
6	2015	46

Source: National Institute of Statistics, 2016 [2]

The first hotel-type accommodation units were set up in Suceava, and then expanded to more deserted cities, especially in the tourism sector.

According to booking, in 2017 there are 18 hotel units in the Bucovina region, the price of one night accommodation in July of this year starts at 15 euros per one-star hotel, reaching up to 65 euros in a four-star hotel.

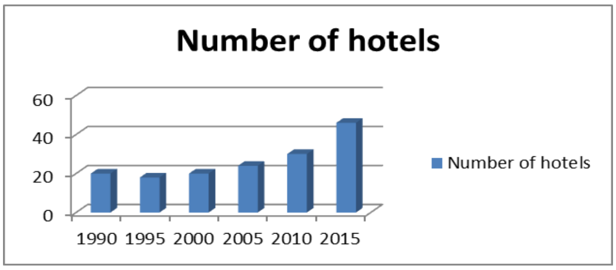


Fig.4. Evolution of the hotel accommodation units in Bucovina
Source: Own determination.

Table 5. Number of youth hostels, hostels and apartment hotels in Bucovina

Crt. No.	Year	Youth hotels	Hostels	Apartment hotels
1	1990	-	-	-
2	1995	-	-	-
3	2000	-	-	-
4	2005	3	2	-
5	2010	-	8	1
6	2015	-	8	-

Source: National Institute of Statistics, [2]

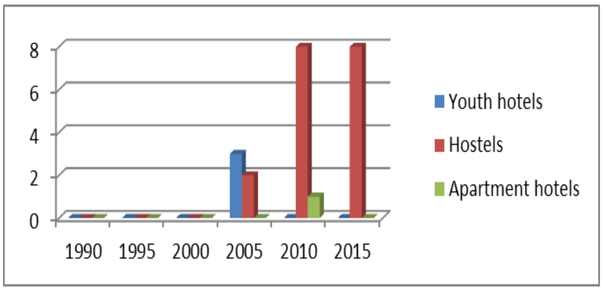


Fig. 5. Evolution of hotel accommodation units, hostel or apartment hotel
Source: Own determination.

The hostel is recognized as an accommodation unit for young people or tourists with a smaller budget. These accommodation units are at a lower price because they have both bedrooms and shared bathrooms. Beds are single or bunk beds in general, and the payment is made per booked bed.

Table 6. Number of inns and motels

Crt. No.	Year	Inns	Motels
1	1990	6	-
2	1995	7	-
3	2000	7	-
4	2005	-	3
5	2010	-	3
6	2015	-	6

Source: National Institute of Statistics, [2]

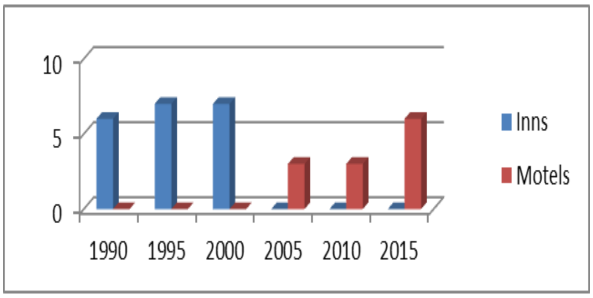


Fig. 6. Evolution of inn-type accommodation units and motels
Source: Own determination.

Table 7.Number of tourist villas, tourist chalets and bungalows

Crt. No.	Year	Tourist villas	Tourist huts	Bungalows
1	1990	13	12	-
2	1995	11	5	-
3	2000	15	4	-
4	2005	22	3	1
5	2010	19	7	2
6	2015	15	14	3

Source: National Institute of Statistics, [2]

Accommodation units such as villa, cottage or bungalow are units that are often rented in full by groups of tourists. The Bucovina area is an area where mountain hikes can be traversed, with varying degrees of difficulty, there are also many chalets where you can dance, or where tourists can take a leisure break. Compared to 1990, in 2015, the number of tourist villas increased by 15.38 %, the number of the tourist huts by 16/66 % and the number of bungalows was 3 times higher in the analyed period.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

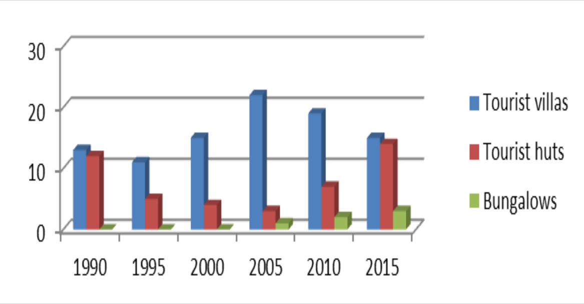


Fig.7. Evolution of accommodation units such as villa, cottage and bungalow
Source: Own determination.

Table 8. Number of Campings and Holiday Villages

Crt. No.	Year	Holiday Villages	Campings
1	1990	-	8
2	1995	-	4
3	2000	-	2
4	2005	-	5
5	2010	-	4
6	2015	1	4

Source: National Institute of Statistics, [2]

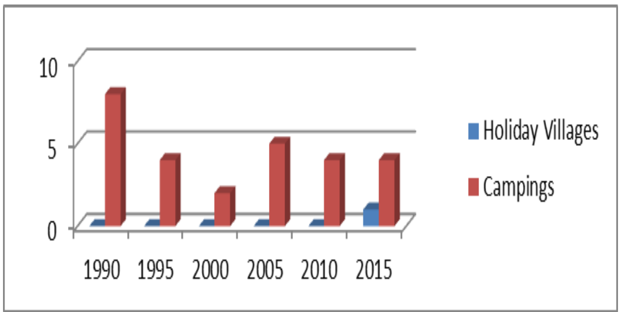


Fig. 8. Evolution of holiday villages units and campings
Source: Own determination.

In Bucovina, according to the National Institute of Statistics, there is only one vacant village in 2015, located in Sucevița [1].
The camps are more numerous, but many have disappeared after the year 2000 as a possible cause of the emergence of agro-touristic pensions.

Table 9. Number of tourist pensions

Crt.No.	Year	Tourist pensions
1	1990	-
2	1995	-
3	2000	-
4	2005	44
5	2010	62
6	2015	80

Source: National Institute of Statistics, [2]

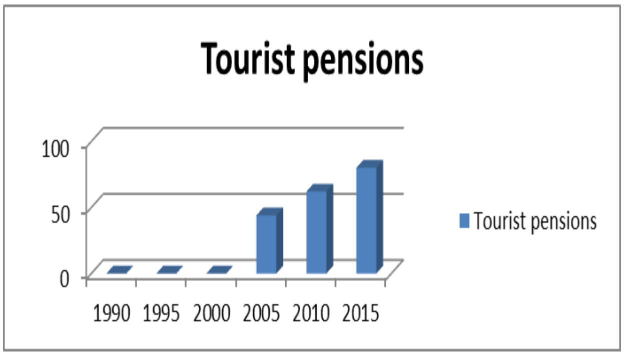


Fig.9.Evolution of tourist accommodation type accommodation units
Source: Own determination.

Most hostels have been created since the 2000s, especially in rural areas, yet near major cities or tourist attractions of national interest.

Table 10. Number of agro-touristic pensions (according to INSSE - National Institute of Statistics)

Crt.No.	Year	Agro-touristic pensions
1	1990	-
2	1995	-
3	2000	-
4	2005	70
5	2010	107
6	2015	129

Source: National Institute of Statistics, [2]

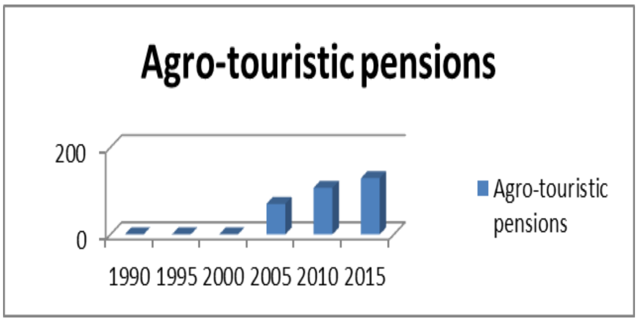


Fig. 10. Evolution of agrotourist hostel accommodation units
Source: Own determination.

Most tourists who practice this kind of tourism are urban adults who want to escape the city's tumult.

Table 11. The total capacity of the existing tourist accommodation places (beds)

Crt. No.	Year	Tourist accommodation places (beds)
1	1990	6,841
2	1995	5,654
3	2000	5,269
4	2005	6,526
5	2010	8,033
6	2015	10,143

Source: National Institute of Statistics, [2]

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

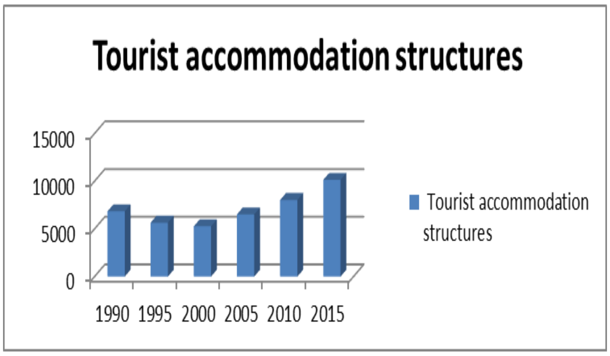


Fig.11. Accommodation capacity in terms of places (beds) Bucovina
Source: Own determination.

The accommodation capacity is slightly fluctuating, starting from 6,841 places registered in 1990, shows a deficit of 1,187 seats in 1995, down to 5,269 in 2000, the difference between 1990-2000 and 1,572 places, is recovered in the following years, so in 2015 there are 10,143 accommodation places [1].

Table 12. Overnight stays in tourist reception structures 2005-2015

Crt.No.	Year	Number of overnight stays
1	2005	435,199
2	2010	460,637
3	2015	699,491

Source: National Institute of Statistics, [2]

Using the statistical data provided by the National Institute of Statistics, 435,199 overnight stays were recorded in the tourist accommodation establishments in 2005, the number increasing by 2010 by 25,438 overnight stays and reaching 699,491 overnight stays in 2015.

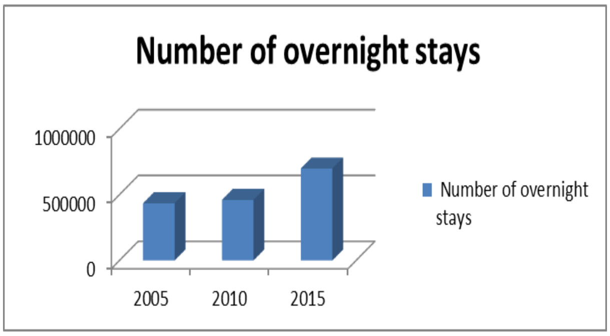


Fig. 12. Number of overnight stays in Bucovina
Source: Own determination.

The accommodation capacity rigistered fluctuations, after the 1990s followed a decrease, which was recovered in 2005, following a huge increase until 2015, having a double accommodation capacity compared to the year 2000.

The index of accommodation capacity utilization during the period 2010-2015 does not recorded drastic changes. An improvement was noticed in July-January in 2015, the most significant increase being in the summer months of July and August.

Food units

The network of catering establishments in the Bucovina region does not include a statistic given the total number of restaurants in the region.

In the Bucovina area there are 266 accommodation units, of which 123 have a restaurant within the unit, most of them hotels. The rest of the units are boarding houses, cottages, camping sites that offer tourists space where they can prepare their own meals.

Most of the food establishments are located in the main cities of the Bucovina area, or in the immediate vicinity of the roads that pass through the area.

Tourism transport infrastructure

The area is crossed by numerous European, county, national, communal roads:

-From the south of the country you can reach Suceava by car, on the European road E85 (DN2), by train on Bucharest - Suceava route, and by plane to Suceava airport;

-From the west of the country is reached Suceava on the European road E576 (DN17) Cluj-Napoca - Suceava and on the railway Cluj Napoca-Suceava;

-From the northwest of the country, from Maramureş, Suceava passes through the Prislop pass, on the national road DN18 Baia Mare - Sighetu Marmației - Iacobeni;

-Suceava County is located at the intersection of two European highways: E85 - Giurgiu - Bucharest - Suceava - Siret and E576 - Suceava - Dej - Cluj Napoca;

-Around the monasteries there are five heliports, and at Floreni (Vatra Dornei) there is a small airport for low capacity aircrafts [2].

Tourism SWOT analysis of the Bucovina area

Strenghts

-Number of accommodation units;
-Number of tourists arriving is growing;
-Diversity of tourist objectives;
-Holding the Golden Apple on February 19, 2010;
-The presence of monasteries included in the UNESCO heritage list;
-Boat of Natural Heritage;
-The fact that traditions are still kept alive in this area over other areas of the country.

Weaknesses

-Development of the transport infrastructure;
-The efficiency of promoting the area in the online environment;
-Timer number of tourist information centers.

Opportunities

-Bucovina has become an intensely visited area by tourists in recent years, especially due to the promotion of the agrotourism concept. Which can lead to continued environmental development.

Threats

-Repeal legislative amendments;
- Lack of cooperation between regions for the development of tourism (promoting a tourism that includes the Maramureş and Bucovina area);
-High weather conditions (cold and rainy summers, cold winters with abundant rainfall).

CONCLUSIONS

Bucovina is a touristic area in full ascension, especially due to the introduction of agrotourism as a form of tourism.

The wide range of traditions and customs of Bucovina is kept with holiness of the inhabitants and transmitted with love to future generations. These are preserved and capitalized in numerous festivals throughout the year.

The main events of life, birth, baptism, wedding, funeral are captured and retained by the inhabitants of the area.

Creating a popular costume is a true art, stitching, embroidery can be considered a source of inspiration for all generations to come. These creations of great value have been noticed over the centuries, due to the skill and skill that women have created.

The tourist infrastructure of Bucovina is on the rise, one of the main reasons being the rural tourism development, ie the desire to escape from the urban menu and to spend free time in communion with nature [9].

The accommodation capacity suffered fluctuations, after the 1990s followed a decrease, which was later recovered in 2005, following a huge increase until 2015, having a double accommodation capacity compared to the year 2000.

The index of accommodation capacity utilization during the period 2010-2015 does not suffer drastic changes; an improvement is noted in July-January in 2015, the most significant increase being in the summer months of July and August.

All these aspects are complemented by the public catering network, the general transport and tourism network and leisure facilities.

REFERENCES

[1]Anuarul Statistic al României 2015, Institutul Național de Statistică
[2]Anuarul Statistic al României 2016, Institutul Național de Statistică
[3]Cândea, M., Erdeli, G., Simon, T., 2001, România, Potenţialul turistic si turism, University Publishing House, Bucharest.pp.53-54
[4]Cocean, P., Vlăsceanu, Gh., Negoescu, B., 2002, Geografia generală a turismului, Publisher Meteor Press, Bucureşti, pp.48-49
[5]Geografia României II, Geografia Umana si Economica,1984, Academy of the Socialist Republic of Romania Publishing House, Bucureşti. pp.39
[6]Glăvan, V., 2000, Turismul în România, Economic Publishing House, București, pp.28-29
[7]Iacobescu, M., 1993, Din istoria Bucovinei. Vol.I. (1774-1862), Romanian Academy Publishing House, București, pp.113
[8]Ielenicz, M., 2005, Geografia fizică a României, University Publishing House, București, pp.25-26
[9]Nistor,I.,1991,Istoria Bucovinei, Humanitas Publishing House, București
[10] www.booking.com, Accessed January 20, 2018.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ASPECTS AND TRENDS IN THE EUROPEAN UNION AND ROMANIA'S EGG MARKET

Agatha POPESCU

University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest Romania, Phone: +40213182564, Fax: +40213182888, Email: agatha_popescu@yahoo.com

Corresponding author: agatha_popescu@yahoo.com

Abstract

The purpose of the paper was to analyze the main aspects and trends in the EU an Romania's egg market based on the Eurostat and National Institute of Statistics data. The dynamics of laying hens, egg production, consumption, price and trade have been the main indicators analyzed in this study pointing out the problems in the Romanian egg market and the differences compared to the EU market mainly regarding egg price. The EU egg market is facing with a relatively stable egg production, 90 % intra-EU export, 20 % extra-EU imports, a slight decline of the egg price, but large variations from a country to another. The egg sector is subsidized in almost all the EU countries, except Romania. This helps the breeders from the subsidized countries to have a smaller production cost and a high economic efficiency selling at a higher price. The EU egg trade balance is a positive one, the EU being one of the most important egg producer and exporter in the world. In Romania, the laying hen number and egg production declined because of high price for farm inputs, the movement from the cage system to the barn and free range systems. to reduce production cost. Egg price has increased, but it is not at the average EU level, being influenced by seasonality of production and offer/demand ratio. Egg price declines in the warm season when production is higher, and increases in the fall-winter season when production is lower but the demand is higher. The inflow of imports determine Romanian producers to reduce the selling price. Romania's egg trade balance is still a positive one, but the imports have an increasing trend. This situation imposes a new strategy at the EU level to assure a loyal competition among all the producers, and to export more eggs to the extra-EU countries and assure a better consumer protection. In Romania, the Government must allot subsidies to support the egg sector, and the breeders must pay attention to egg quality, production cost and intensify export.

Key words: *eggs, production, consumption, price, export, import, EU, Romania*

INTRODUCTION

The demographic evolution at the global level will increase the world protein requirements, and the expectations are that the world protein market will grow by about 50 % in the next decade, and 60 % of the world protein demand will be in the Asian area [18].

Egg is a exceptional food with a high nutritive value given by its content in protein (13%), fats (11%), minerals and vitamins and also with a good energetic value accounting for 155 kcal/ 100 g [27]. Also, its digestibility accounts for 97-100 %[17]. For this reason, the nutritionists recommend 3-4 eggs weekly in human diet [15].

The world statistics mention that egg consumption increased from 5.5 kg/person in 1980 to 9 kg/person in 2016 [13].

This was possible due to the continuous growth of the world egg production which accounted for 7,742 thousand metric tonnes in 2016 and the forecast for the year 2025 is for 8,224 thousand metric tonnes [22]. The top egg producing countries in the world, in terms of billion kg eggs, are China (24.8), USA (5.6), India (3.8), Japan (2.52), Mexico (2.51), Brazil (2.2), Indonesia (1.22), Turkey (1.03), France (0.94), and Germany (0.89) [31].

The EU is one of the largest producers of agro-food products, with high self-sufficiency rates and trade. The increased demand at the world level have determined the creation of a new pole of production and trade, Asia, which have diminished the EU market share in the international trade with agro-food products. In the period 2014-2016, the EU market share in the world trade accounted for 11 % compared to 14.5 % in the period 2000-2002 [1].

In 2012, the egg sector contribution to the EU

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

agricultural production was 2.5 %, but among the EU member states there were differences, for instance: 1.5 % in Germany, 1.7 % in France, 2.4 % in the Netherlands, 2.9 % in Spain, 3 % in Italy and 6.1 % in Romania. In 2012, Romania came on the 9th position for egg production [14].

In 2016, of the Euro 400 billion EU output value, egg sector represented 2.2 % and the whole poultry sector accounted for 5.3 % [6].

In the same year, the EU-28 produced 7,742 thousand tonnes eggs by 11.28 % more than in 2007. Of this total production, the percentage of use accounted for 97.02 % in the year 2016, compared to 97.72 % in the year 2007. The egg consumption per EU inhabitant registered a slight increase from 12.4 kg eggs in 2007 to 12.9 eggs/capita in 2016. The surplus of production stimulated exports whose growth rate was 21.07 %, while the imports declined by 63.1 %. The forecast for the year 2030 is that the EU will produce 8,287 thousand tonnes eggs, the egg consumption will reach 13.5 kg/inhabitant, the export will account for 320 thousand tonnes and the import for 26 thousand tonnes [7].

The EU egg market will continue to develop to satisfy better consumer preference by extending laying hens growing in free range and organic, and at the same time keeping barn system as the basic technological standard [18].

Romania is an egg producing, exporting and importing country. After 1989, the laying poultry stock and the production of eggs were in decline. Romania's entry into the EU has offered new opportunities for the development of the egg sector, but egg production is not yet at the level of expectations taking into account the efforts done by breeders and the strong competition in the EU egg market. At present just 216 producers are dealing with the egg production at industrial scale, but there are also the peasant households which are able to produce a very important amount of eggs. Egg demand is relatively stable, but much higher in the period of legal holidays. Production covers consumption and the surplus is subject of export. Egg price has registered a continuous increase but is much less than in other EU countries [20].

In 2016, the output value achieved by Romania in the egg sector was Euro 729.42 million, representing 18.8 % of the animal production output in Romania and 8.4 % of the animal production output in the EU-28 [25].

In this context, the present paper had two objectives: (i) to analyze the main aspects and trends in the EU egg market during the last years pointing out the situation of holdings and laying hens by way of keeping, egg production at the EU and also the main producers, egg consumption, self-sufficiency, egg price, egg intra and extra-EU trade, the main EU exporting and importing countries and the main EU beneficiaries and suppliers of eggs, and (ii) to analyze the similar main aspects and trends in Romania in the period 2007-2016 emphasizing the egg market problems and the most important factors which have negatively affected the laying poultry stock, production, price and trade of this country with a long experience and high potential for producing eggs.

MATERIALS AND METHODS

The paper is based on the study of various important reports and other written materials with new information on the topic provided by FAO, Eurostat, National Institute of Statistics, articles published in various international and national journals.

The empirical data were mainly supplied by Eurostat Statistics Explained and the National Institute of Statistics, Tempo online Data base for the period 2007-2016.

The main indicators analyzed in this study were the following ones: the number of holdings raising laying hens, the number of laying hens, the egg production, egg production per inhabitant, egg consumption per inhabitant, the self-sufficiency rate, egg price, egg export, import and trade balance, the export/import ratio.

These aspects were approached both on the European market as well as in Romania, pointing out the situation in Romania during the last decade and the main problems this country is facing in the egg market.

Also, it was studied the correlation between consumption and production, and the regression of consumption as a dependent variable on egg production as an independent variable trying to find out if there is any important relationship between these two indicators.

The analysis was based on various methods such as:

-*The fixed index method*, utilized to characterize the evolution of the variables in the analyzed period compared to the 2007 level considered as term of reference, according to the formula: $I_{FB} = (X_n/X_0)*100$.

-*The linear regression model*, Y= bx + a, where Y is de dependent variable and X is the independent variable, used to analyze the relationship of determination between egg production and consumption.

-*The Pearson correlation coefficient* and *the determination coefficient*, used to assess the direction and intensity of the connection between these indicators.

The results were tabled and graphically illustrated and then correspondingly interpreted.

RESULTS AND DISCUSSIONS

(A)The EU egg market.

The EU is an important producer and trader of eggs in the world. The egg sector has been developing fast and has been continuously improved by the introduction of the Common Agricultural Policy destined to increase egg quality, to assure consumer's protection and to harmonize egg market [8, 24].

In 2016, in the EU-28, there were 384,067,572 ***laying hens*** grown in 4,396,308 ***holdings***. Poultry farming for egg production has been developed rapidly in close relationship to the market demand so that the actual technologies are oriented in two directions: (i) enriched cage and (ii) production alternatives. About 90 % of the farmers growing laying hens are practicing enriched cage, while 10 % prefer production alternatives, of which barn 9.63 %, free range 0.27 %, and organic 0.11 %.

The distribution of the laying hens by way of keeping is the following one: enriched cage 55.56 % and production alternatives 44.4 %, of which: free range 14.14 %, barn 25.65 % and organic 4.61 % (Table 1).

Table 1. The number of holdings growing laying hens and the number of laying hens in the EU-28 in 2016 by way of keeping

Way of keeping	Holdings		Laying hens	
	Number	%	Number	%
Total EU-28, of which:	4,396,309	100.0	384,067,572	100.0
(a)Enriched cage	3,950,800	89.9	213,476,005	55.5
(b)Production alternatives, of which:	445,509	10.1	170,591,567	44.5
-Free range	-	0.3	-	14.1
-Barn	-	9.7	-	25.7
-Organic	-	0.1	-	4.7

Source: Own calculations based on the data provided by CIRCA, U:\Aviculture\Normes oeufs (communications)\Number of laying hens by way of keeping_CIRCA.xlsx [3].

The number of laying hens by the top egg producers in the EU are the following in the decreasing order: Germany (52.5 million), France (48.5 million), Spain (43.6 million), Poland (43.4 million), United Kingdom (42.1 million), Italy 941.6 million), Romania (8.2 million), Portugal (8.1 million), Sweden (8 million) and Belgium (7.8 million), totalizing 390.7 million, representing 78 % of the total EU-28 number of laying hens in the year 2016 (Fig.1).

Egg production has continuously increased in the EU-28, so that in 2016, it accounted for 7,702 thousand tonnes eggs in egg equivalent, being by 9.49 % higher than in the year 2010 (7,034 thousand tonnes) (Fig.2).

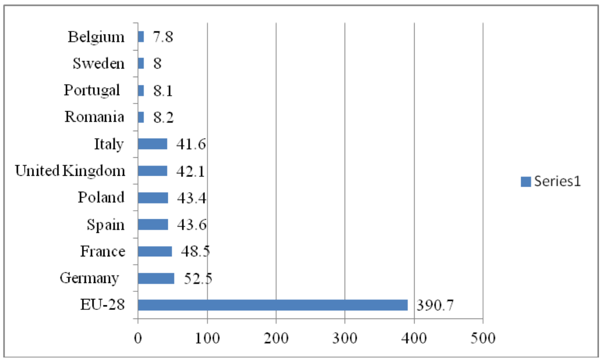


Fig.1.The number of the laying hens in the main EU countries in 2016 (million)
Source: Own designed based on Eurostat, Egg- Market situation, Dashboard, 2016 [9].

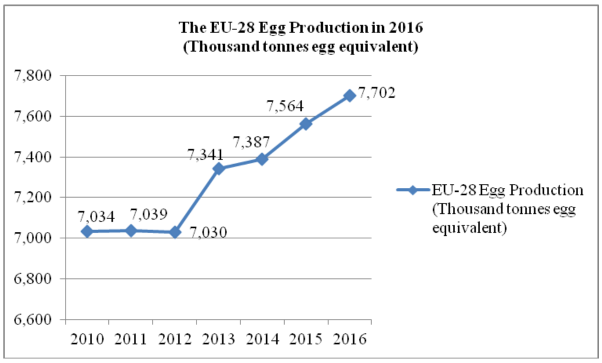


Fig.2.The dynamics of hen egg production in the EU-28, 2010-2016 (thousand tonnes egg equivalent)
Source: Own designed based on Eurostat, Egg- Market situation, Dashboard, 2016 [9].

The main egg producers in the EU are presented in Fig.3.

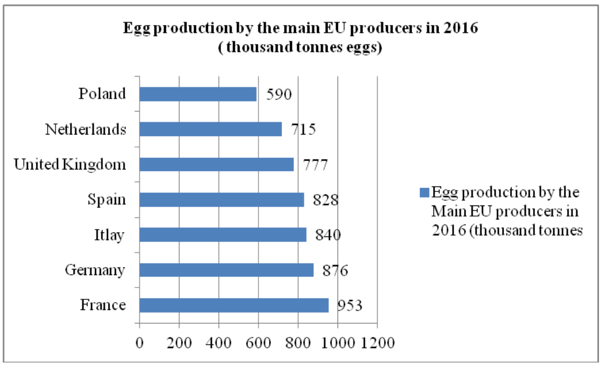


Fig.3.The egg production by EU main producers in 2016 (Thousand tonnes)
Source: Own designed based on Eurostat, Egg- Market situation, Dashboard, 2016 [9].

In the decreasing order, they are the following ones: France (953 thousand tonnes), Germany (876 thousand tonnes), Italy (840 thousand tonnes), Spain (828 thousand tonnes), United Kingdom (777 thousand tonnes), The Netherlands (715 thousand tonnes), and Poland (590 thousand tonnes), all together totalizing 7,496 thousand tonnes eggs, representing 74 % of the EU egg production in the year 2016 (Fig.3).

The market share in egg production of these producers is the following one: France 13 %, Germany 12 %, Italy 11 %, Spain 11 %, United Kingdom 10 %, Netherlands 9 % and Poland 8 %.

Egg production contributed by 2.3 % to the output of the agricultural industry of the EU-28 [10].

Egg consumption in the EU has continuously increased reaching 7,339 thousand tonnes in 2016, being by 6.59 % higher than in 2010, when it accounted for 6,885 thousand tonnes (Fig.4.).

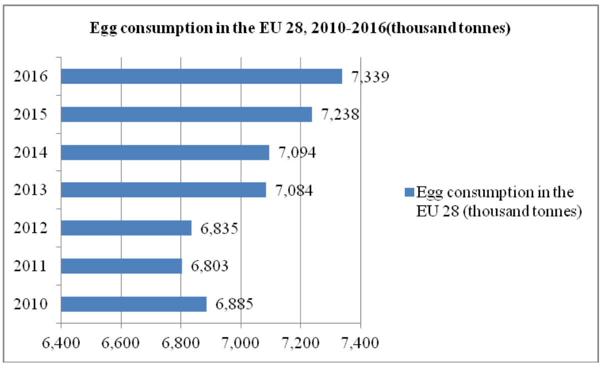


Fig.4.The egg consumption in EU-28, 2010-2016 (Thousand tonnes)
Source: Own designed based on Eurostat, Egg- Market situation, Dashboard, 2016 [9].

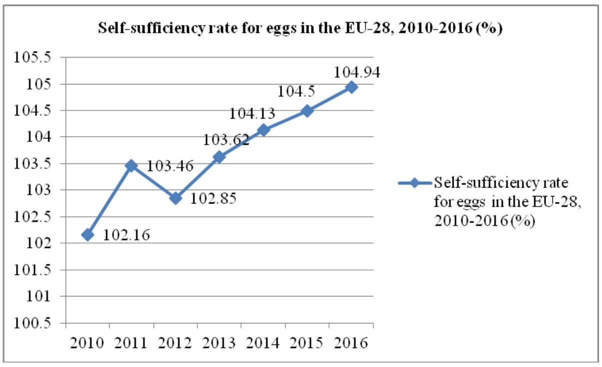


Fig.5.The egg self-sufficiency rate in EU-28, 2010-2016 (Thousand tonnes)
Source: Own designed based on Eurostat, Egg- Market situation, Dashboard, 2016 [9].

Making a comparison between production and consumption, one can easily notice that ***the self-sufficiency rate*** was ranging between 102.16 % in 2010 and 104.94 % in the year

2016, As a consequence, the surplus of eggs was available for export. (Fig.5) [16].

Egg consumption per inhabitant in the EU, increased by 4.03 % in the period 2007-2016, from 12.4 kg/capita in 2007 to 12.9 kg/capita in 2016 [7].

The annual egg market price in the EU-28 has recorded a relatively general decreasing trend from Euro 115.06/100 kg eggs in 2011 to Euro 113.71/100 kg eggs in 2016 (Fig.6).

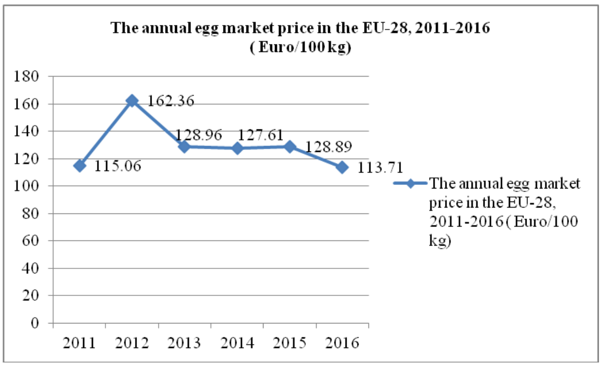


Fig.6.The annual egg market price in the EU-28, 2011-2016 (Euro/100kg)

Source: Own designed based on Eurostat, Egg- Market situation, Dashboard, 2016 [9].

Egg price is influenced by supply/demand ratio, but there are important differences among the EU countries. The highest egg price is in Sweden, Denmark and Austria and the lowest one in Spain and Czech Republic.

The egg price is also influenced by seasonality and during the year 2017 by the shortage posed by Fipronil [16].

Because egg offer exceeds demand in the EU, egg price has registered a declining trend in general, affecting producers who were obliged to sell eggs at prices lower than production cost sometimes.

The decline of egg price varied from country to another. The highest price decline was recorded in the countries from the Euro-zone, where egg producers were advantaged by the European Central Bank which launched a high amount of money in the economy. Producing at lower prices compared to the producers from the countries belonging to the non Euro-zone and exporting eggs in this non Euro-area, the selling price has also decreased in the non Euro-zone, leading to a high deflation which has deeply affected the local producers [4].

The EU is one of the main egg and egg products traders in the world, commercializing mainly hen eggs.

In 2016, the EU-28 egg export value accounted for Euro 960 million, of which 90 % intra-EU export. The market share of the main EU egg exporting countries was the following one: the Netherlands 40 %, Poland 21 %, Germany 16 %, and Belgium 6 %.

In the same year, the market share of the main EU importing countries was the following one: Germany 43 %, the Netherlands 20 %, Belgium 7 %, United Kingdom 4 %, Italy 3 %, France 3 %, totalizing 80 % of the total EU-28 import value [2].

About 10 % of the export value represents the extra-EU export and about 20 % of the import value is represented by the extra-EU countries.

In the period 2007-2016, the exported amounts of eggs by the EU-28 increased by 47.9 % from 167 thousand tonnes egg equivalent in 2007 to 247 thousand tonnes in 2016 (Fig.7).

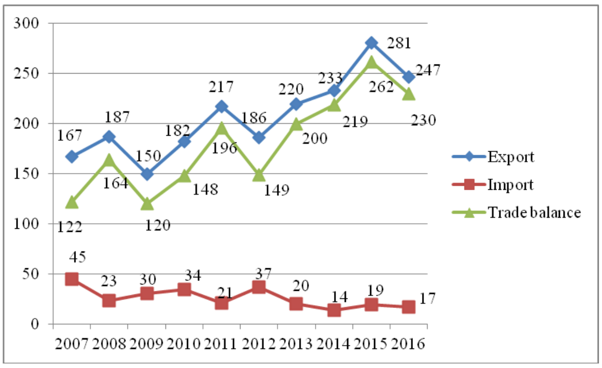


Fig.7.The extra-EU egg export amounts in the period 2007-2016 (Tonnes egg equivalent)

Source: Own designed based on Eurostat, Comext, Eggs, Tonnes egg equivalent, 2017 [11].

At the same time, the EU imports of eggs decreased by 37.77 % from 45 thousand tonnes in 2007 to 17 thousand tonnes in 2016. This decline of egg imports was justified by the surplus of production existing on the EU market.

Therefore, the EU egg trade balance was a positive one in the period 2007-2016, reflecting that the EU is a net exporter of eggs to the non-EU countries [8].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The main beneficiaries of the EU-28 eggs are Japan, Switzerland, Israel, Thailand, Arab United Emirates, South Korea and other countries, totalizing 206,583 tonnes egg equivalent.

The main egg suppliers for the EU-28 are Ukraine, Argentina, USA, Albania, Switzerland, Norway and others. The imported amount of eggs is definitely very small accounting for 14,807 tonnes egg equivalent in 2016, being 13.95 times smaller compared to egg exported quantities (Table 2).

Table 2. The extra-EU exported and imported amounts of eggs by trade partners in 2016 (tonnes egg equivalent)

Exports			Imports		
Country	Amount (tonnes)	Market share (%)	Country	Amount (tonnes)	Market share (%)
EU-28	206,593	100.00	EU-28	14,807	100.00
Japan	37,429	18.11	Ukraine	7,209	48.68
Switzerland	33,455	16.19	USA	2,201	14.86
Arab United Emirates	14,867	7.19	Argentina	1,844	12.46
Israel	11,950	5.79	Norway	1,142	7.72
Taiwan	5,626	2,73	Albania	820	5.54
Thailand	4,997	2.42	Switzerland	337	2.28
South Korea	4,285	2.08	Other	1,254	8.46
Other	93,984	45.49	-	-	-

Source: Own calculations. based on Eurostat, Egg- Market situation, Dashboard, 2016 [9].

Regarding ***the export/import ratio*** reflected by the extra-EU egg trade balance, one can say that it has registered a continuous increasing trend from 3.71 % in 2010 to 14.52 % in 2016 (Fig.8).

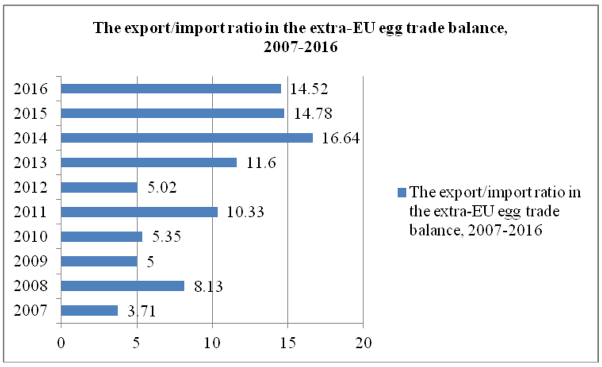


Fig.8.The dynamics of export/import ratio in the extra-EU egg trade balance, 2007-2016
Source: Own design based on the data provided by Eurostat Egg- Market situation, Dashboard, 2016 [9].

The EU-28 exports and imports the following egg and egg products:

(a)Shell eggs, being exported mainly to Japan and Switzerland, and imported especially from Argentina, USA and India. The main EU-exporting countries of shell eggs are the Netherlands (exporting mainly to Germany), Poland (exporting to Germany, Netherlands, Czech Republic and Slovakia) and Germany (exporting to Netherlands). The main EU importers of shell eggs are Germany, Netherlands and Belgium.

(b)Dried eggs products. The EU is the main exporter of dried eggs in Europe with 90 % market share. The main exporting countries of this product category are the Netherlands, Germany and Belgium. The main importers of dried eggs in the EU are Germany, United Kingdom, Netherlands, Denmark and Spain.

(c)Liquid egg products. About 87 % of the global export with this egg products is performed by Europe, and 99 % of Europe export is made by the EU-28. The main EU exporting countries of liquid egg products are Netherlands (50%), Spain, Belgium, Germany and France. The main importing countries of liquid egg products are Germany, France, United Kingdom, Belgium, Spain and Netherlands [12].

The EU egg market is characterized by the over production on the common market and the slight decline in egg price, by the change in the way of keeping the laying hens to the alternative systems of production to adapt much better to the consumer needs, by the differences regarding the egg production and price in various countries.

(B)Romania's egg market

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Romania has a long tradition in poultry farming and after its entry in the EU, it succeeded to align very fast and well to all the EU regulations regarding the technological aspects in poultry farming, both in egg and meat sector.

In 2016, ***the number of holdings*** accounted for 216 units where 8,209,254 laying hens were raised (Table 3).

Table 3. The number of holdings growing laying hens and the number of laying hens by way of keeping in Romania, in 2016

Way of keeping	Holdings		Laying hens	
	Number	%	Number	%
Total Romania, of which:	216	100.0	8,209,254	100.0
(a)Enriched cage	98	45.3	5,102,322	62.15
(b)Production alternatives, of which:	118	54.7	3,106,932	37.85
-Free range	16	7.4	119,741	1.45
-Barn	98	45.3	2,940,698	35.82
-Organic	4	2	46,493	0.58

Source: Own calculations based on the data provided by CIRCA, U:\Aviculture\Normes oeufs (communications)\Number of laying hens by way of keeping_CIRCA.xlsx [3].

According to National Institute of Statistics, Romania registered 40,833.1 thousand laying adult poultry, in 2016, by about 10 % less than in 2007 (Fig.9).

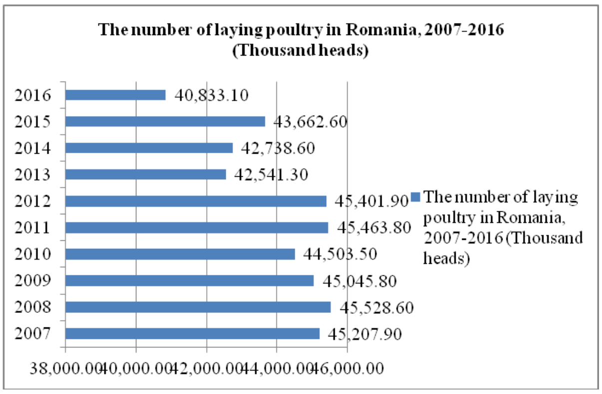


Fig.9.The dynamics of laying adult poultry in Romania, 2007-2016 (Thousand heads)

Source: Own design based on the data provided by National Institute of Statistics, Tempo online Data base, 2017 [19].

The reduction in the number of laying hens was determined by the changes in the way of keeping as a consequence of the high price for the enriched cage in order to assure a double space per bird. A part of the breeders considered that moving to barn technology or to free range technology, they are advantages in reducing production cost. In this way, the number of birds per holding was diminished and production performance as well.

Egg production declined by 5.22 % in the analyzed period, from 6,522 million pieces in 2007 to 6,182 million pieces in 2016 and this was the result of the reduction of the adult laying poultry and also and of the change in technological was of keeping with a larger space per poultry (Fig.10).

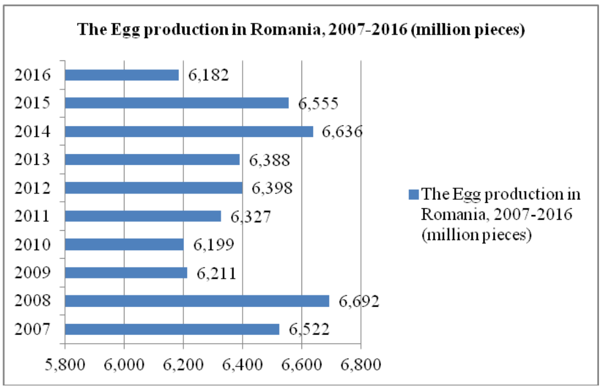


Fig.10.The dynamics of egg production in Romania, 2007-2016 (Million pieces)

Source: Own design based on the data provided by National Institute of Statistics, Tempo online Data base, 2017 [19].

At present, egg production achieved in Romania is much less than before 1989 [28]. Despite that, egg production increased in terms of deliveries, which reached 1,423.8 million eggs in 2015, according to the Union of Poultry Breeders in Romania, but egg production is still less than the provisions of the National Plan for Rural Development 2014-2020.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

In addition, in Romania it is a strange situation of egg market. The best egg market is in the urban areas where the poultry companies are able to cover the most important part of the consumer's need (140-150 eggs/inhabitant). In the rural areas, self consumption comes on the first position because from the peasant households are produced about 4 billion eggs which can't be sold in the market, not meeting the EU standards. Also, a part of the urban consumers uses eggs produced in the rural households by their relatives and friends. This situation creates a huge discrepancy between the real egg production and consumption potential of Romania and the official statistical data, producing a distortion in the image of egg market [30].

Egg production per inhabitant recorded a different evolution depending of the laying poultry stock and the demographic dynamics in Romania and egg production per laying bird. In 2016, it was registered 314 eggs/capita by 0.64 % more than in 2007 (312 eggs)(Fig.11).

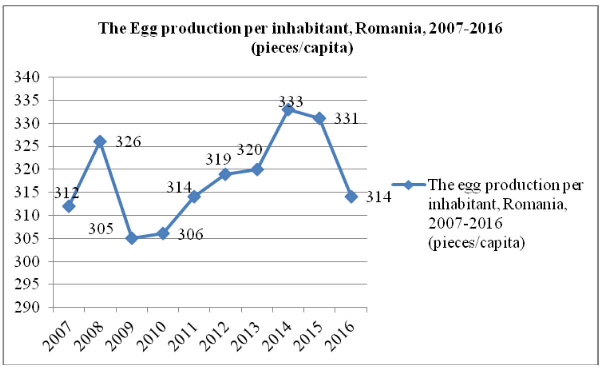


Fig.11.The dynamics of egg production/inhabitant in Romania, 2007-2016 (pieces/capita)
Source: Own design based on the data provided by National Institute of Statistics, Tempo online Data base, 2017 [19].

The value of egg production at producer's price (basic price) in current prices has increased by 34.95 % from RON 2,230.79 million in 2007 to RON 3,010.53 million in 2016. This was due, on one side, by the dynamics of egg production, and also by the producer price (egg price at the farm gate) which in Romania is similar with the basic price, as starting from 2011, poultry farming, including both meat and egg sectors has not received any subsidies, situation which has deeply affected the producers (Fig.12).

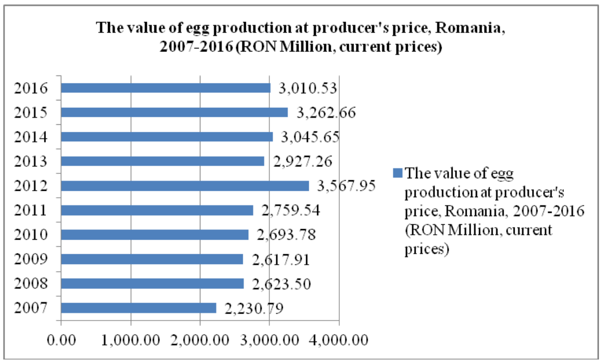


Fig.12.The dynamics of the value of egg production in Romania, 2007-2016 (RON Million, current prices)
Source: Own design based on the data provided by National Institute of Statistics, Tempo online Data base, 2017 [19].

The slight egg price increase was benefic for egg producers and had a positive influence of the growth of the egg production value.

The egg price varied from a year to another having in general an increasing trend. In 2016, egg price accounted for RON 0.49/egg or RON 486/tonne, being by 44.11 % higher than in 2007, when it was RON 0.34/egg or RON 342/tonne (Fig.13).

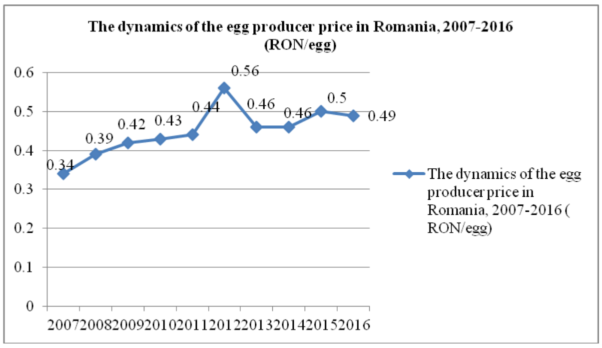


Fig.13.The dynamics of the egg producer's price in Romania, 2007-2016 (RON/egg)
Source: Own design based on the data provided by National Institute of Statistics, Tempo online Data base, 2017 [19].

The hen egg price in the agro-food markets increased by 54.76 % from RON 0.42/egg in 2007 to RON 0.65/egg in 2016 (Fig.14).
Even though, egg price increased in Romania, it is still at a very low level compared to the EU average and the egg price level in other EU countries.
Taking into account the Eurostat Data, in

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Romania the egg price declined by 5.61 % from Eurocents 6.78/egg in 2007 to Eurocents 6.40/egg in 2015 for eggs of consumption.

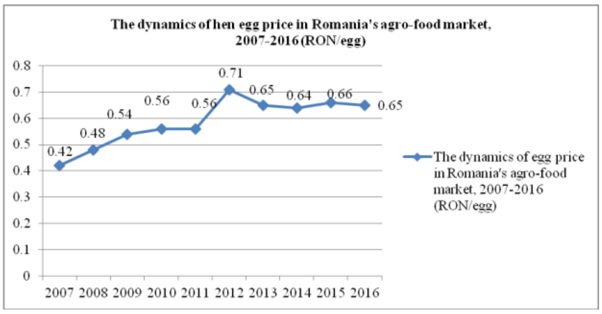


Fig.14.The dynamics of the hen egg price in Romania, 2007-2016 (RON/egg)
Source: Own design based on the data provided by National Institute of Statistics, Tempo online Data base, 2017 [19].

In 2007, the egg price in Romania was closer to the EU average price (Eurocents 6.90/egg). But, from a year to another, the egg price in the EU increased so that in 2015 it accounted for Eurocents 8.15/egg, being by 18.11 % higher than in 2007.

Therefore, if in 2007, the egg price in Romania represented 98.26 % of the EU egg price, in 2015, the egg price in Romania represented 78.52 % of the EU price (Table 4).

The gap regarding the egg price in Romania has many causes, among which the main important ones are: the general trend of decline of egg price in the world and in the EU markets, the egg imports on the Romanian market coming from countries with subsidized egg production and especially from the Euro zone where production costs are lower, the disloyal competition practiced by a few countries such as Poland which exported eggs at high prices in Romania and commercialized then by means of its own retail net, obliging the Romanian producers to reduce egg price.

Table 4. The dynamics of egg price for consumption egg in Romania and the EU 28, 2007-2015 (Eurocents/egg)

	EU	Romania	Romania's egg price/EU egg price % (Deflation)
2007	6.90	6.78	98.26
2008	7.07	6.95	98.30
2009	7.49	6.76	90.25
2010	7.00	5.77	82.42
2011	6.98	6.04	86.53
2012	10.01	8.50	84.91
2013	8.07	6.39	79.18
2014	8.59	6.40	74.50
2015	8.15	6.40	78.52
2015/2007 %	118.11	94.39	79.91

Source: Van, I, 2016, The Romanian poultry breeders, good technologists, but the marketing must be improved, AviMagazine No.1/2016 [30].

Therefore, even thou the Romanian egg producers have improved their technologies of production aligning them at the EU standards and reduced production cost, even thou in Romania the delivery price increased in the domestic market, the gap between Romania's egg price and the EU price has become more accentuated [30].

Egg consumption/inhabitant varied from a year to another depending on the egg production and the demographic evolution in Romania. In 2016, the average egg consumption per inhabitant accounted for 313 pieces, having a general decreasing trend from the year 2008 till the year 2014, and then registering a recover. In 2015, the average egg consumption was 262 pieces/capita, by 5.08 % less than in 2007 (Fig.15).

The self-sufficiency rate registered a general positive trend from 113.04 % in 2007 to 126.33 % in 2016. The figures reflect that production is enough higher compared to consumption and that there are important amounts of eggs which could be exported (Fig.16).

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

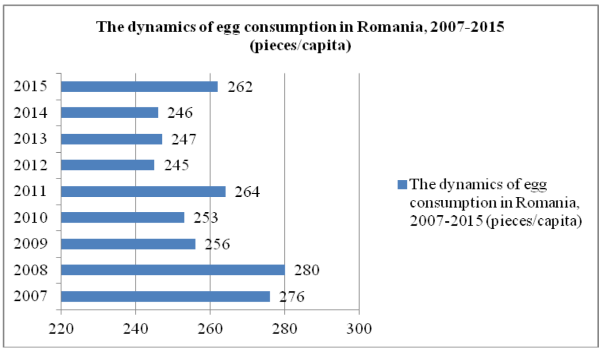


Fig.15.The dynamics of the egg consumption in Romania, 2007-2015 (pieces/capita)
Source: Own design based on the data provided by National Institute of Statistics, Tempo online Data base, 2017 [19].

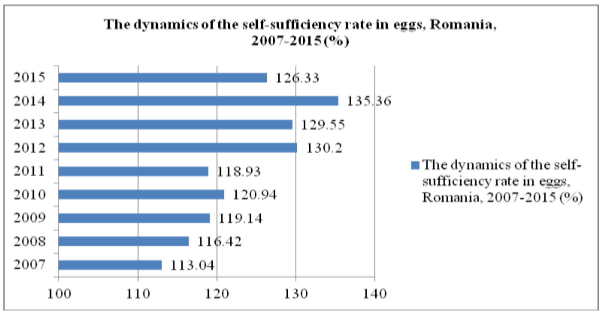


Fig.16.The dynamics of the self-sufficiency rate for egg in Romania, 2007-2015 (%)
Source: Own calculations.

The regression model of egg consumption per inhabitant (Y) depending on egg production per inhabitant (X) was Y= - 0.0437 X +272.7. This regression equation reflects that an increase by 1 kg of egg production will led to a decline consumption by 0.0437 eggs. Also, the determination coefficient showed that only 12 % of the variation of the consumption is due to the variation of egg production per inhabitant. Therefore, other factors have a deeper influence on the egg consumption such as: income per household, preference for a special type of eggs, diets and restrains in consumption due to diseases etc.

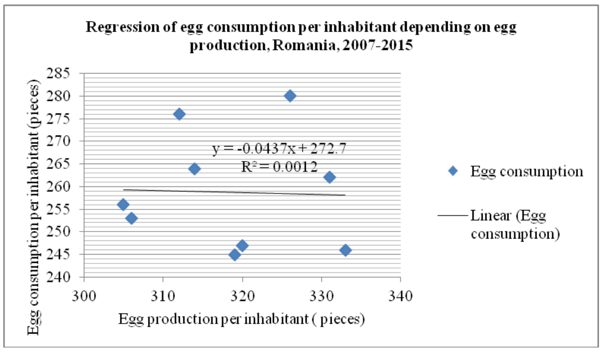


Fig.17.The regression model of egg consumption depending on egg production per inhabitant, Romania, 2007-2015
Source: Own design based on the data provided by National Institute of Statistics, Tempo Online Data base, 2017 [19].

The coefficient of correlation, r = 0.034 reflects that between consumption and production of eggs per inhabitant is a very weak but a positive relationship. Therefore, the hypothesis Ho that between consumption and production is a positive and strong relationship it must not be accepted (Fig.17).
The regression statistics and ANOVA for the egg consumption per inhabitant depending on the egg production per inhabitant is presented in Table 5. The results confirm once more that between consumption and production is a weak relationship.

Table 5. The estimated regression model for the agro-food export value depending on the GDP created in agriculture, Romania, 2007-2016

Regression statistics						
Multiple R	0.0346					
R Square	0.00119					
Adjusted R Square	-0.1414					
Standard Error	13.711					
Observations	9					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	1.5782	1.578	0.0083	0.9295	
Residual	7	1315.977	187.99			
Total	8	1317.556				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	272.695	151.9697	1.7944	0.1158	-86.655	632.047
X Variable 1	-0.0437	0.4770	-0.0916	0.9295	-1.1716	1.0842

Source: Own computation based on National Institute of Statistics, Tempo on line Data Base, 2017, [19]

Romania's trade with eggs varies during the year. In general, it increases in the fall-winter season, and decline in the warm season, when in fact production is higher. In the fall-winter period, the imports invade the Romanian market leading to the decline in egg price. In 2015, the amount of exported eggs increased by 36.87 %, while the amount of imported eggs increased faster by 56.68 %, so that in 2015 the export exceed by only 1.4 % the import. However, the positive aspect is that the trade balance is still an excess one (Table 6).

Table 6.The quantity of exported and imported eggs by Romania, 2014-2015 (Million eggs)

	2014	2015	2015/2014%
Exported eggs	133.7	183.0	136.87
Imported eggs	115.9	181.6	156.68
Trade balance	+27.8	+1.4	5.03

Source: Pop Patricia Alexandra, 2016, The Romanian eggs in competition with the Polish ones, Agribusiness, May 9, 2016, http://www.agro-business.ro/ouale-romanesti-in-competitie-cu-cele-poloneze/2016/05/09/, Accessed on January 4, 2018 [21]

The value of egg export, import and trade balance is presented for the same year in Table 7. One can see that the egg export value reached Euro 14,451 thousands in 2015, being by 98.63 % higher than in 2014. The egg import value also increased by 60.18 %, reaching Euro 12,781.2 thousands. As a result, the trade balance was a negative one in 2014, but a positive one in 2015 (Table 7).

Table 7.The value of exported and imported eggs by Romania, 2014-2015 (Euro Thousand)

	2014	2015	2015/2014%
Exported eggs	7,275	14,451	198.63
Imported eggs	7,979	12,781.2	160.18
Trade balance	-704	+1,669.8	166.16
Export/Import ratio	91.17	113.06	-

Source: Pop Patricia Alexandra, 2016, The Romanian eggs in competition with the Polish ones, Agribusiness, May 9, 2016, http://www.agro-business.ro/ouale-romanesti-in-competitie-cu-cele-poloneze/2016/05/09/, Accessed on January 4, 2018 [21]

The value of egg export and import price is presented in Table 8 The export price increased by 15.74 % in 2015 compared to the level of 2014, while the egg import price increased by 6.18 %. The ration between export price and import price has improved from 81.44 in 2014 to 88.77 in 2015. But, the export price is still lower compared to the import price which is much higher (Table 8).

Table 8.The egg export and import price, Romania, 2014-2015 (Eurocents/egg)

	2014	2015	2015/2014%
Export price	5.40	6.25	115.74
Import price	6.63	7.04	106.18
Differences (E-I)	-1.23	-0.79	64.22
Export/Import price ratio	81.44	88.77	-

Source: Pop Patricia Alexandra, 2016, The Romanian eggs in competition with the Polish ones, Agribusiness, May 9, 2016, http://www.agro-business.ro/ouale-romanesti-in-competitie-cu-cele-poloneze/2016/05/09/, Accessed on January 4, 2018 [21]

The main problems of the egg market in Romania are the following ones:

-the high price for inputs in poultry growing for egg production, which determines some breeders to relinquish the enriched cage system of keeping laying poultry and to pass to barn or free range system in order to reduce production cost;

-the reduction of the egg production carried out in cage system to 60 % (compared to the EU where is still 75 %) and the increased egg production from the alternative systems of

keeping (40%), mainly barn and free range, because the Romanian farmers' desire to reduce production cost;
-the increased production cost in egg production due to the higher and higher price of farm inputs;
-the low selling price compared to other EU countries;
-the disloyal competition practiced by Poland selling eggs at higher price in Romania and determining the local producers to reduce the price;
-the existence of a about 4 billion eggs produced in the peasant households, which can't be sold in the market as they do not compile with the EU regulations;
-the high production and consumption per inhabitant in the rural areas and the non sufficient production achieved by the commercial companies to cover egg consumption in the urban areas which determines Romania to import eggs;
-the unfavorable market in summer season, but favorable in winter season; however, even thou it is a favorable period, in fall-winter season, the inflow of egg imports is higher and determine a reduction in egg price (44%) affecting the Romanian producers;
-the consumption of eggs is limited by the low purchasing power of the Romanians who have lower income levels per household, by the consumer's lack of knowledge about the high nutritive value of eggs, about how many eggs a person could consume per week, month or year, and how to identify the organoleptic features of the egg on the shelf (freshness, term of availability), traceability (origin of the egg);
-egg quality which does not always compile with the EU standards and restrict the amounts of eggs for export;
-the export based just on a small percentage of processed eggs (5%) compared to other countries which are more oriented for egg processing and trading in order to get a higher export price;
-the strong seasonality of egg consumption with a peak mainly around Easter fest leading to a decline of egg price in the market [4, 21, 23, 26, 29].

CONCLUSIONS

The EU egg market is characterized by an overproduction of eggs which has intensified the egg intra-EU export from the countries with high egg production to the countries with a low output performance. Due to this, the egg price has a slight trend to decline at the EU level, but the price is very different from a country to another. The export price creates advantages for some exporting countries, disadvantaging other countries reflecting a non consequence in respecting the EU regulations. In the Euro-zone and the countries with a subsidized egg sector, production cost is smaller and egg price is high. The egg trade balance is a positive one, as long as the EU is one of the most important egg producer and exporter in the world.
Despite that Romania has a long tradition and high potential for egg production as proved before 1989, at present the production performance is far away from the figures recorded in the old times. The laying hen number and the number of holdings raising hens is low and with a decreasing trend. Egg production registered a decline as well as egg production per inhabitant because of the changes in the poultry growing technologies for producing eggs, the movement from the cage system to the barn and free range systems as decided by breeders in order to reduce production cost. The poultry farmers are facing year by year by the increased price for farm inputs (enriched cages, combined fodder, electricity, water etc), with a deep impact of production cost. Egg price at the farm gate has increased, but it is not at the average EU level and even at the level in the other EU countries. As long as the egg sector in Romania is not subsidized, the poultry breeders are not able many times to cover production cost by egg selling price. The high seasonality in egg production, with peaks in the fall-winter season when the demand is lower, and the seasonality of egg consumption with peaks around Easter has a negative influence of egg price. Egg price declines in the warm season when production is higher, and increases in the fall-winter season when production is lower but the demand is higher.

However, the imports are more intensified on the Romanian market exactly on the fall-winter season, which determine Romanian producers to reduce the selling price. Romania's egg trade balance is still a positive one, but the imports have an increasing trend affecting the Romanian producers.

For the moment, the Romanian egg market remains relatively stable, with a slight decline in the number of laying poultry and egg production. the gap between egg price in Romania and at the EU level is bigger and bigger year by year, because of the lack of subsidies in the Romanian poultry sector.

Also, an important amount of eggs produced in the peasant household is not commercialized in the market due to the fact that the eggs do not compile with the EU standards.

The disloyal competition practiced by Poland exporting eggs at high price on the Romanian market affects the interests of the Romanian producers, obliging them to diminish the selling price.

Taking into account the main aspects and trends identified in the Romania's egg market, some proposals to improve it are required as follows:

-the assurance of subsidies from the Government for poultry farmers both for the egg and meat poultry sectors;

- an easier access to the EU funds in order to keep pace with the technological orientation and to assure equipments and biological material at high standards;

- the improvement of the EU regulation regarding egg export, imposing the countries with high egg production to intensify extra-EU egg export for not affecting the egg producers from the countries were production is lower;

-the EU regulations must be entirely respected by all the EU countries assuring a loyal competition which must stimulate the development of the egg sector in all the EU member states;

-the quality of the commercialized eggs by each EU country must compile from all the points of view with the EU standards in order to assure a real consumer protection;

-at the EU level it is needed a new strategy in the egg producing sector in order to face better the pressures existing in the world egg market;

-also this strategy must avoid the risk of the reduction of egg consumption due to the increased egg price as a result of the extend of free range and organic ways of producing eggs; it is sure that just a low percentage of consumers will desire to pay more for buying eggs;

-in Romania, it is needed a specific strategy for the development of the egg sector in order to strengthen it to be able to face better to the pressures from the EU and world market.

REFERENCES

[1]Agriculture Statistics, Facts and figures. Production, yields and productivity. http://ec.europa.eu/agriculture/sites/agriculture/files/statistics/facts-figures/production-yields-productivity.pdf, Accessed on January 6, 2018.

[2]Balaban, C, 2017, The egg exports of Romania in the EU are inferior to those of Bulgaria, Lithuania, and Latvia, Agerpres, https://www.agerpres.ro/economie/2017/10/13/exporturile-de-oua-ale-romaniei-in-ue-sunt-inferioare-celor-ale-bulgariei-lituaniei-sau-letoniei-10-42-45, Accessed on December 25, 2017

[3]CIRCA, U:\Aviculture\Normes oeufs (communications)\Number of laying hens by way of keeping_CIRCA.xlsx

[4]Covasa Ana-Maria, Cofas, V., 2016, The market of the poultry products in the EU and Romania (Piata produselor avicole in UE si Romania), AviMagazine No.3/2016.

[5]Covasa Ana-Maria, Cofas, V., 2016, The market of poultry products in EU in 2015 and at the beginning of the year 2016, AviMagazine No.1/2016, pp.8-16

[6]EU, Agriculture and farm income. http://ec.euorpa.eu/agriculture/sites/agriculture/files/statistics/facts-figures/agricultural-farm-income.pdf, Accessed on January 6, 2018.

[7]EU Agriculture Outlook for the agricultural markets and income 2017-2030, 18 Dec.2017, https://ec.europa.eu/agriculture/sites/agriculture/files/markets-and-prices/medium-term-outlook/2017/2017-fullrep_en.pdf, Accessed on January 8, 2018.

[8]EU, Egg, http://ec.europa.eu/agriculture/eggs.ro, Accessed on December 20, 2017

[9]Eurostat, 2016, Egg- Market situation, Dashboard, 2016

[10]Eurostat, 2016, EU Agriculture, Forestry and Fishery Statistics, 2016 edition.

[11]Eurostat, 2017, Comext, Eggs, Tonnes egg equivalent, 2017

[12] Global Poultry Trends, 2015, Europe Dominates

World Egg Trade, April 8, 2015, http://www.thepoultrysite.com/articles/3421/global-poultry-trends-europe-dominates-world-egg-trade/, Accessed on December 18, 2017

[13]Global Poultry Trends - Egg Consumption Continues to Grow in Americas, 2015, March 25, http://www.thepoultrysite.com/articles/3395/global-poultry-trends-egg-consumption-continues-to-grow-in-americas/, Accessed January 7, 2018.

[14]Grigoras, M.A., 2016, Trends in Romania's animal production, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.16(4)2016, 137-148

[15]Kritchevsky, S.B. (2004). A review of scientific research and recommendations regarding eggs. J. Am. Coll. Nutr. 23(6):596-600.

[16]Mc Dougal Tony, 2017, Eggs, 75 5 of the EU egg production is concentrated in 7 countries, 15 Sept.2017, http://www.poultryworld.net/Eggs/Articles/2017/9/75-of-EU-egg-production-is-concentrated-in-7-countries-184560E/, Accessed on Dec. 28, 2017.

[17]Mincu, I. (1993). The impact human being-food. Medical Publishing House.

[18]Mulder Nan-Dirk, 2017, Outlook for the Global and EU industry, Shapen the industry for competitiveness, Poultry Congress, 2017.

[19]National Institute of Statistics, Tempo online Data base, 2017

[20]Pirvutoiu, I., Popescu Agatha, 2012, Research on the Major Trends in the Romanian Egg Market, Bulletin UASVM Horticulture, 69(2)/2012, 229-238

[21]Pop Patricia Alexandra, 2016, The Romanian eggs in competition with the Polish ones, Agribusiness, May 9, 2016, http://www.agro-business.ro/ouale-romanesti-in-competitie-cu-cele-poloneze/2016/05/09/, Accessed on January 4, 2018

[22]Poultry Trends 2017, www.poultry.trends.com/201711/Accessed on January 5, 2018

[23]Rogalski, D., 2017, The Romanians and the egg consumption: Eight of ten consume weekly, but less that a half have correct knowledge about egg properties, 7 dec 2017, https://www.smark.ro/articol/41045/romanii-si-consumul-de-oua-opt-din-zece-le-consuma-saptamanal-mai-putin-de, Accessed on January 5, 2018

[24]Single CMO [Council Regulation (EC) No 1234/2007 of 22 October 2007

[25]Statistical Factsheet, European Commission, Romania, June, 2017, https://ec.europa.eu/agriculture/sites/agriculture/files/statistics/factsheets/pdf/eu_en.pdf, Accessed on December 20, 2017.

[26]The Romanians buy 180 million eggs in the period of Easter feast, 2017, https://ziarmm.ro/romanii-cumpara-180-de-milioane-de-oua-in-perioada-sarbatorilor-pascale/, Acceseed on January 4, 2018

[27]Vacaru-Opris, I. (2007). Treatise of Aviculture, Vol. I, Ceres Publishing House, Bucharest.

[28]Van, I., 2016, 55 years of industrial poultry farming in Romania, AviMagazine No.3/2016, pp.2-4

[29]Van Ilie, 2017, Is the agro-food market of the EU a competitive or concurential market? (Este piata agroalimentara a UE o piata competitiva si concurentiala?), 24 March 2017, http://www.avicultura.ro/este-piata-agroalimentara-UE28-competitiva-concurentiala, Accessed on December 20, 2017.

[30]Van, I, 2016, The Romanian poultry breeders, good technologists, but the marketing must be improved, AviMagazine No.1/2016, 2-4

[31]Wee Y. Rolando, 2017, Top egg producing countries in the world, http://www.worldatlas.com/articles/top-egg-producing-countries-in-the -world.html, Accessed on January 6, 2018

THE COMPARATIVE EFFICIENCY IN ROMANIA'S FOREIGN TRADE WITH CEREALS, 2007-2016

Agatha POPESCU, Toma Adrian DINU, Elena STOIAN

University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest Romania, Phone: +40213182564, Fax: +40213182888, Email: agatha_popescu@yahoo.com, tomadinu@yahoo.fr, stoian_ie@yahoo.com

Corresponding author: agatha_popescu@yahoo.com

Abstract

The purpose of the paper was to analyze Romania's foreign trade with cereals in order to point out its efficiency by type of traded cereal in the period 2007-2016 using the empirical data provided by the National Institute of Statistics. The study required a large variety of specific indicators and methods to reach its goal. In the period 2007-2016, both cereal export and import value increased, accounting for Euro 2,097.2 Million export and for Euro 591.1 Million import. As a result, Romania is a net exporting country of cereals as its trade balance was Euro 1,505.1 Million. Also, the volume of cereal trade increased by 5.36 times, reaching Euro 2,689.3 Million in 2016, the export per inhabitant increased reaching Euro 106.13/capita, and the coverage degree of import by export was 3.54 by 6 times higher than in 2007. In 2016, in the agro-food trade of Romania, cereals represented 35 % in the export value and 9 % in the import value. In 2016, the share of various cereals in the cereal export value accounted for: wheat 55.3 %, maize 34.4 % and barley 9.15 %, all together totalizing 98.85%, while the share of these cereals in cereal import value accounted for: wheat 56.9 %, maize 24.9 %, barley 11.9 % and rice 5.1 %, all together accounting for 98.8 %. In 2016, the trade balance for the main traded cereals was positive: wheat Euro 823.4 million, maize Euro 574.3 million, and barley Euro 121 million. The index of coverage degree of import by export was: 4.9 for maize, 3.4 for wheat, 3.1 for oats, 2.7 for barley, 1.9 for sorghum, 0.4 for rice and 0.3 for rye. The main trade partner for cereal export is the EU with a share of 30.7 %, the difference being represented by countries from the extra-EU market, and for import the EU had the top position with 95.8 % market share. The hierarchy of the cereals, in the decreasing order of the efficiency of their trade was the following one: wheat, barley, maize, rye, sorghum, oats and rice. But, the main cereals which deserve to be traded on external markets are wheat, maize and barley. This analysis has drawn the conclusion that Romania must commercialize more cereals with a high efficiency in foreign trade in terms of high export value, low import value, high positive trade balance and a high index of coverage degree of import by export. The positive trade balance had a good impact on the payment balance and on the economic growth.

Key words: *cereals, foreign trade, Romania, efficiency*

INTRODUCTION

Cereals are a strategic food for humans and for animals, and also an important raw material for processing industry [5, 6].

The international trade with cereals is running by means of the activities carried out by the main "market actors": producers, exporters and importers in the context of the continuous of cereals demand and consumption.

However, at the world level, there is a gap between the developed and developing countries regarding cereals supply which will become more accentuated in close relationship with the demographic evolution.

Trade balance is the most synthetic indicator reflecting efficiency of the international trade of a country. It places each country in the hierarchy of the global international trade and reveals its competitiveness among other "traders".

The flows of commercialized cereals in terms of export and import are determined by the relationship existing between production and consumption in different countries, by production factors and random items, by the benefits and the advantages of a country and by cereals price in various markets.

At the world level, the value of cereals export accounted for USD 118.9 Billion in 2014, being by 41 % higher than in 2010. The largest world exporting countries are: USA, India, France, Canada, Australia, Russian Federation, Ukraine, Thailand, Argentina,

Brazil and Germany [11, 21].
The market share of the top 10 exporters of cereals is 73.2 % in the world export value with cereals. The EU-28 is an important producer and trader of cereals worldwide. In 2016, it cultivated 57 million ha with cereals and harvested 301.3 million tonnes, representing 11.6 % of the global cereal production. [5]. In 2016, cereal production achieved by the EU was by 2.6 % higher than in the period 2000-2015, while the cultivated surface declined by 7.5 %. As a result, cereal production per inhabitant recorded 590 kg/capita in 2016.
The market share of the main cereals producers in the EU is: France 18 %, Germany 15.1 %, Poland 9.9 %, Spain 8 % and all together totalize 50 %.
With 21.8 million tonnes, Romania came on the 6th position among the top cereal producers in the EU-28 in 2016, after France, Germany, Poland, Spain, United Kingdom [8,9,10].
The EU-28 is a net exporter of cereals. In 2016, the EU-28 exported 33.15 million tonnes of cereals in grain equivalent, by 18.01 more than in 2013. Its export consists mainly of wheat (15 % of production) and barley. The main imported cereal by the EU is maize and also other grains [25].
Romania's agriculture is deeply oriented to grain production, whose contribution to GDP created in agriculture is about 5-6 % [24]. Wheat, maize, barley and oats are the main cereals produced in Romania with a share of 95 % in the cereal market. Wheat and maize are the most competitive cereals in the external market [28].
Romania is not only an important cereal producer, but also one of the most important exporters of the EU. Also, Romania is situated among the top 15 exporters of cereals in the world. In 2017, Romania was the main EU supplier of cereals, exporting 7.15 million tonnes, representing 1/4 of the EU export from the 2016-2017 harvest. Wheat is the most important cereal exported by Romania (70%).
The actual performance in cereal foreign trade of Romania is the result of many efforts done along the time. While the cultivated area registered a decline compared to 2007, the year when Romania became an EU member state, production has grown grace to the new technologies applied [1,2,3, 16,17].
In this context, the present paper aimed to analyze Romania's cereal foreign trade at the cereal group level, but also by each type of cereal using some specific indicators such as export, import, trade balance, export/inhabitant, coverage of import by export in the period 2007-2016. The final purpose is to establish the hierarchy of the traded cereals based on their efficiency in the foreign trade of the country as a basis for developing a more adequate strategy in cereal trade in the international market.

MATERIALS AND METHODS

Study area.
The cereals trade analyzed in this study refers to Romania which is an important cereal producer, exporter and importer in the EU and even in the world. Located in South Eastern Europe, it lies between the latitudes 43° and 49°N and longitudes 20° and 30° E. Its surface accounts for 238,391 square kilometers. The relief is like an amphitheater including 1/3 mountains, 1/3 hills and 1/3 plains. It has a typical temperate continental climate with four seasons, and favorable soils for cereals cropping [23].
In 2016, of 8.9 million ha cultivated area, 5.486 million ha were cultivated with cereals representing 23 % of the total area of Romania, and 36.99 % of the agricultural surface which is 14.83 million ha.
The main cereals cultivated in Romania are: wheat, maize, barley, oats, rye, sorghum and rice. The cereal production has substantially grown along the time reaching 21.7 million tons in the year 2016, being by 178.5 % higher than in 2007. The share of various types of cereals is: 49.3 % maize, 38.7 % wheat, 5.8 % barley and 1.7 5 oats, all together representing 95.5% in the cereals production.
The growth of cereal production was more intense after Romania's access into the EU. The modern technologies, high performance varieties and hybrids, the extend of irrigation

and the use of fertilizers and plant protection measures have contributed to the cereal sector development. However, the high production level has diminished cereals price in the domestic market and contributed to the growth of cereals export. This was also determined by the non sufficient capacity of storage for the whole cereal production. Also, the imports were justified to complete the internal offer mainly in the years when extreme phenomena (droughts, rainfalls etc) have diminished the production performance [22].

Data collection.

In order to set up this study, the primary empirical data were collected from various data bases represented mainly by the National Institute of Statistics, Tempo on line, Eurostat Statistics Explained and United Nations COMEXT Data Base [8,9,10, 13,14, 27].

The main current information was studied from various sources represented by research articles and EU reports regarding cereal production and Romania's position among the cereal producers and traders.

The main specific indicators used to characterize Romania's trade with cereals in the period 2007-2016 were the following ones:

-the value of cereal export, import and trade balance, determined for the group of cereals and also by category of cereal;

-the foreign trade volume (TV) with cereals;

-cereals export per inhabitant;

-the index of coverage degree (ICV) of import by export; this indicator was calculated at the cereal group level and also by each category of cereal;

-the cereal foreign trade concentration;

-the structure of export and import by type of cereal;

-the geographical orientation of cereals trade mainly with the EU-28, as the principal partner for export and with other extra-EU partners as well.

The utilized methods have been the following ones:

Index method based on the index with fixed basis, calculated according to the formula: $I_{FB} = (X_n/X_0)*100$ in order to characterize the dynamics of each indicator in the analyzed period. All the indicators mentioned above were analyzed in their dynamics in the period 2007-2016 computing the fixed indices taking into account the year 2007 as term of reference.

The foreign trade volume (TV) with cereals was calculated as the sum between export, E, and import, I, of cereals, according to the formula: TV= E + I.

The cereal export per inhabitant was calculated as a ratio between the export value divided by the population of Romania in each year of the analysis.

The index of coverage degree (ICV) of import by export was calculated according to the formula: ICV= E/I.

The cereal foreign trade concentration was determined based on Hirschman coefficient, as the share of cereals trade in Romania's agro-food trade.

The structure of export and import by type of cereal was established dividing the export value or import value recorded by each cereal in the total value of cereal export or cereal import, in percentage.

The geographical orientation of cereal foreign trade was discussed based on the share of each destination country for Romania's cereal export and also based on the share of various suppliers in Romania's cereal import [15].

Statistical parameters such as: *Mean, Standard Deviation and Coefficient of variation* have been also determined for each of the analyzed indicators in this study.

Point Method was used to compare the efficiency of each cereal in foreign trade. The method used a series of criteria such as: export value, import value, trade balance and index of coverage degree to evaluate the efficiency in foreign trade. For each criterion, each type of cereal received a position ranging from 1 to 7, having the following meaning in the decreasing order as importance:

1- for the highest value of export, trade balance and ICD;

7- for the lowest value of export, trade balance and ICD;

1- for the lowest value of import;

7-for the highest value of import.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Finally, the figures (numeric score) of the positions received for all these four criteria have been added up, resulting a total number of points. The hierarchy of the cereals was established based on the number of total points. On the top position was placed the cereal with the lowest number of points and on the last position the cereal with the largest number of points.

The results were compared among various cereals indentifying the type of cereal with the highest impact on the foreign trade efficiency [4].

All the results of this study were tabled and graphically illustrated and correspondingly interpreted. Finally, the conclusions pointed out the main ideas and were followed by recommendations how Romania's cereal trade could become more efficient.

RESULTS AND DISCUSSIONS

The dynamics of Romania's export, import and trade balance for cereals

Romania is an important cereals exporting country. In 2016, its cereals export value accounted for Euro 2,097.2 Million, being 13.85 times higher than in 2007.

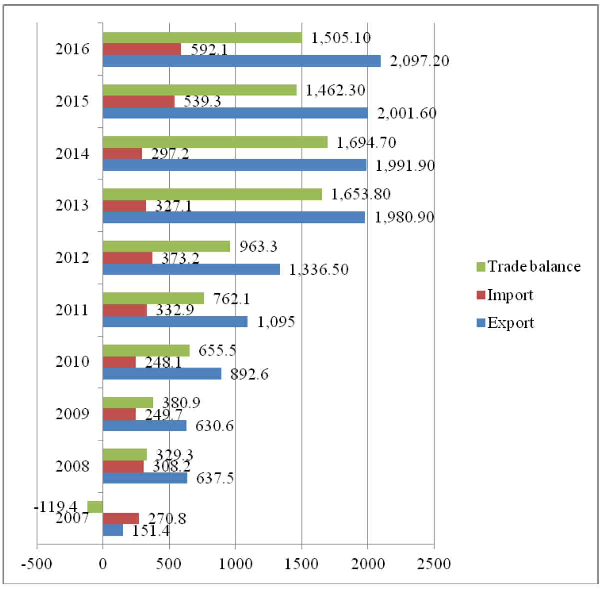


Fig.1. The dynamics of Romania's cereals export value, import value and trade balance, 2007-2016 (Euro Million)

Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018, [13].

At the same time, Romania is a cereals importing country, its cereals import value in the year 2016 accounted for Euro 591.1 Million, being 2.18 times higher than in 2007.

Therefore, both cereal export and import increased. However, cereal export value has recorded a higher growth rate compared to import value.

As a result, the trade balance was a negative one only in the year 2007, but then it has become a positive one, being characterized by a continuous ascending trend. In 2016, the cereals trade balance accounted for Euro 1,505.1 Million, being 12.6 times higher than in 2007 (Fig.1.).

The dynamics of Romania's foreign trade volume for cereals

Taking into account both the cereal export value and import value, the volume of foreign trade with cereals increased by 536.97 % in the analyzed period from Euro 422.2 Million in the year 2007 to Euro 2,689.3 Million in 2016 (Fig.2.).

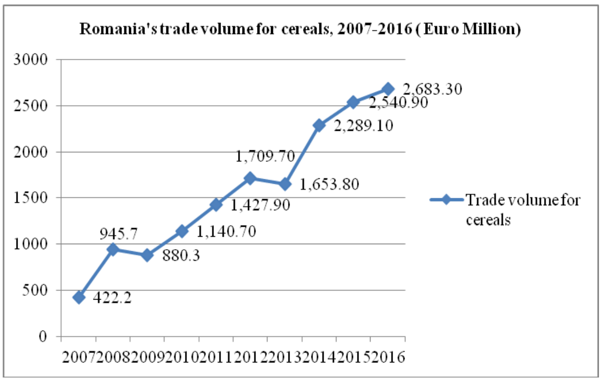


Fig.2. The dynamics of Romania's trade volume for cereals, 2007-2016 (Euro Million)

Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018, [13].

The dynamics of cereals export value per inhabitant has registered a continuous increasing trend in the analyzed period, from Euro 7.16/capita in 2007 to Euro 106.13/capita in the year 2016. Therefore, in 2016, the cereal export value per inhabitant was 14.82 times higher than in 2007, due to the growth of export and the decline of the population (Fig.3).

The dynamics of the coverage degree of cereals import by export. The index of the coverage degree of cereals import by export (ICD) increased 6.43 times in the analyzed period, in 2016, it accounted for 3.54 compared to 0.55 in 2007. It was noticed a peak value of 6.7 in the year 2014. therefore, the ICD values are higher than 1, starting from the year 2008 till the last year of the chronological series of time (Fig.4).

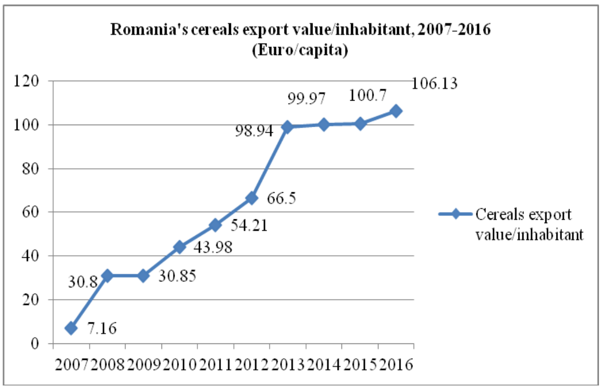


Fig. 3. The dynamics of Romania's cereals export value/inhabitant, 2007-2016 (Euro/capita)
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

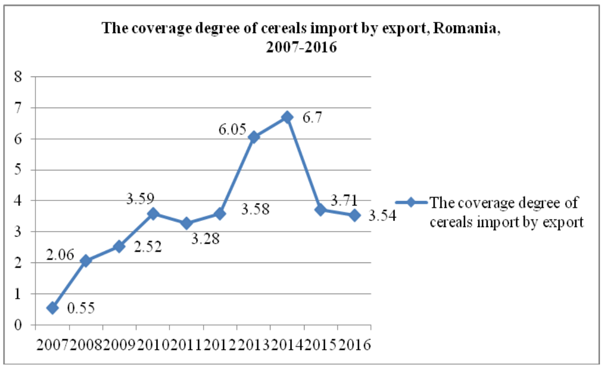


Fig. 4. The dynamics of the coverage degree of the cereals import by export, Romania, 2007-2016
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The dynamics of foreign trade concentration was reflected by the share of cereals trade value in Romania's agro-food trade. The share of cereals export value in Romania's agro-food export value increased from 13.45 % in the year 2007 to 34.60 % in the year 2016, i.e. 2.57 times. At the same time, the share of cereals import value in Romania's agro-food import value increased by only 7.64 %, from 8.11 % in 2007 to 8.73 % in 2016. A peak of 37.48 % was recorded in the year 2013 (Fig. 5).

This reflects that more than 1/3 of Romania's agro-food export value is coming from cereals (raw materials. The cereals import value represents 8.7 % of Romania's import value with agro-food products.

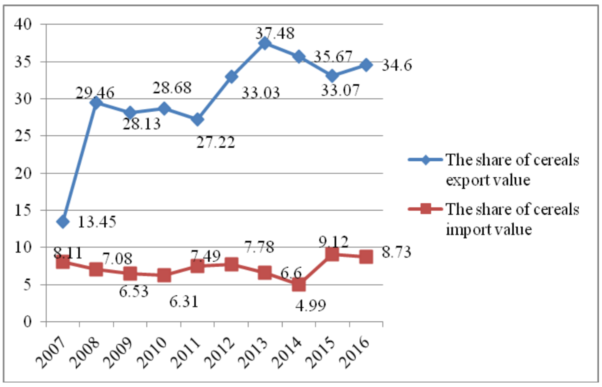


Fig. 5. The dynamics of the share of the cereals export value in Romania's agro-food export value, and the share of cereals import value in Romania's agro-food import value (%)
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The dynamics of export value by type of cereal reflects that all the cereals exported by Romania: wheat, maize, barley, oats, rye, sorghum and rice recorded an ascending trend of their export value.

Wheat is on the top position with the highest export value in 2016, accounting for Euro 1,160.7 Million, being 24.96 times higher than in 2007 (Euro 46.5 Million).

Maize comes on the 2nd position with Euro 722.1 Million export value in 2016, being 9.48 times higher than in 2007 (Euro 76.1 Million).

Barley is on the 3rd position with an export value of Euro 192 Million in 2016, which was 7.19 times higher than in 2007 (Euro 26.7 Million).

Rice comes on the 4th position with Euro 12.81 Million export value in 2016, when it was 11.04 times higher than in 2007 (Euro 1.16 Million).

Sorghum is on the 5th position with an export value of Euro 2.42 Million in 2016, being by 93 times higher than in 2008. In 2007, Romania did not export this type of cereal.

Oats comes on the 6th position with Euro 1.12

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Million export value in 2016, when it was 37.33 times higher than in 2007 (Euro 0.03 Million).

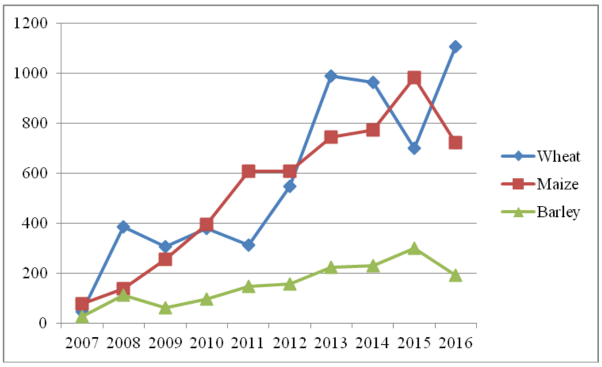


Fig.6.The evolution of the export value for wheat, maize and barley, Romania, 2007-2016 (Euro Million)
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

Rye comes on the 7th position with the smallest export value, Euro 0.067 Million, in 2016, but 11.16 times higher than in 2007 (Euro 0.006 Million).

Therefore, the most important cereals exported by Romania, in the descending order of their export value are the following ones: wheat, maize, barley and rice, which totalized Euro 2,087.61 Million in 2016, representing 99.5 % of the total cereals export value.

The evolution of the export value for wheat, maize and barley is graphically illustrated in Fig.6 and for oats, rye, sorghum and rice in Fig.7.

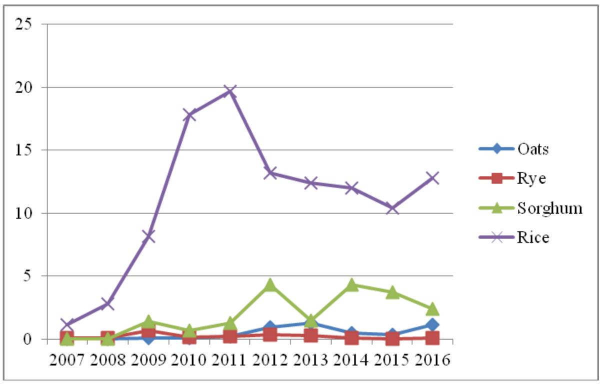


Fig.7.The evolution of the export value for oats, rye, sorghum and rice, Romania, 2007-2016 (Euro Million)
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The dynamics of the structure of cereals export value by type of cereal is presented in Table 1. This table shows that the main cereal crops in the cereals export value are wheat, maize and barley, all together representing 98.8 %.

In the analyzed period, the share of ***wheat*** in the cereals export value registered a relatively continuous growth from 30.7 % in the year 2007 to 55.3 % in 2016. ***Maize*** represented 50.2 % in the cereals export value in 2007, and its share varied along the years with a peak of 55.4 % in the year 2011, and then registered a decline reaching 34.4 % in 2016.

Table 1. The dynamics of the share of each cereal in the Romania's cereals export value, 2007-2016 (%)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wheat	30.70	60.40	48.3	42.3	28.5	41.0	49.9	48.3	34.9	55.3
Maize	50.20	21.70	40.3	44.3	55.4	45.5	37.6	38.8	49.0	34.4
Barley	17.60	17.30	9.50	10.7	13.4	11.6	11.3	11.5	14.9	9.15
Oats	0.001	0.003	0.01	0.01	0.02	0.06	0.07	0.02	0.01	0.05
Rye	0.003	0.010	0.10	0.01	0.002	0.03	0.01	0.002	0.0007	0.003
Sorghum	0	0.004	0.20	0.07	0.11	0.32	0.07	0.21	0.18	0.11
Rice	0.70	0.40	1.30	2.00	1.80	0.99	0.62	0.60	0.51	0.61
Other cereals	0.70	0.20	0.30	0.7	0.75	0.50	0.43	0.57	0.50	0.38

Source: Own calculations based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The weight of ***barley*** declined from 17.6 % in 2007 to 9.15 % in 2016 in the cereals export value. All the other cereals: oats, rye and rice recorded a small and decreasing share in the analyzed period, except Sorghum whose weight accounted for 0.11 % in 2016 (Table 1).

The dynamics of the import value by type of cereal is presented in Fig.8 and 9.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

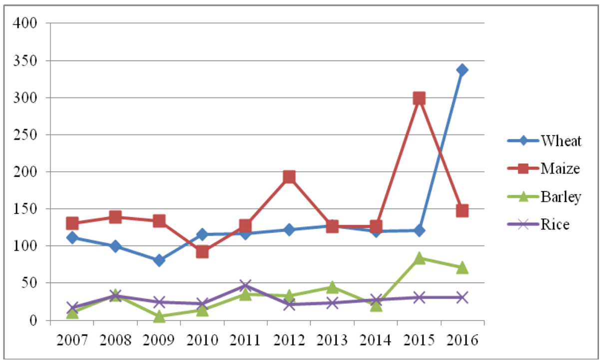


Fig. 8.The evolution of the import value for wheat, maize, barley and rice, Romania, 2007-2016 (Euro Million)
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The figure reflects that all the cereals, except sorghum, registered an increasing trend of their import value in the period 2007- 2016. In 2016, the ***wheat*** import value was Euro 337.3 Million, 3.03 times higher than in 2007 (Euro 111.1 Million). The ***maize*** import value reached Euro 148.8 Million in 2016, being 1.13 times higher than in 2007 (Euro 130.2 Million), with a peak of Euro 196.3 in the year 2012. The import value of ***barley*** accounted for Euro 71 Million in 2016, being 6.7 times higher than in 2007 (Euro 10.5 Million).

The import value of ***rice*** increased 1.79 times, in 2016 accounting for Euro 30.5 Million, compared to Euro 17 Million in 2007. These four cereals: wheat, maize, barley and rice totalized Euro 586.6 Million import value in 2016, weighting 99.4 % of the cereals import value of Romania.

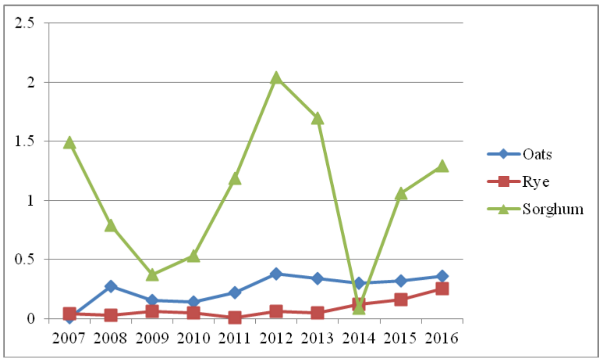


Fig. 9.The evolution of the import value for oats, rye, and sorghum, Romania, 2007-2016 (Euro Million)
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The evolution of the import value for wheat, maize, barley and rice is presented in Fig.8 and for oats, rye and sorghum in Fig.9.

The dynamics of the structure of cereals import value is presented in Table 2. The figures from this table show that the highest share in the cereals import value in the year 2016 belonged to: wheat 56.9 %, maize 24.9 %, barley 11.9 % and rice 5.1 %, all together accounting for 98.8 %. All the cereals imported by Romania registered an increasing weight in the cereals import value, except maize, sorghum and rice, whose share declined in 2016 compared to the year 2007 (Table 2).

Table 2. The dynamics of the share of each cereal in the Romania's cereals import value, 2007-2016 (%)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wheat	41.00	32.20	32.30	46.70	35.10	32.60	39.00	40.30	22.30	56.90
Maize	48.00	45.00	53.50	37.40	38.30	51.80	38.60	42.50	55.30	24.90
Barley	3.80	10.90	2.24	5.80	10.50	8.70	13.70	6.69	15.50	11.90
Oats	0.003	0.08	0.06	0.05	0.06	0.26	0.10	0.10	0.005	0.06
Rye	0.01	0.009	0.02	0.02	0.002	0.01	0.01	0.04	0.02	0.04
Sorghum	0.55	0.25	0.14	0.21	0.35	0.54	0.51	0.03	0.19	0.21
Rice	6.27	10.80	9.70	9.18	13.90	5.60	7.30	9.40	5.80	5.10
Other cereals	0.39	0.77	2.04	0.64	1.79	0.45	0.78	0.94	0.89	0.99

Source: Own calculations based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The dynamics of the trade balance for each category of cereal. Taking into account the evolution of export and import value by category of cereal, the trade balance is presented in Table 3. The figures from this table reflect that the value of trade balance registered an ascending trend from 2007 to 2016 in general in case of wheat, maize, barley, oats and sorghum, and a decreasing trend in case of rye and rice.

In case of ***wheat***, in 2007, the trade balance was a negative one, while in all the coming years it has become a positive one, registering a peak of Euro 862 Million in 2013, and in 2016, Euro 823.4 Million.

Maize registered a negative trade balance in 2007 and 2008, but a positive one in all the other years with a peak of Euro 683.9 Million in 2015 and in 2016, Euro 574.3 Million.

Barley recorded only a positive trade balance in each year of the analyzed period. The peak was Euro 215.5 Million registered in the year 2015, and in 2016, it was recorded Euro 121 Million, 7.46 times more than in 2007.

Oats had a positive balance in 2007, but in the period 2008-2011, it recorded a negative one, and in the last years 2012-2016, its trade balance was a positive one, with a peak of Euro 0.95 Million in 2013 and in 2016 it registered Euro 0.76 Million, being 38 times higher than in 2007. In 2015, the trade balance of oats was zero as the export value was equal to import value.

Rye recorded a negative trade balance in 2007, and also in the period 2014-2016. In the years 2008-2013, oats trade balance was a positive one with a peak of Euro 0.29 Million in the year 2012. In 2016, rye recorded minus Euro 0.18 Million, being 5.29 times a higher deficit compared to the 2007 level.

Sorghum had a negative trade balance in 2007, 2008 and 2013, but a positive one in all the other years, with a peak of Euro 4.22 Million in the year 2014, and in 2016 Euro 1.13 Million.

Rice recorded a negative trade balance in all the analyzed years, in 2016, the deficit accounted for Euro 17.69 Million, being 1.11 times higher compared to the 2007 level (Table 3).

Table 3. The dynamics of the trade balance sheet by each category of cereal, Romania, 2007-2016 (Euro Million)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wheat	-64.6	285.9	223.8	262.1	196.0	426.6	862.0	843.2	579.8	823.4
Maize	-54.1	-0.4	121.1	303.3	479.1	414.6	617.9	646.3	683.9	574.3
Barley	16.2	76.6	54.9	81.1	111.5	123	178.9	208.5	215.5	121.0
Oats	0.02	-0.25	-0.06	-0.05	-0.01	0.38	0.95	0.17	0	0.76
Rye	-0.034	0.034	0.59	0.10	0.21	0.29	0.24	-0.07	-0.14	-0.18
Sorghum	-1.49	-0.76	1.06	0.17	0.07	2.25	-0.21	4.22	2.69	1.13
Rice	-15.8	-30.6	-16.2	-4.95	-26.84	-7.97	-11.49	-15.8	-21.0	-17.69

Source: Own calculations based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The dynamics of the coverage degree of cereal import by export by category of cereal is presented in Table 4.

The values of the ICD have been > 1 in the period 2007-2016 in case of ***wheat,*** except the year 2007 (ICD=0.4). The peak accounted for ICD=8 in the year 2014. In 2016, the ICD value was 8.5 times higher than in 2007.

In case of ***maize,*** the ICD value accounted for 4.9 in the year 2016, being 8.1 times higher compared to the level recorded in the year 2007. Maize registered a peak ICD= 6.1 in the year 2014, and the lowest value, ICD=0.6, in 2007.

The ICD for ***barley*** was 2.7 in the year 2016, being by 8 % higher than in 2007. A peak of ICD = 10.8 was noticed in the year 2009.

Oats recorded ICD=3.1 in 2016, by 3 % higher than in 2007 and a peak of this index, ICD=3.7, in 2013.

Rye increased its ICD 3 times in the analyzed period, reaching 0.3 in the year 2016. However, in 2011, rye recorded a peak of 24.4 and in 2009 another peak of 10.8.

The ICD for ***sorghum*** accounted for 1.9 in the year 2016, being 1.9 times higher than in 2007. The top value was 3.8 registered in the year 2009.

The ICD of ***rice*** increased 6.6 times from 0.06 in the year 2007 to 0.4 in 2016. Rice is the only cereal with an ICD < 1 in all the years, as export value exceeded the import value.

The dynamics of the coverage degree of import value by export value by type of cereal of Romania in the period 2007-2016 is presented in Table 4 and Fig.10.

Table 4. The dynamics of the coverage degree of import value by export value by type of cereal, Romania, 2007-2016

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2016/2007 %
Wheat	0.4	3.8	3.7	3.2	2.6	4.5	7.7	8	5.8	3.4	850.0
Maize	0.6	1.0	1.9	4.3	4.7	3.1	5.8	6.1	3.3	4.9	816.6
Barley	2.5	3.2	10.8	6.6	4.2	4.7	5.0	11.5	3.6	2.7	108.0
Oats	3.0	0.07	0.6	0.6	0.9	2.4	3.7	1.5	1	3.1	103.0
Rye	0.1	2.1	10.8	3.0	24.4	5.8	5.8	0.4	0.1	0.3	300.0
Sorghum	0	0.03	3.8	1.3	1.1	2.1	0.9	4.1	3.5	1.9	190.0
Rice	0.06	0.08	0.3	0.7	0.4	0.6	0.5	0.4	0.3	0.4	666.0

Source: Own calculations based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

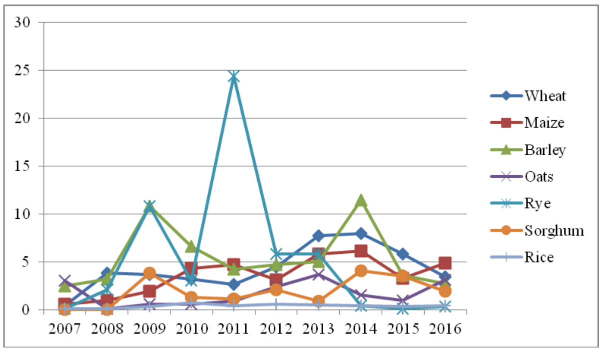


Fig.10. The dynamics of the index of coverage degree of import by export by type of cereal, Romania, 2007-2016
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

The dynamics of the geographical orientation of Romania's cereals export and import. The main trade partner in Romania's trade with cereals is the EU-28.

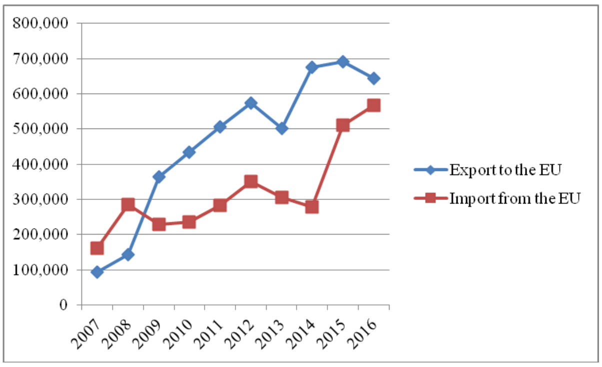


Fig.11.The dynamics of Romania's cereals export value to the EU-28 and import value from the EU-28, 2007-2016 (Euro Thousand)
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

In 2016, Romania' cereals export value to the EU-28 accounted for Euro 645,243 thousand, being 6.88 times higher compared to the level of 2007. Also, in 2016, Romania's import value of the cereals bought from the EU-28 was Euro 567,437 thousand, being 3.53 times higher than in 2007 (Fig.11).

The EU share in Romania's cereals export value declined from 61.8 % in the year 2007 to 30.7 % in 2016, while the share in the cereals import value increased from 59.3 % in 2007 to 95.8 % in 2016. Therefore, the EU-28 is an important destination for the Romanian cereals, with a market share of 30.7 % in 2016 and also the main cereals supplier with a market share of 95.8 % in the same year. Also, this means that about 2/3 of Romania's cereals export value is determined by the cereals sold in the extra-EU markets (Fig.12.).

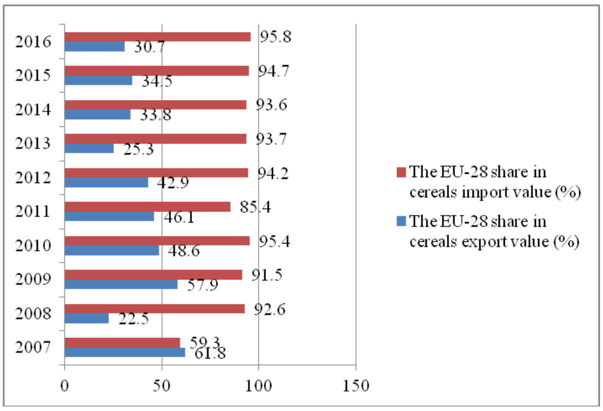


Fig. 12. The dynamics of the EU-28 share in Romania's cereals export and import value, 2007-2016 (%)
Source: Own design based on the data provided by the National Institute of Statistics, Tempo Online Data base, 2018 [13].

According to the United Nations Comtrade Data Base [28], as mentioned by Trading Economics [26] in 2016, Romania's cereals export value accounted for USD 2,226.04 Million and the market share of the beneficiary countries was as presented in Table 5.

Making a simple calculus, it was identified that 71.3 % of Romania's export value was carried out with the extra-EU countries, accounting for USD 1,537.24 Million, compared to 28.67 % in case of the intra-EU trade with cereals which accounted for USD 688.8 Million.

Table 5.Romania's cereals export value and the market share by beneficiary country in the year 2016

Romania's cereals export value in 2016 (USD Million)								
Country	Export value USD Million	%	Country	Export value USD Million	%	Country	Export value USD Million	%
1.Egypt	286	12.0	14.Djibouti	48.5	2.0	27.Irak	25.2	1
2.Jordan	188	7.8	15.Morroco	44.9	1.9	28.Germany	23.9	0.99
3.Spain	187	7.7	16.Portugal	38.8	1.6	29.Austria	23.9	0.99
4.Vietnam	169	7.0	17.Lebanon	38.5	1.6	30.Belgium	23.6	0.98
5.Lybia	135	5.6	18.United Arab Emirates	36.7	1.5	31.Syria	23.4	0.97
6.Italy	104	4.3	19.Tunisia	36.5	1.5	32.Cyprus	21.8	0.91
7.Saudi Arabia	92.8	3.9	20.Russia	35	1.5	33.Indoneasia	21.3	0.88
8.Ehiopia	77.9	3.2	21.Ukraine	34	1.4	34.South Korea	20.4	0.85
9.Netherlands	66.9	2.8	22.Hungary	34	1.4	35.Japan	10.9	0.45
10.Israel	62.9	2.6	23.Turkey	33.7	1.4	36.Iran	10.8	0.45
11.France	59.5	2.5	24.Bulgaria	28.1	1.2	37.Thailand	10.2	0.42
12.Sudan	52.2	2.2	25.Ireland	27.8	1.2	38.Nigeria	8.88	0.37
13.Greece	49.5	2.1	26.Bangladesh	25.9	1.1	39.Kuweit	8.66	0.36

Source: Trading Economics, http://tradingeconomics.com/romania/exports/cereals/, Accessed on January 11, 2018 [26].

Romania is on the 3rd position in the EU for the cereal export in the extra-EU markets and for maize export on the top position. The amounts of cereals exported in the extra-EU markets and the position of Romania export to other destinations are presented in Table 6. In 2015, Romania was on the 1st position for maize, on the 3rd position for wheat and also on the 3rd position for barley [18].

Table 6. Romania's export of cereals in the extra-EU markets, 2007-2015

	MU	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015
Cereal exported quantities	Million tonnes	0.57	3.5	1.4	2.2	3.5	3.4	7	2.1
Position in the EU	-	5	3	3	3	2	3	3	3
The share in the extra EU deliveries	%	3.9	12.3	6.2	8.1	16.1	12.2	17.7	5.4

Source: Razi, G., 2014, Romania is on the 3rd position in the EU for the cereal export to the extraEU markets. For maize, it is on the 1st position. www.zf.ro/companii/retail-agrobusiness/romania-este-pe-locul-trei-in-UE-la-exportul-de-cereale-catre-pietele-extracomunitare-la-porumb-este-pe-primul-loc-13432403/24 Oct.2014, Accessed on January 13, 2018, [18].

In 2016, Romania exported 6.9 million tonnes wheat, of which 80 % in the extra EU markets. Compared to 2015, this means 2.09 times more exported cereals [14,19]. In the first nine months of the year 2017, Romania exported 7.87 million tonnes cereals [12,20].

The estimated efficiency of Romania's cereals foreign trade based on Point Method. Based on the numeric score or position received for export, value, import value, trade balance and index of coverage degree of import by export, it was calculated

the total sum of points received by each cereal. This sum has allowed to establish the hierarchy of cereals as follows:
-for the lowest sum, a cereal was placed on the 1st position, meaning that it has the most efficient foreign trade;
- for the highest sum, a cereal received was placed on the 7th position, reflecting that the cereal has the lowest efficient foreign trade.
The results are shown in Table 7.

Table 7. The comparative position of each cereal reflecting the efficiency of foreign trade based on Point Method applied for the criteria: export value, import value, trade balance and index of coverage degree of import by export

	Position for Export value	Position for Import value	Position for Trade Balance	Position for Index of Coverage Degree	Total points	Final position in the hierarchy
Wheat	1	6	1	3	11	1
Maize	2	7	2	4	15	3
Barley	3	5	3	1	12	2
Oats	6	2	5	6	19	6
Rye	7	1	6	2	16	4
Sorghum	5	3	4	5	17	5
Rice	4	4	7	7	22	7

Source: Own calculations.

The figures show that the most efficient foreign trade was achieved in case of wheat, followed in the decreasing order by: barley, maize, rye, sorghum, oats and rice.
The statistical parameters for all the studied indicators are presented in Table 8.

Table 8.The statistical parameters: Mean, Standard deviation and coefficient of variation for the indicators used in this study

	MU	Total 2007-2016	Mean	St. Deviation	Coeff. of var. (%)
Cereal export	Euro Million	12,815.2	1,281.51	705.71	55.06
Cereal import	Euro Million	2,538.6	253.86	118.74	46.77
Cereal trade balance	Euro Million	9,287.6	928.76	631.66	68.01
Cereal trade volume	Euro Million	15,693.6	1,569.36	753.73	48.21
Cereal export/inhabitant	Euro/capita	639.24	63.92	35.85	56.08
Cereal ICD	-	35.58	3.55	1.78	50.14
Cereal export to the EU	Euro Thousand	4,629,023	462.902.3	209,369.84	45.42
Cereal import from the EU	Euro Thousand	3,211,372	321,137.2	126,418.21	39.36
Wheat export	Euro Million	5,735.9	573.59	352.38	61.43
Maize export	Euro Million	5,302.3	530.23	300.3	56.63
Barley export	Euro Million	1,538.8	153.88	83.85	54.49
Oats export	Euro Million	4.57	0.45	0.28	62.22
Rye export	Euro Million	1.97	0.19	0.17	89.47
Sorghum export	Euro Million	19.67	1.96	1.65	84.18
Rice export	Euro Million	110.52	11.05	5.82	52.66
Wheat import	Euro Million	1,351.7	135.17	72.79	53.48
Maize import	Euro Million	1,516	151.63	57.38	37.84
Barley import	Euro Million	351.6	35.16	25.59	72.78
Oats import	Euro Million	2.49	0.24	0.11	45.83
Rye import	Euro Million	0.829	0.08	0.07	87.5
Sorghum import	Euro Million	10.55	1.05	0.61	58.09
Rice import	Euro Million	2578.9	27.89	8.24	29.54
Wheat trade balance	Euro Million	4,438.2	443.82	320.33	72.17
Maize trade balance	Euro Million	3,786	378.6	273.79	72.31
Barley trade balance	Euro Million	1,187.2	119.72	65.74	55.37
Oats trade balance	Euro Million	1.91	0.19	0.17	89.47
Rye trade balance	Euro Million	1.04	0.1	0.08	80.00
Sorghum trade balance	Euro Million	9.13	0.91	0.73	80.21
Rice trade balance	Euro Million	-168.34	-16.83	7.87	-46.76
Wheat ICD	-	43.1	4.41	2.31	53.59
Maize ICD	-	35.7	3.57	1.92	53.78
Barley ICD	-	54.8	5.48	3.22	58.75
Oats ICD	-	16.87	1.68	1.26	75.00
Rye ICD	-	52.8	5.28	4.55	86.17
Sorghum ICD	-	18.73	1.87	1.49	79.67
Rice ICD	-	3.74	0.37	0.20	54.05

Source: Own calculations.

The figures of the coefficients of variation are very high, reflecting a large variation of the data in the chronological series.

CONCLUSIONS

The study reflected the development of Romania's trade with cereals in the period 2007-2016. Both export and import value with cereals have substantially increased in the analyzed period so that in 2016 the export value accounted for Euro 2,097.2 Million and the import value for Euro 591.1 Million, resulting a positive trade balance of Euro 1,505.1 Million, reflecting that Romania is a net exporting country of cereals.

Taking into account the export and import values, the volume of cereal trade increased by 5.36 times, reaching Euro 2,689.3 Million in 2016. Also, the export per inhabitant increased, accounting for Euro 106.13/capita in the year 2016. Also, import was much better covered by export, as shown by ICD whose value accounted for 3.54 in 2016 compared to 0.55 in 2007.

In 2016, cereal trade contributed by about 35 % to the agro-food export value of Romania, and by about 9 % to the agro-food import value. While the contribution to the export increased more than 2 times, the contribution to the import remained relatively stable in the analyzed period.

The main cereals commercialized by Romania on the external markets are: wheat, maize, barley, oats, rye, sorghum and rice, but the most important cereals traded in other countries are: wheat, maize, and barley. In 2016, the share of these cereals in the cereal export value accounted for: wheat 55.3 %, maize 34.4 % and barley 9.15 %, all together totalizing 98.85%.

The most important cereals imported by Romania are: wheat, maize, barley and rice. In the year 2016, the share of these cereals in cereal import value accounted for: wheat 56.9 %, maize 24.9 %, barley 11.9 % and rice 5.1 %, all together accounting for 98.8 %.

In 2016, the trade balance was positive with high values for: wheat Euro 823.4 million, maize Euro 574.3 million, and barley Euro 121 million. Also it had low positive values for sorghum and oats, and low negative values for rice and rye.

The index of coverage degree of import by export has recorded 4.9 for maize, 3.4 for wheat, 3.1 for oats, 2.7 for barley, 1.9 for sorghum, 0.4 for rice and 0.3 for rye in the year 2016.

The main trade partner for cereal export is the EU with a share of 30.7 % in 2016, two times lower than in the year 2007 (61.8%). In the cereal import value, the EU keeps the top position with a share of 95.8 % in 2016, compared to 59.3 % in 2007. Therefore, about 70 % of Romania's cereal export is represented by the extra-EU markets.

If we take into consideration the efficiency of each cereal in terms of four criteria: export value, import value, trade balance and ICD, the hierarchy established according to the results of the application of the Point Method was the following one, in the decreasing order: wheat, barley, maize, rye, sorghum, oats and rice. However, the principal cereals which deserve to be traded on external markets are wheat, maize and barley.

This analysis has allowed to draw the conclusion that Romania must commercialize more cereals which have a high efficiency in foreign trade in terms of high export value, low import value, high positive trade balance and a high index of coverage degree of import by export.

A new orientation in Romania's foreign trade is required in relation to the EU, because Romania import value is very high and the export value has declined two times. Romania is able to produce more cereals than it consumes, and this is reason to export more cereals on the markets where the price is more convenient and to reduce the imports from the EU where the price is high.

As a conclusion, Romania's foreign trade with cereals has a positive balance with a good impact on the payment balance and the economy in general.

REFERENCES

[1]Alecu, I., Constantin, M., 2013, Romania’s International Trade with Agricultural Foodstuffs, Quantitative and Structural Features, Romanian

Statistical Review, 3rd Quarter/2013, Supplement, 81-91.
[2]Arhiroiu, G. A., 2015, Foreign trade perspective with cereals and oleaginous of Romania in the context of Europe 2020 strategy implementation, Ph. D. Thesis, UASVM Bucharest.
[3]Beldescu Alina, 2011, Romania, Cereals, Romania Trade and Invest (CRPCIS), Accessed on January 8, 2018.
[4]Bergmann, T. J., Scarpello, V. G., 2001, Point schedule to method of job evaluation. In Compensation decision. This is one making. New York, NY: Harcourt.
[5]Caraba-Meita Nela-Loredana, 2017**,** Perspectives and trends in the evolution of agricultural activities in countries with advanced economies, Annals of University of Craiova, Economic Sciences Series, 1, 45, 154-163, Link: http://feaa.ucv.ro/annals/v1_2017/0045v1-014.pdf, Accessed on January 6, 2018.
[6]Chiran, A., Gîndu, Elena, Banu, A., Ciobotaru, Elena-Adina, 2004,The Agricultural and Agrifood Products Market, Ceres Publishing House, Bucharest
[7]Cofas, E., Soare, E., 2013, Study on grain market in the world, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.13(2), 65-70
[8]Eurostat Statistics Explained, Agricultural Production-Crops, 2017, http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_production_-_crops, Accessed on January 8, 2018
[9]Eurostat Statistics Explained, Cereal production in the EU, http://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20171130-1, Accessed on January 8, 2018
[10]Eurostat Statistics Explained, Main annual crop statistics, http://ec.europa.eu/eurostat/statistics-explained/index.php/Main_annual_crop_statistics, Accessed on January 8, 2018
[11]Evolution of basic food, http://www..agro-business/evolutia-alimentelor-de-baza/2014/08.04, Accessed on January 10, 2018
[12]Ministry of Agriculture and Rural Development, General data about Romania's agriculture, www.madr.ro, Accessed on January 7, 2018
[13]National Institute of Statistics, Tempo Online Data base, www.insse.ro, Accessed on January 7, 2018
[14]National Institute of Statistics, 2017, www.insse.ro, Accessed on January 7, 2018
[15]Popescu Agatha, 2012, Home and International Trade, 2nd Ed., Publishers: Comunicare coediting with RawexComs, Bucharest, 401 pp.
[16]Popescu Agatha, 2014, Trends in Romania's agro-food foreign trade in the period 2007-2014, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.14(4), 223-236
[17]Popescu Agatha, 2017, Trends and correlations in Romania's agro-food foreign trade in the period 2007-2016, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.17(4), 293-304
[18]Razi, G., 2014, Romania is on the 3rd position in the EU for the cereal export to the extraEU markets. For maize, it is on the 1st position. www.zf.ro/companii/retail-agrobusiness/romania-este-pe-locul-trei-in-UE-la-exportul-de-cereale-catre-pietele-extracomunitare-la-porumb-este-pe-primul-loc-13432403/24 Oct.2014, Accessed on January 13, 2018
[19]Romania doubled its wheat export, http://www.digi24.ro/Stiri/economie/agricultura/romania-si-a-dublat-exporturile-de-grau-717097, Accessed on January 13, 2018.
[20]Romania exported 8 million tonnes cereals, 8 January 2018, http://www.agroino.ro/vegetal/romania-a-exportat-aproape-8-milioane-tine-de cereale.
[21]Romania versus Central and Eastern Europe for the cereals exports to the USA market, cnipmmr.ro/2016/01.26, Accessed on January 12, 2018
[22]Romanian Statistical Yearbook, Agriculture, www.insse.ro, http://statistici.insse.ro/shop/index.jsp?page=tempo2&lang=ro&context=45, Accessed on January 8, 2018.
[23]Romanian Statistical Yearbook, Geography, Meteorology and Environment, www.insse.ro, Accessed on January 7, 2018.
[24]Soare, E., Chirciu, I., 2016, Research on the Romanian wheat market, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.16(2), 287-292
[25]Trade in cereals, oilseeds and protein crops, European Commission, Agriculture and Rural Development, https://ec.europa.eu/agriculture/cereals/trade_en, Accessed on January 11, 2018
[26]Trading Economics, https://tradingeconomics.com/romania/exports/cereals, Accessed on January 11, 2018
[27]United Nations Comext Data Base, https://comtrade.un.org/, Accessed on January 8, 2018
[28]Voicilas, D.M., 2014, Cereal market in Romania-regional competitiveness, MPRA Paper No. 61730, https://mpra.ub.uni-muenchen.de/61730/, Accessed on Jannuary 8, 2018.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CONSIDERATIONS UPON THE TRENDS IN THE WOLRD SILK TRADE

Agatha POPESCU

University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest Romania, Phone: +40213182564, Fax: +40213182888, Email: agatha_popescu@yahoo.com

Corresponding author: agatha_popescu@yahoo.com

Abstract

The purpose of the paper was to analyze the dynamics of the world silk production, export, import and trade balance in the period 2012-2016 and to identify the trends and estimate the forecast for the horizon 2017-2021, based on the data supplied by ISC, ITC and UN COMTRADE and using the modern specific methods. The world silk production accounted for 192,692.45 Metric tonnes in the year 2016, being 1.26 times higher than in 2012. China and India produced 97.94 % of the world silk production. The most traded products worldwide are woven fabrics, raw silk on thrown, silk waste, silk yarn and yarn spun from silk waste, despite that it was registered a decline of the exported and imported quantities, because of the increased demand on the domestic markets of the main producers. The silk export value was USD 2,149 Million in 2016, by 31.49 % less than in 2012. The highest share in the world export value belong to woven fabrics, raw silk non thrown, silk yarn and yarn spun from silk waste, which together cumulated 95.77 %. The top silk exporters and China (53.9%), Italy (13.4 %), India (4.2 %), Romania (4 %), France (3.7 %), all together totalizing 79.2 % in the world silk export value. The world silk import value was USD 1,785 Million in 2016, by 29.21 % less than in 2012.The highest share in the world silk import value is kept by woven fabrics (56.13 %), raw silk non thrown (22.51%), and silk yarn (12.85%) which together totalize 91.49 %. The world top silk importers are: Italy (18.3 %), India (11.6%), Japan (7%), Romania (6.4 %), Vietnam (6.3 %), USA (5.7 %), France (4.4 %), Rep. Korea (3.9 %), Hong Kong China (3.3 %), China (3.2 %) and Germany (3%), all together accounting for 73.1 % of the world silk export value. The silk trade balance reached USD 354.3 Million in 2016, by 41.08 lees than in 2012. The main exporting and producing countries registered a negative trade balance, except China which had a positive balance. Silk price varied from a product to another, in relation to the demand/offer ratio. Woven fabrics, raw silk non thrown and silk yarn have the highest export price, while raw silk non thrown and silk yarn have the highest import price. In the horizon 2017-2021, it is expected as silk production to grow, but the export and import to decline due to the higher and higher requirement in the domestic markets of the producing countries.

Key words: *silk, world, production, trade, analysis, trends, forecast, export, import, trade balance*

INTRODUCTION

Silk is considered one of the most valuable natural textile fibers besides cotton and wool. Its roots are found more than 3,000 years ago in China and then in India, from where silkworm rearing was spread by means of the "silk road" to the Mediterranean area and then to Europe. From a standard for royalty and special gifts in the old times, nowadays silk is successfully used for producing luxury textiles and fabrics, but also has many other utilizations in medicine, aeronautics and automotive industry [17].

Silk demand is continuously increasing for producing fabrics and clothes so much desired to be worn both by women and men due to its special fineness, pleasant and delicate touch, resistance, unique shining and elegant appearance [2, 12].

Silk is a luxury natural fiber which can't be compared to synthetic fibers such as polyester and viscose which have become more and more used for textile and clothes due to their lower production cost [8, 9].

Also, silk is in competition with cotton which at present represents 90 % of the global natural fibers production, while silk represents only 0.2 %. This was caused by the extend of cotton production, the unbalanced demand/supply ratio, the fail of silk industry in Europe and the high growth rate of silk industry in China, the world leader in cotton and silk production which is able to produce with the lowest cost and sell at "dumping" prices.

The silk market continues to be in a strong competition with the market of super fine synthetic fibers and of other natural fibers whose quality has been substantially improved. After a long period when silk price was low, at present silk price has recovered being higher than USD 55/kg, stimulating the revival of silk cocoon and raw silk production in many countries [15].

Nowadays, silk is produced in more than 60 countries in the world, most of them being developing countries. The Asian area is in the top with 90 % of the world mulberry silk and 100 % of non mulberry silk production. A few other producers are in the Latin America, mainly Brazil, Africa mainly Egypt and Madagascar and in Europe only Bulgaria [5].

Silk industry is an important branch of agriculture and even of economy and an income source for rural population in some countries. The silkworm rearing and silk obtaining require simple operations which could be easily made by women and old people [7, 10].

Therefore, silk industry is a job supplier for millions of people preventing and limiting migration to cities. The business in silk industry needs just small investments and the marketed silk provides high return to the producers living in the rural areas of the developing countries. More than this, the increased demand in the international market contributed to the development of the silk trade assuring important currency inflows in the payment balance of the developing countries, In this way, equity from the major consumers, the developed countries, was transferred to the main suppliers, the developing counties.

In addition, silk industry involves production processes which are environment friendly, mulberry trees assure a green cover, soil conservation and erosion protection and allow the use of unsuitable land for crop cultivation. Silk production and processing is not polluting, the CO_2 emissions are very low and wastes could be easily degraded [11].

Sericiculture, followed by agro-forestry, organic farming, composting and beekeeping are the main activities offering "green jobs" able to assure sustainable development by means of the green economy [3].

Therefore, silk industry brings an important contribution to the sustainable development by increasing the living standard in the developing countries, reducing poverty, hungry, gender discrimination and risk of diseases [13].

In this context, the paper aimed to analyze the situation of silk market at the world level in order to identify the major trends in silk production, export and import quantities, export value, import value and trade balance, and silk price in the period 2012-2016 and to set up a forecast for the horizon 2017-2021.

MATERIALS AND METHODS

Data collection.

The study used the empirical data collected from International Sericiculture Commission, International Trade Center and UN COMTRADE for the period 2012-2016 [5, 6, 16]. Also various useful information was collected from various sources such as published articles in scientific journals and magazines, reports and websites.

In order to identify the trends in silk international trade, the following indicators were used:

-silk production, analyzed in its dynamics in the analyzed period;

-the main producers and consumers of silk in the world;

-the silk production achieved by the top producing countries in the world by producer:

-the quantity of exported silk products by product type at the world level;

-the quantity of imported silk products by product type at the world level;

-the silk export value at the world level;

- the silk import value at the world level;

-the silk export value at the world level by silk product type;

- the silk import value at the world level by silk product type;

- the share of each silk product type in the world silk export value;

- the share of each silk product type in the world silk import value;

-the share of various silk products in the silk export value;

-the share of various silk products in the silk import value;
-the trade balance by silk product;
-the silk export value in the top exporting countries in the world;
-the silk import value in the top importing countries in the world;
-the market share of the top silk exporting countries in the world silk export value;
-the market share of the top silk importing countries in the world silk import value;
-the trade balance for the top exporters and importers of silk in the world;
-the average export price of silk by silk products;
-the average import price of silk by silk products;
-the forecast for the world silk production;
-the forecast for the world silk export value;
-the forecast for the world silk import value;
-the forecast for the world silk trade balance.

The methods used in this study have been the following ones:

Index method, using the index with fixed basis, I_{FB}, determined by means of the formula: $I_{t/t0} = (Y_t/Y_0)100$. This was utilized for pointing out the evolution of each indicator in the analyzed period, comparing the level recorded in the last year 2016 with the level registered in the first year, 2012, considered term of reference.

The structure of export and import by type of silk product was determined dividing the export value (E_i) and respectively, the import value (I_i) belonging to type of silk product in the total value of silk export (E) or import (I), in percentage. The corresponding formula was: $S_{E\%}= (E_i/E)x\ 100$ for the share of export, and $S_{I\%}= (I_i/I)x\ 100$ for the share of import.

The descriptive statistics including*:* mean, standard deviation and variation coefficient were calculated for the silk export value, silk import value and trade balance at the world level.

The forecast for the horizon 2017-2021 was based on the average annual growth rate (%) or the average annual absolute change in the period 2012-2016 for the indicators mentioned above.

In this purpose, there were determined:

-*The absolute annual change* using the formula: $\Delta t/_{t-1}= Y_t - Y_{t-1}$

-*The indices with variable basis* using the formula: $I_{t/t-1} = (Y_t/Y_{t-1})100$

-*The annual growth rate (%), $R_{t/t-1}$* according to the formula: $R_{t/t-1} = [(Y_t/Y_{t-1})/(Y_{t-1})]100$

-*The forecast* was established using the formula: $Y_{t+1} = Y_t + \bar{\Delta}_{t/t-1,}$ where Y_{t+1} is each year of the forecast period, Y_t is the level of the indicator in the year 2016 and $\bar{\Delta}_{t/t-1}$ is the average annual absolute change of the indicator in the period 2012-2016.

In the study, all the results were illustrated either in graphics or tables accompanied by comments and interpretations. At the end, there were presented the main conclusions reflecting the main trends indentified for each analyzed indicator.

RESULTS AND DISCUSSIONS

The dynamics of the world silk production

The world silk production increased in the analyzed period from 20,837.5 Metric tonnes in 2007 to 192,692.45 Metric tonnes in the year 2016. This was the consequence of an increased demand for silk both for textiles and clothes industry, but also for other industries: aeronautics, electronics, medicine etc, both in the producing countries and in the international market (Fig.1.). Therefore, in this period, the world silk production increased 9.24 times.

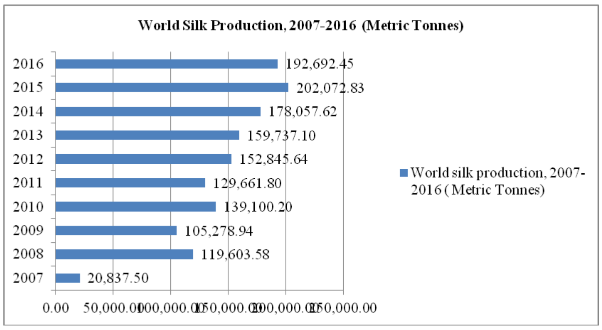


Fig. 1. The dynamics of the world silk production, 2007-2016 (Metric tonnes)
Source: Own design based on the data provided by ISC/Statistics/Production, 2012 and 2018, www.inserco.org, Accessed on January 20, 2018 [5].

The main silk producing countries are especially from Asia and just a few from the Latin America, Middle East, Africa and

Europe.

The top 12 producers in the world, in the descending order of silk production performed in the year 2016 and also in the previous years, are the following ones: China, India, Uzbekistan, Thailand, Brazil, Vietnam, North Korea, Philippines, Iran, Bangladesh, Japan and Bulgaria.

The market share of these countries in the world production in 2016 was: China 82.20 %, India 15.74 %, Uzbekistan 0.65 %, Thailand 0.36 %, Brazil 0.33 %, Vietnam 0.27 %, North Korea 0.19 %, Philippines 0.09 %, Iran 0.06 %, Bangladesh 0.02 %, Japan 0.02 % and Bulgaria 0.0046 %.

Therefore, the main silk producer in the world is China, followed by India, and the both countries together produced 97.94 % of the global silk production.

At the world level, silk production increased by only 38.52 % in the period 2010-2016. It was noticed a different trend in the dynamics of silk output in the main producing countries (Table 1).

Table 1.The world silk production in the top producing countries in the period 2010-2016, (Metric Tonnes)

	2010	2011	2012	2013	2014	2015	2016	2016/2010 %
1. China	115,000	104,000	126,000	130,000	146,000	170,000	158,400	137.73
2.India	21.005	23,060	23,679	26,480	28,708	28,523	30,348	144.47
3.Uzbekistan	940	940	940	980	1,100	1,200	1,255	133.51
4.Thailand	655	655	655	690	692	698	712	108.70
5.Brazil	770	558	614	550	560	600	650	84.41
6.Vietnam	550	500	450	475	420	450	523	94.05
7.North Korea	-	300	300	300	320	350	365	121.66
8.Philippines	1	1	0.89	1	1.1	1.2	182	182.00
9.Iran	75	120	123	123	110	120	125	166.66
10.Bangladesh	40	38	42.5	43	44.5	44	44	110.00
11.Japan	54	42	30	30	30	30	32	59.25
12.Bulgaria	9.4	6	8.5	8.5	8	8	9	95.70

Source: ISC, 2018, www.inserco.org, Accessed on January 20, 2018 [5].

Silk production registered the following growth rate in the analyzed period by country: +82.66 % in Philippines, +66.66 % in Iran, +44.47 % in India, +37.73 % in China, + 33.51 % in Uzbekistan, +21.66 % in North Korea, + 10 % in Bangladesh, +8.7 % in Thailand, while in other countries silk production declines as follows: Japan by -40.75 %, Brazil by -15.59 %, Vietnam by -4.95 % and Bulgaria by -4.30 %.

Besides the countries mentioned above, the Latin America is another pole of sericulture development for producing high quality raw silk mainly in Brazil, which is situated of the 5th position in the global silk production. Besides Brazil, Argentina, Bolivia, Colombia, Cuba, Ecuador, Mexico, Paraguay, Peru and Venezuela have developed sericiculture as an alternative for the economic development of the small farms [1].

The main silk consumers are USA, Italy, Japan, France, China, United Kingdom, Switzerland, Germany, United Arab Emirates, Korea and Vietnam [5].

USA is not a silk producer, but it is one of the largest silk importers and consumers of silk goods (garments, interior decoration fabrics and accessories). As silk has not the aura like in European countries, the USA is well known for "easy-care" fabrics, its main supplier being China.

Italy is one of the most important importer and processor of silk and also an exporter of silk products in Europe. It imports raw silk and silk yarn, but also blouses for ladies, silk garments. The Italian processing industry produce mainly high quality scarves and neckties, which are successfully exported.

France is also a silk importer, producer and exporter. It produces high quality silk fabrics, of which 70 % are used for clothing and the remaining for interior decorations (curtains, wall covers, bed spreads etc). Besides the domestic consumption, many of the French silk goods are sold mainly to the USA.

Japan is a producer, but also an importer and major consumer of silk. Beside the local production of silk goods, Japan imports various silk products. About 50 % of its raw silk consumption is used for producing "kimonos".

Germany is one of the largest importers of silk for textile and clothing of the highest quality to meet the consumers' requirements. Its main suppliers are China, India and Thailand [14].

The main silk sorts which are object of international trade, according to the Harmonized System, HSN codes for GTS, 50 Silk have the following codes and meaning: HSN 5001- Silkworm cocoons, suitable for reeling, HSN 5002- Raw silk (non-thrown), HSN 5003- Silk waste (including cocoons unsuitable for reeling, yarn waste and garneted stock); HSN 5004- Silk yarn (excluding that spun from silk waste and that put up for retail sale); HSN 5005- Yarn spun from silk waste (excluding that put up for retail sale); HSN 5006- Silk yarn and yarn spun from silk wastes put up for retail sale, silkworm gut; HSN 5007- Woven fabrics of silk or of silk waste [4].

The world amount of exported silk products. The highest quantity of exported silk belongs to the Code 5002, Raw silk, non thrown, despite that it recorded a slight decline in the period 2012-2016 from 9,126 Tonnes in 2012 to 8,964 Tonnes in 2016.

On the 2nd position comes the Code 5003 - Silk waste, whose exported quantities increased by 15.35 % from 5,378 Tonnes in 2012 to 6,204 Tonnes in 2016.

On the 3rd position is the Code 5004 - Silk yarn which recorded 4,917 Tonnes in 2016 by about 18 % less than in 2013.

On the 4th position comes the silk product with the Code 5005-Yarn spun from silk waste whose exported amounts in the international markets deeply declined by -45.98 % from 5,986 Tonnes in 2012 to 3,235 Tonnes in 2016.

On the 5th position is situated the silk product with the Code 5006-Silk yarn and yarn spun from silk wastes whose exported amounts increased by 151.26 % from 476 Tonnes in 2012 to 1,196 Tonnes in 2016.

On the 6th position is the Code 5001-Silk worm cocoons for reeling whose exported quantity increased by 56.01 % from 291 Tonnes in 2013 to 454 Tonnes in 2016.

Finally, the Code 5007-Woven fabrics of silk and silk waste declined by 37.14 % in 2015 reaching only 15,421 Tonnes compared to 2012 when it accounted for 24,532 Tonnes.

Therefore, this category was object of the highest amounts exported in the analyzed period (Fig.2).

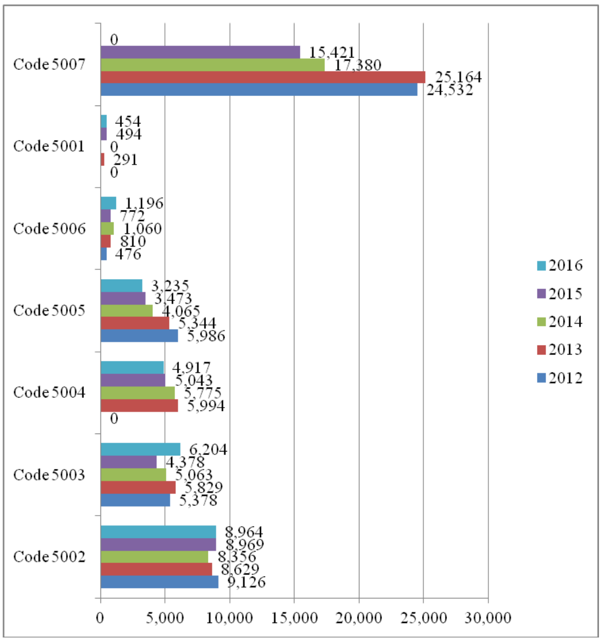


Fig. 2. The dynamics of the world exported silk quantities by HSN Codes, 2012-2016 (Tonnes)

Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The world amount of imported silk products. The Code 5002 is on the top position with 9,045 imported Tonnes in the year 2016, despite that it was by 4.77 % less than in 2013.

On the 2nd position comes the Code 5003 with 6,527 Tonnes imported in the year 2016, by 45.82 % more than in 2012 (4,476 Tonnes).

The Code 5004 accounted for 4,858 imported Tonnes in 2016, by 18 % less than in 2012 9 5,925 Tonnes).

The Code 5005 came on the 4th position for 3,458 Tonnes imported in 2016, but by 28.62 % less than in 2012 9 4,844 Tonnes).

The Code 5001 accounted for 594 Tonnes imported in 2016, by 34.08 % less than in 2012.

The Code 5006 also declined as its imported amount was 404 Tonnes in 2016, by 43.74 % lower than in 2012 (718 Tonnes).

Finally, the Code 5004 was imported only in the years 2013 and 2014, accounting for 57,026 Tonnes and, respectively for 62,883 Tonnes (Fig.3).

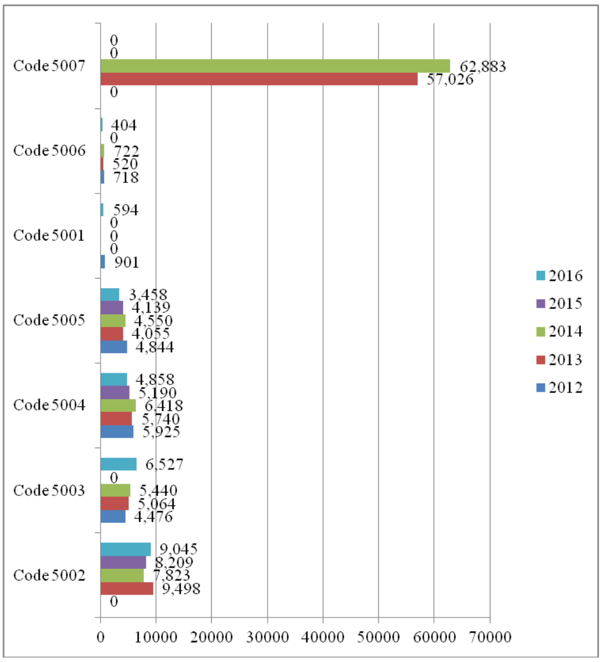


Fig. 3. The dynamics of the world imported silk quantities by HSN Codes, 2012-2016 (Tonnes)
Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The world silk export value accounted for USD 2,149,157 thousand in the year 2016 compared to USD 3,136,722 thousand in the year 2012.

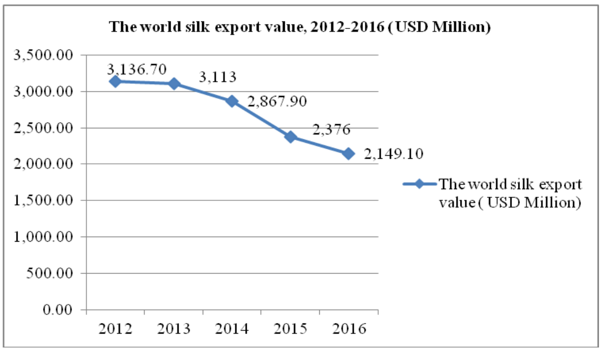


Fig. 4. The dynamics of the world silk export value, 2012-2016 (USD Thousand)
Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

This means a decline by 31.48 % in the analyzed period, as in 2016, the global silk export value represented 68.51 % of the level in 2012 (Fig.4.)

The world silk export value by silk product. On the 1st position in the Code 5007 Woven fabrics, whose export value accounted for USD 1,312,049 thousand in 2016, being by 39.18 % lower than in 2012.

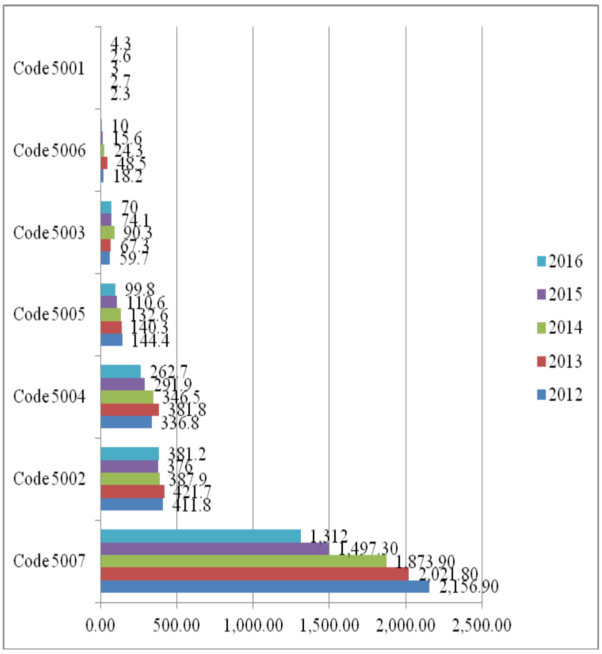


Fig. 5. The dynamics of the world silk export value by HSN Codes, 2012-2016 (USD Million)
Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

On the 2nd position, it is situated the Code 5002 Raw silk non-thrown, whose export value was USD 318,217 thousand in 2016, by 7.44 % lower than in 2012.

On the 3rd position, it was the Code 5004 Silk yarn, with an export value of USD 262,739 thousand in 2016, being by 22 % lower than in 2012.

On the 4th position came the Code 5005 Yarn spun from silk waste with USD 99,868 thousand export value, by 30.88% lower than in 2012.

On the 5th position, it was situated the Code 5003 Silk waste (unreeling cocoons and yarn waste) which recorded USD 70,020 thousand export value in 2016, by 17.19 % more than in 2012.

On the 6th position, it was situated the Code 5006 Silk yarn and yarn spun from silk wastes, whose export value accounted for USD 10,009 thousand in 2016, by 45 % less than in 2012.

On the 7th position it was the Code 5001 Woven fabrics with the lowest export value accounting for USD 4,390 thousand in 2016, by 84.9 % more than in 2012.

Therefore, the general trend of the export value was a decreasing one for the silk products with the Codes: 5007,5002,5004,5005 and 5006, but an increasing trend for the codes 5003 and 5001 (Fig.5).

The share of various silk products in the world silk export value was the following one in the year 2016: 61.03 % Code 5007, 17.81 % Code 5002, 12.27 % Code 5004, 4.66 % Code 5005, 3.27 % Code 5003, 0.76 % Code 5006 and 0.20 % Code 5001 (Table 2).

Table 2. The share of the silk products by their HSN Codes in the world silk export and import value in the year 2016 compared to 2012 (%)

Code of silk product	The share in the world export value (%)		The share in the world import value (%)	
	2012	2016	2012	2016
5007	68.90	61.03	63.13	56.13
5002	13.15	17.81	18.64	22.51
5004	10.76	12.27	12.16	12.85
5005	4.61	4.66	3.31	3.95
5003	1.91	3.27	2.06	3.78
5006	0.58	0.76	0.58	0.61
5001	0.09	0.20	0.12	0.17

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The world top silk exporters are presented in Fig.6.

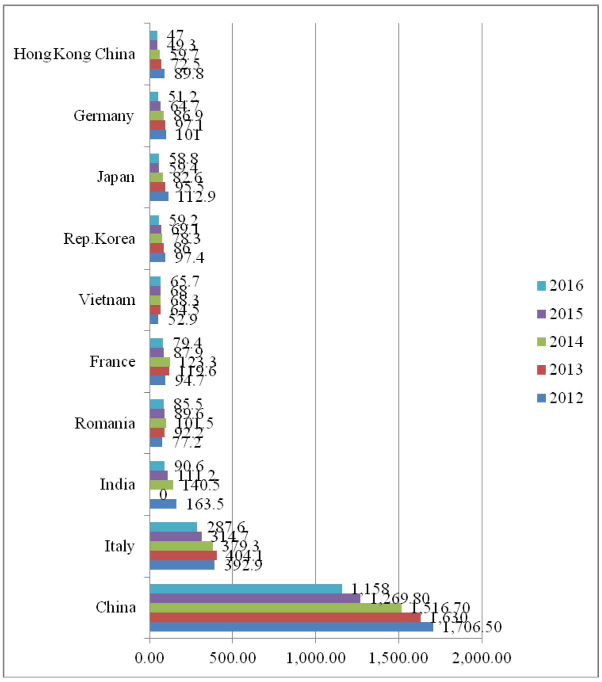


Fig. 6. The dynamics of the world silk export value by main exporting countries, 2012-2016 (USD Million)
Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

In the descending order, are: China, Italy, India, Romania, France, Vietnam, Republic of Korea, Japan, Germany and Hong Kong-China, all together exporting silk of USD 1,983,473 thousand in 2016, representing 92.26 % of the world silk export value.

Compared to the total silk export value registered by these 10 producers in the year 2012, which accounted for USD 2,889,314 thousand, in 2016 their silk export value represented 68.64 % of that value, reflecting the decline of silk export worldwide (Fig.6).

In the period 2012-2016, almost all the silk exporters registered a decline of the export value which accounted for: China -36.15 %, Italy -16.81 %, India -44.55 %, France -16.16 %, Rep. Korea -39.17 %, Japan -47.94 %, Germany -49.30 % and Hong Kong China -47.69 %.

The only exceptions are Romania, whose silk export value increased by 10.81 % and Vietnam, whose export value increased by 24.11 % in the period 2012-2016.

The market share of the top 10 silk exporters in the global silk export value was the following one in 2016: China 53.9 %, Italy 13.4 %, India 4.2 %, Romania 4 %, France 3.7 %, Vietnam 3.1 %, Rep. Korea 2.8 %, Japan 2.7 %, Germany 2.4 % and Hong Kong China 2.2 % (Table 3).

Table 3. The dynamics of the market share of the top exporters in the world silk export value and the market share of the top importers in the world silk import value in the year 2016 (%)

Country	Market share in the world silk export value (%)	Country	Market share in the world silk import value (%)
World Silk export value (USD Thousand)	2,149,657	World Silk import value (USD Thousand)	1,794,815
China	53.9	Italy	18.3
Italy	13.4	India	11.6
India	4.2	Japan	7.0
Romania	4.0	Romania	6.4
France	3.7	Vietnam	6.3
Vietnam	3.1	USA	5.7
Rep. Korea	2.8	France	4.4
Japan	2.7	Rep. Korea	3.9
Germany	2.4	Hong Kong China	3.3
Hong Kong China	2.2	China	3.2
		Germany	3.0

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The world silk import value followed a similar descending trend like the global silk export value. In 2016, the world silk import value was USD 1,794,815 thousand compared to USD 2,535,352 thousand in the year 2012. This means that it registered a decline of 29.21 % in the analyzed period, in the year 2016, the silk import value representing 70.79 % of the level recorded in 2012 (Fig.7).

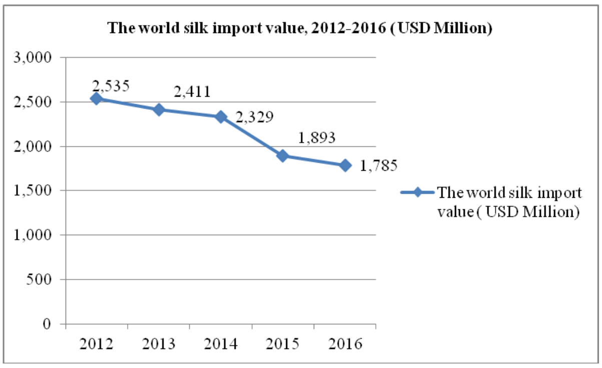


Fig. 7. The dynamics of the world silk import value, 2012-2016 (USD Thousand)
Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The world silk import value by silk product.

On the top position it is the products with the Code 5007 Woven fabrics with USD 1,000,991 thousand import value in 2016, by 37.08 % less than in 2012.

On the 2nd position, it is the Code 5002 Raw silk non thrown, whose import value accounted for USD 401,457 thousand in 2016, being by 14.48 % lower than in 2012.

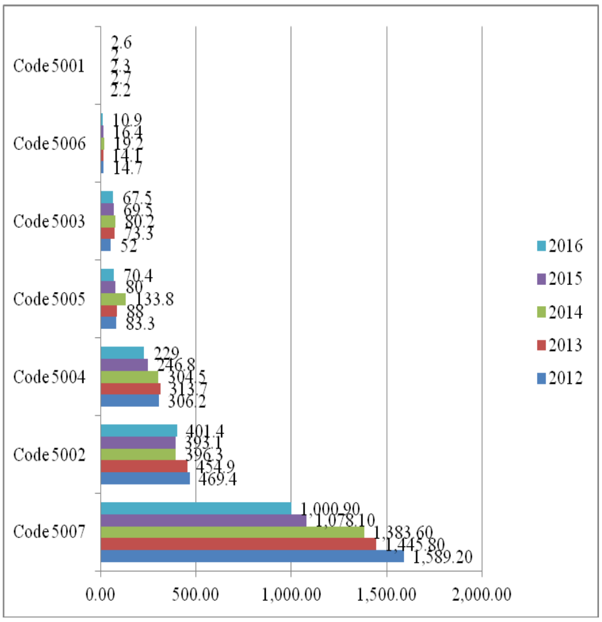


Fig. 8. The dynamics of the world silk import value by HSN Codes, 2012-2016 (USD Million)
Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

On the 3rd position came the Code 5004 Silk yarn, whose import value accounted for USD 229,098 thousand in 2016, being by 25.20 % lower than in 2012.

On the 4th position it was situated the Code 5005 Yarn spun with USD 70,471 thousand import value, by 15.46 % less than in 2012.

On the 5th position it was the Code 5003 with USD 67,515 thousand import value, by 29.61 % higher than in 2012.

On the 6th position, it was placed the CODE 5006 Silk yarn and yarn spun from silk wastes with USD 10,979 thousand import value in

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

2016, being by 25.80 % less than in 2012.

Finally, on the 7th position it was situated the Code 5001 Silk cocoons with USD 2,658 import value being by 16.83 % higher than in 2012.

Therefore, the general trend of the silk import value was a decreasing one for the silk products with the Codes: 5007, 5002, 5004, 5005 and 5006, but an ascending one for the Codes 5003 and 5001, like in case of the export value (Fig.8).

The share of various silk products in the silk import value was the following one in the year 2016: 56.13 % Code 5007, 22.51 % Code 5002, 12.85 % Code 5004, 3.95 % Code 5005, 3.78 % Code 5003, 0.61 % Code 5006 and 0.17 % Code 5001 (Table 2).

The world top silk importers, in the decreasing order are: Italy, India, Japan, Romania, Vietnam, USA, France, Rep. Korea, Hong Kong China and Germany (Fig.9).

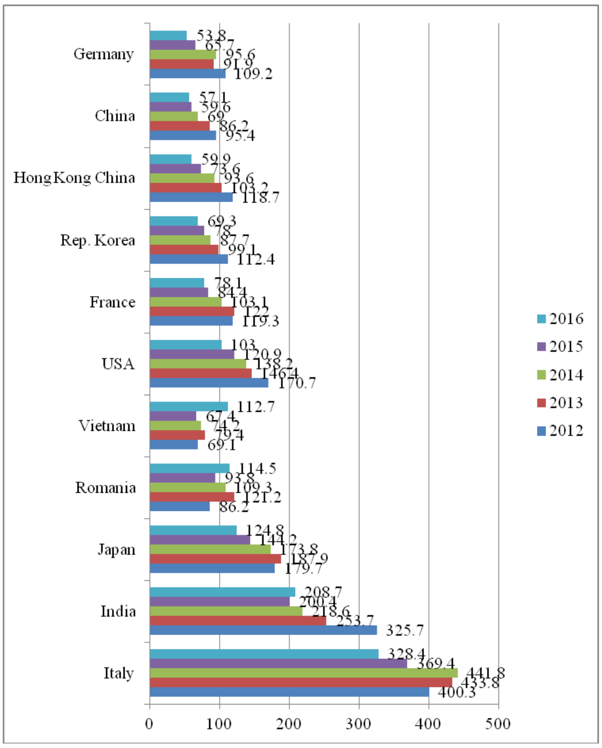


Fig. 9. The dynamics of the world silk import value by main importing countries, 2012-2016 (USD Million)
Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

All these 11 countries registered USD 1,310,756 thousand silk import value in the year 2016, representing 73.03 % of the world silk import value. In 2012, the import value of these countries accounted for USD 1,787,234 thousand. Therefore, in 2016, their silk import value was only 73.33 % of the level of the year 2012. The silk import value registered a decline (Fig.9).

The decrease of the silk import value in the year 2016 was the following one by importing country: Italy -17.97 %, India -35.91 %, Japan -30.56 %, USA -39.68, France -34.56 %, Rep. Korea -38.37 %, Hong Kong China -49.54 %, China -40.12 % and Germany -50.66 %.

Romania and Vietnam are the only main importing countries whose silk import value increased in the year 2016 compared to 2012, in case of Romania by + 32.86 % and in case of Vietnam by 63 %.

The market share of the top 11 silk importing countries in the world silk import value for the year 2016 is presented in Table 3. The weight in the decreasing order was the following one: Italy 18.3 %, India 11.6 %, Japan 7 %, Romania 6.4 %, Vietnam 6.3 %, USA 5.7 %, France 4.4 %, Rep. Korea 3.9 %, Hong Kong China 3.3 %, China 3.2. % and Germany 3 %. All these 11 countries accounted for 73.1 % in the world silk import value in the year 2016 (Table 3).

The world silk trade balance had a descending evolution taking into account the decreasing trend both of the export and import value. In 2016, the global silk trade balance accounted for USD 354,342 thousand compared to USD 601,370 Thousand in the year 2012. Therefore, in the last year of the analyzed period, the silk trade balance was by 41.08 % lower than in 2012 (Fig.10).

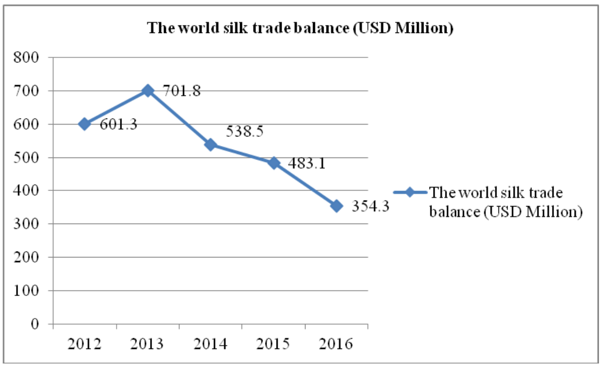


Fig. 10. The dynamics of the world silk trade balance, 2012-2016 (USD Million)
Source: Own design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The world silk trade balance by silk product is presented in Table 4. The figures from this table show that the silk products Cod 5007 Woven fabrics, 5004 Silk yarn, 5003 Silk waste, 5001-Silk cocoons had a positive value, meaning that the export value was higher than the import value in all the analyzed years in the period 2012-2016.

In case of the Code 5005 Yarn spun from silk waste, the trade balance was in general a positive one in almost all the years, except the year 2014, when it was registered a deficit.

In case of the Code 5006 Silk yarn and yarn spun from silk wastes, in the period 2012-2014 the trade balance was a positive one, while in the last two years 2015 and 2016 it was a negative one.

Finally, the only product with a negative balance in all the analyzed years was the Code 5002 Raw silk non thrown, meaning that its import value was higher than its export value.

In 2016, taking into account the dynamics ex the export and import values, the trade balance registered a descending trend in case of the Code 5007 (-45.21 %), Code 5005 (-51.93%), Code 5003 (-67.21%), Code 5006 (-28.48 %), an increasing trend in case of the Code 5004 (+10.02 %), the Code 5001 (17.67 times higher in 2016 compared to 2012) and the Code 5002 (+35.15 %), despite that in 2012 it was a deficit (Table 4).

Table 4. The dynamics of the world silk trade balance by silk product Codes, 2012-2016 (USD Thousand)

	2012	2013	2014	2015	2016	2016/2012 %
5007	567,637	576,033	490,324	419,166	311,058	54.79
5004	30,575	68,020	41,937	45,172	33,641	110.02
5005	61,150	52,270	-1,223	30,681	29,397	48.07
5003	7,669	13,991	10,044	4,616	2,515	32.79
5001	98	39	641	563	1,732	1,767.34
5006	3,405	34,344	5,107	-795	-970	-128.48
5002	-57,578	-43,175	-8,420	-17,130	-20,240	35.15

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The silk trade balance for the top exporters and importers in the world. The silk trade balance was a positive one only in case of China, which is the main silk producer and exporter which dominates the international market. Its trade balance accounted for USD 1,000,862 thousand in the year 2016, being by 31.67 5 lower than in 2012.

Almost all the other "players" in the silk international trade registered a negative trade balance in almost all the years from the studied period 2012-2016. The exceptions were represented by France, which registered a positive trade balance in 2014, 2015 and 2016, Vietnam with a positive trade balance in the year 2015 and Germany with a positive trade balance in the year 2013.

Compared to the year 2012, in 2016, the silk trade balance registered a lower positive value in case of China (68.33 %).

Table 5. The dynamics of the silk trade balance in the top exporting and importing countries in the world, 2012-2016 (USD Thousand)

	2012	2013	2014	2015	2016	2016/2012 %
China	1,611,094	1,543,720	1,447,621	1,210,225	1,100,862	68.33
Italy	-7,364	-29,674	-62,452	-54,713	-40,785	553.84
India	-162,244	-71,450	-78,104	-89,204	-118,113	72.79
Romania	-9,011	-29,097	-7,843	-4,278	-28,994	321.76
France	-24,559	-2,466	20,294	3,446	1,365	-5.55
Vietnam	-16,180	-14,889	-5,896	631	-46,082	290.37
Rep Korea	-15,034	-13,059	-9,530	-8,920	-10,041	66.78
Japan	-66,776	-92,436	-91,137	-84,771	-66,001	98.83
Germany	-8,201	5,142	-8,662	-911	-2,678	32.65
Hong Kong China	-28,892	-30,699	-33,863	-24,324	-12,910	44.68
TOTAL	1,272,833	1,265,M092	1,170,428	947,181	775,723	60.94

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The deficit of the trade balance was 5.53 times diminished in Italy, but in Romania increased 3.21 times and in Vietnam 2.90 times.

In 2016 compared to 2012, India registered a lower deficit by 27.21 %, Rep. Korea by 33.22 %, Japan by 1.17 %, Germany by 67.35 % and Hong Kong China by 55.32 %.

France registered a positive trade balance which was 17.99 times higher in 2016 compared to 2012 when it was a negative one.

Taking into account the trade balances of all these top 11 exporting and importing countries, their cumulated trade balance was a positive one in all the studied years and accounted for USD 775,723 thousand in 2016, being by 39.16 % lower than in 2012 (Table 5).

The dynamics of silk export price (FOB) by silk product is presented in Table 6. The figures show that the silk export price is the highest in case of the Code 5007 Woven fabrics, ranging between USD 87 and 108 per kg. On the 2nd position is the CODE 5004 Silk yarn whose export price ranged between USD 53 and 64 per kg. For the Code 5002 Raw silk non thrown the export price varied between USD 41-48 per kg, for the Code 5006 Silk yarn it varied between USD 8 and 38 per kg, for the Code 5003 Silk waste the export price ranged between USD 11 and 17.8 per kg and for the Code 5001 Silk cocoons it varied between USD 5.3 and 9.6 per kg.

In the analyzed period, the silk price declined in case of the Code 5007 (-5.77 %), Code 5002 (-5.77%), Code 5004 (-16.11 %), Code 5006 (-78.14 %), but it increased in case of the Code 5005 (+27.93 %), Code 5003 (+1.53 %) and Code 5001 (+2.98%).(Table 6).

Table 6.The dynamics of the world silk export price (FOB), 2012-2016 (USD/kg)

	2012	2013	2014	2015	2016	2016/2012 %
Code 5007	87.92	80.34	107.82	97.09	No data	94.23
Code 5002	45.12	48.17	46.42	41.92	42.52	94.23
Code 5004	No data	63.69	60.00	57.89	53.43	83.89
Code 5005	24.13	26.26	32.62	31.86	30.87	127.93
Code 5003	11.11	14.97	17.84	16.94	11.28	101.53
Code 5006	38.23	59.87	23.00	20.26	8.36	21.86
Code 5001	No data	9.38	No data	5.31	9.66	102.98

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The dynamics of silk import price (CIF) by silk product is presented in Table 7. In the analyzed period, the price silk import price registered a visible decline in case of the Code 5007 (-13.22 %), Code 5002 (-9.34%), Code 5004 (-8.79%), and Code 5003 (-11.10 %), but a growth in case of the Code 5005 (+18.36%), Code 5006 (+31.89%) and Code 5001 (+77.38).

The price varied between the following minimum and maximum values: Code 5007 USD 22-25.3 per kg, Code 5002 USD 44.3-50.6 per kg, Code 5004 USD 47.1-54.6 per kg, Code 5005 USD 17.2-29.4 per kg, Code 5003 USD 10.3-14.7 per kg, Code 5006 USD 20.6-27.2 per kg and Code 5001 USD 2.6-4.4 per kg (Table 7).

Table 7.The dynamics of the world silk import price (CIF), 2012-2016 (USD/kg)

	2012	2013	2014	2015	2016	2016/2012 %
Code 5007	No data	25.35	22.00	No data	No data	86.78
Code 5002	No data	48.95	50.66	47.89	44.38	90.66
Code 5004	51.69	54.66	47.45	47.55	47.15	91.21
Code 5005	17.21	21.72	29.41	19.32	20.37	118.36
Code 5003	11.63	14.47	14.75	No data	10.34	88.90
Code 5006	20.60	27.72	26.69	No data	27.17	131.89
Code 5001	2.52	No data	No data	No data	4.47	177.38

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The variations of the silk prices were determined by the change in demand/offer ratio at international level.

The descriptive statistics in terms of mean, standard deviation and coefficient of variation is presented for the following indicators: world silk production, world silk export value, world silk import value and world silk trade balance in Table 8.

Table 8. The descriptive statistics in terms of mean, standard deviation and coefficient of variation for the main indicators, 2012-2016

	MU	Mean	St.Dev.	Coeff. of variation (%)
World silk production	Metric Tonnes	177,081.12	20,960.83	11.83
World silk export value	USD Million	2,728.54	445.49	16.32
World silk import value	USD Million	2,190.7	331.66	15.13
World silk trade balance	USD Million	535.8	129.97	24.25

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The forecast of the world silk production for the horizon 2017-2021. In the period 2012-2016, the total absolute change of the world silk production accounted for 39,846.81 Metric tonnes, meaning an average absolute change of 9,961.70 metric tonnes per year.

Table 9.The forecast of the world silk production for the horizon 2017-2021 (Metric tonnes)

Year	World silk production (Metric tonnes)	Absolute change $\Delta t/_{t-1}$	Indices (%) $I_t/_{t-1}$	Growth rate (%) $R_t/_{t-1}$	Forecast 2017-2021	
					Year	Metric tonnes
2012	152,845.64	-	100.00	-	2017	202,654.15
2013	159,737.10	6,891.46	104.50	4.50	2018	212,615.85
2014	178,057.62	18,320.52	111.46	11.46	2019	222,577.55
2015	202,072.83	24,015.21	113.48	13.48	2020	232,539.25
2016	192,692.45	-9,380.38	95.35	-4.65	2021	242,500.95
Total		39,846.81		24.79		
Annual average		9,961.70		6,1975		
Annual average for 1 % growth		1,607.3739 Metric tonnes		1%		

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

Therefore, the average annual growth rate in the analyzed period was 6.1975 % (Table 9).

Taking into account the world silk production achieved in the year 2016 and the average annual absolute change registered in the period 2012-2016, it was estimated the world silk production for the horizon 2017-2021.

For 1 % annual growth rate, the world silk production will increase by 1,607.3739 Metric tonnes (Table 9).

In 2021, the world silk production is expected to reach 242,500.95 Metric tonnes by 35.84 % more than in 2016.

The forecast of the world silk production is also illustrated in Fig.11.

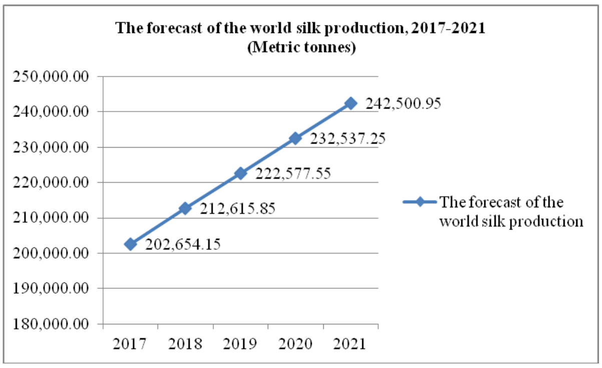


Fig. 11. The forecast of the world silk production for the horizon 2017-2021 (Metric tonnes)

Source: Own calculations and design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The forecast of the world silk export value. In the period 2012-2016, the world silk export value registered a total absolute change of -

USD 987.6 million, meaning an average absolute change of -USD 246.9 million per year. Therefore, the average annual decline rate in the analyzed period was -8.8375 %. Under these conditions and considering that the world silk export value will follow the same annual growth/decline rate in the next five years, it was established the forecast for the horizon 2017-2021 as presented in Table 10.

Table 10.The forecast of the world silk export value for the horizon 2017-2021 (USD Million)

Year	World silk export value (USD Million)	Absolute change $\Delta t/_{t-1}$	Indices (%) $I_t/_{t-1}$	Growth rate (%) $R_t/_{t-1}$	Forecast 2017-2021	
					Year	USD Million
2012	3,136.7	-	100.00	-	2017	1,902.2
2013	3,113	-23.7	99.24	-0.76	2018	1,635.3
2014	2,867.9	-245.1	92.12	-7.88	2019	1,408.4
2015	2,376	-491.9	82.84	-17.16	2020	1,161.5
2016	2,147.1	-226.9	90.45	-9.55	2021	914.6
Total		-987.6		-35.35		
Annual average		-246.9		-8.8375		
Annual average for 1 % growth		-27.937765 USD Million		-1%		

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

Therefore, it was estimated as the world silk export value to account for USD 914.6 million in the year 2021.

The forecast of the world silk production is also illustrated in Fig.12.

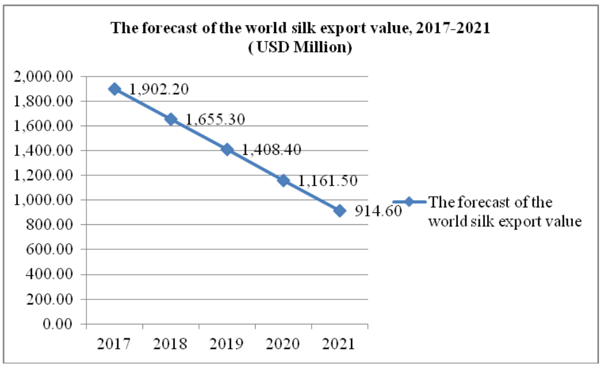


Fig. 12. The forecast of the world silk export value for the horizon 2017-2021 (USD Million)
Source: Own calculations and design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The forecast of the world silk import value. In the period 2012-2016, the world silk import value registered a total absolute decline of - USD 187.5 million, meaning an average absolute decrease of - USD 22.900763 million per year.

Therefore, the average decrease rate in the analyzed period was -8.1875 %.

For the next five years, it was considered that the world silk import value will continue its decline with a similar average decrease rate. In Table 11, it is presented the forecast of the world silk import value for the horizon 2017-2021.

For 1 % decline, the world silk import value will decrease by USD 22.900763 Million every year (Table 11).

Therefore, it was estimated as the world silk import value to account for USD 847.5 million in the year 2021.

The forecast of the world silk production is also illustrated in Fig.13.

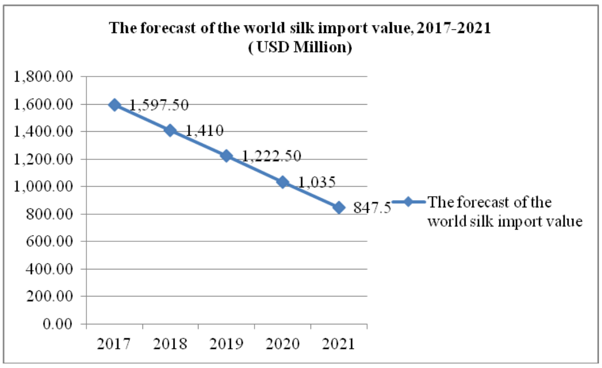


Fig. 13. The forecast of the world silk import value for the horizon 2017-2021 (USD Million)
Source: Own calculations and design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

Table 11.The forecast of the world silk export value for the horizon 2017-2021 (USD Million)

Year	World silk export value (USD Million)	Absolute change $\Delta t/_{t-1}$	Indices (%) $I_t/_{t-1}$	Growth rate (%) $R_t/_{t-1}$	Forecast 2017-2021	
					Year	USD Million
2012	2,535	-	100.00	-	2017	1,597.5
2013	2,411	-124	95.10	-4.90	2018	1,410.0
2014	2,329	-82	96.59	-3.41	2019	1,222.5
2015	1,893	-436	81.27	-18.73	2020	1,035.0
2016	1,785	-108	94.29	-5.71	2021	847.5
Total		-750		-32.75		
Annual average		-187.5		-8.1875		
Annual average for 1 % growth		-22.900763 USD Million		-1%		

Source: Own calculations based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

The forecast of the world silk trade balance. Taking into account the estimates for the world silk export and import value for the horizon 2017-2021, the world silk trade balance is expected to reach USD 67.1 million in the year 2021. This means that in the period 2017-2021, the silk trade balance will continue its decline keeping its positive value, but in 2021, it will be by 81.07 % lower than in 2016 (Fig.14).

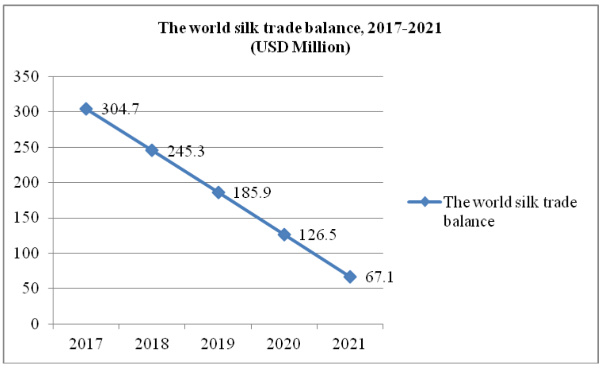


Fig. 14. The forecast of the world silk trade balance for the horizon 2017-2021 (USD Million)
Source: Own calculations and design based on the data provided by ITC, 2018, UN COMTRADE, 2018 [6, 16].

CONCLUSIONS

The world silk production increased 9.24 times in 2016 compared to 2007 and 1.26 times compared to 2012. In 2016, it accounted for 192,692.45 Metric tonnes.

The main silk producers are China and India which together produced 188,748 Metric tonnes silk in 2016, representing 97.94 % of the world silk production. Their production was by 38.27 % higher in 2016 than in 2012. This is explain by the fact that the internal market requires more silk for various purposes and also these two countries are the main silk suppliers for other countries.

Other silk producing countries with lower shares are, in the decreasing order: Uzbekistan, Thailand, Brazil, Vietnam, North Korea, Philippines, Iran, Bangladesh and Japan and also Bulgaria.

Silk products achieved and commercialized at the world level, are classified in seven categories according to the HSN codes for GTS. Taking into account the exported quantities of each silk product, the decreasing order of the product Codes are the following one in the year 2016: Code 5002, Raw silk, non thrown (8,964 Tonnes), Code 5003 -Silk waste (6,204 Tonnes), Code 5004 - Silk yarn (4,917 Tonnes), Code 5005-Yarn spun from silk waste (3,235 Tonnes), Code 5006-Silk yarn and yarn spun from silk wastes (1,196 Tonnes), Code 5001-Silk worm cocoons for reeling (454 Tonnes) and Code 5007-Woven fabrics of silk and silk waste (15,421 Tonnes).

The world amount of imported silk products in 2016 by silk product codes was the following one, in the decreasing order: Code 5002 (9,045 Tonnes), Code 5003 (6,527 Tonnes), Code 5004 (4,858 Tonnes), Code 5005 (3,458 Tonnes), Code 5001 (594 Tonnes), Code 5006 (404 Tonnes), Code 5004.

Therefore, the most commercialized silk products at the international level are, in the decreasing order, the following ones: woven fabrics, raw silk on thrown, silk waste, silk yarn and yarn spun from silk waste. All these products have recorded a general trend of decline of the exported and imported quantities in the period 2012-2014.

The silk export value also declined by 31.49 % in the analyzed period, accounting for USD 2,149 Million in 2016. The highest export value was registered by woven fabrics (61.03 %), raw silk non thrown (17.81%), silk yarn (12.27%) and yarn spun from silk waste (4.66 %), which all together represented 95.77 % of the world silk export value. All the products recorded a general descending trend of their export value.

The top silk exporters and China (53.9%), Italy (13.4 %), India (4.2 %), Romania (4 %), France (3.7 %), which all together have a market share of 79.2 % in the world silk export value.

The world silk import value also declined by 29.21 % in the analyzed period, accounting for USD 1,785 Million in 2016. The silk products with the highest share in the silk import value worldwide are: woven fabrics (56.13 %), raw silk non thrown (22.51%), and silk yarn (12.85%) which together totalize 91.49 %. The world top silk importers are: Italy (18.3 %), India (11.6%), Japan (7%), Romania (6.4 %), Vietnam (6.3 %), USA (5.7 %), France (4.4 %), Rep. Korea (3.9 %), Hong Kong China (3.3 %), China (3.2 %) and Germany (3%), all together accounting for 73.1 % of the world silk export value.

The silk trade balance followed also a descending trade reaching USD 354.3 Million in 2016, by 41.08 lees than in 2012. Almost all the main exporting and producing countries registered a negative trade balance, except China which had a positive trade balance in every year and France, which recorded a positive trade balance in 2014-2016.

Silk price varies depending on the demand/offer ratio for each type of silk product. The highest export price is for woven fabrics, raw silk non thrown and silk yarn and the highest import price is for raw silk non thrown and silk yarn. The silk export price registered a slight decline for woven fabrics, raw silk and silk yarn while for all the other products it increased. The import price declined for woven fabrics, raw silk, silk yarn and silk waste while for all the other products it increased.

For the next five years, 2017-2021 it is expected as silk production to continue to increase, but the export and import quantities and values and the trade balance to continue their decline due to the higher and higher consumption requirement in the domestic markets of the producing countries.

REFERENCES

[1]A concept paper for the development of sericiculture and silk industry in Latin American regions, http://inserco.org/en/sites/default/files/Concept%20on%20Silk%20for%20Latin%20American%20Countries.pdf, Accessed on January 20, 2018

[2]Cetateanu, N., Brasla, A, Matei, A., Dogaru, D., Serbanescu, S., 1988, Sericiculture practica, Ceres Publishing House, pp.8.

[3]Decent and green jobs in Pakistam's agriculture sector/ International Labor Organization, ILO, Toward Gender Parity in Pakistan (TPG), Project-Islamabad: ILO, 2011, www.ilo.org/publns, apgreenjobs.ilo.org/resources/decent-and-green.../file1, Accessed on January 20, 2018

[4]HSN Code for Silk, 2017, http://howtoexportimport.com/HSN-code-for-Silk-4718.aspx, Accessed on January 20, 2018

[5]International Sericicultural Commission, http://www.inserco.org/, Accessed January 20, 2018

[6]ITC, http://www.intracen.org/,Accessed on January 20, 2018

[7]Jayaprakash, P., Subharani, S., Tiken Singh, N, 2013, Muga seed production linkage for economic empowerment of women in the North East region of India, 6th BACSA International Conference "Building Value Chains in Sericulture" "BISERICA" 2013 Padua, Italy April 7th – 12th 2013, Proceedings of the scientific and technical reports, pp. 383, 414, http://www.bacsa-silk.org/user_pic/file/PROCEEDINGS%20BISERICA%202013.pdf, Accessed on January 20, 2018

[8]Matei, Alexandra, Popescu Agatha, Dolis, M., Tzenov, P.I., Bougiouskos, K., 2006, Research concerning the world natural silk market, Scientific Papers Series Animal Production, Iasi, Vol.49, 899-905

[9]Popescu Agatha, 2013, Trends in World Silk Cocoons and Silk Production and Trade, 2007-2010, Scientific Papers: Animal Science and Biotechnologies, 2013, 46 (2), 418-423

[10]Rajiv, S., 2013, Women In Sericulture, 6th BACSA

International Conference "Building Value Chains in Sericulture" "BISERICA" 2013 Padua, Italy April 7th – 12th 2013, Proceedings of the scientific and technical reports, pp.385, http://www.bacsa-silk.org/user_pic/file/PROCEEDINGS%20BISERICA%202013.pdf, Accessed on January 20, 2018

[11]Sathyanarayana, K., Saratchandra, B., 2013, Carbon trading through afforestation programmes with host plants of tasar silkworm (Antheraea mylitta Drury) in private waste lands: A Value Add for Tribals, 6th BACSA International Conference "Building Value Chains in Sericulture" "BISERICA" 2013 Padua, Italy April 7th – 12th 2013, Proceedings of the scientific and technical reports, pp.394-404, http://www.bacsa-silk.org/user_pic/file/PROCEEDINGS%20BISERICA%202013.pdf, Accessed on January 20, 2018

[12]Scott, P., 1993, The Book of Silk, Themes and Hudson Ltd, London

[13]Shantibala, T, Luikham, R., Victor, Th, Lokeshwari, R.K., Debaraj, H., 2013, Seri-biodiversity of Manipur, NorthEast India: Vision for sustainable livelihood and poverty alleviation, 6th BACSA International Conference "Building Value Chains in Sericulture" "BISERICA" 2013 Padua, Italy April 7th – 12th 2013, Proceedings of the scientific and technical reports, pp.368-369, http://www.bacsa-silk.org/user_pic/file/PROCEEDINGS%20BISERICA%202013.pdf, Accessed on January 20, 2018

[14]Silk in World Markets, 1999, International Trade Forum Magazine, Issue 1, 1999, http://www.tradeforum.org/Silk-in-World-Markets/, Accessed on January 20, 2018

[15]Tzenov, P., 2013, Opening Speech, 6th BACSA International Conference "Building Value Chains in Sericulture" "BISERICA" 2013 Padua, Italy April 7th – 12th 2013, Proceedings of the scientific and technical reports, pp.13-14, http://www.bacsa-silk.org/user_pic/file/PROCEEDINGS%20BISERICA%202013.pdf, Accessed on January 20, 2018

[16]UN COMTRADE, https://comtrade.un.org/, Accessed on January 20, 2018

[17]Wee Y.R., 2017, World Leaders In Silk Production, World Atlas, April 25, 2017, https://www.worldatlas.com/articles/world-leaders-in-silk-production.html, Accessed on January 20, 2018

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE CITY OF CLUJ-NAPOCA AND THE CLUJ COUNTY, IMPORTANT TOURIST ATTRACTIONS IN ROMANIA

Agatha POPESCU[1], Mircea Adrian GRIGORAS[2], Daniela PLESOIANU[3]

[1]University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest Romania, Phone: +40213182564, Fax: +40213182888, Email: agatha_popescu@yahoo.com
[2]University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Manastur Str., Cluj-Napoca 400372, Phone:0264 596 384, Email: magrigoras@yahoo.com
[3]Ovidius University, 1, University Avenue, Campus, Building B, Constanta, Romania,
Email: plesoianudaniela@hotmail.com

Corresponding author: agatha_popescu@yahoo.com

Abstract

The paper aimed to analyze the main trends in tourism in Cluj-Napoca and the Cluj County in the period 2007-2016 based on the empirical data provided by the National Institute of Statistics and the Statistical Division of the Cluj County. Tourism offer was briefly presented in terms of natural, historical and cultural patrimony, and also in terms of accommodation capacity (number of units and places) in its dynamics and correlation with the tourism demand, in terms of number of tourists arrivals and overnight stays. The data have been processed using index method, statistical parameters, Pearson correlation coefficients, linear regression models and the Excel facilities. In 2016, in Cluj-Napoca there were by 81.9 % more units of tourist accommodation and by 74 % more places, while at the county level, there were by 35 % more units and by 20 % more places. More exactly, in 2016, the offer of places was 6,216 in Cluj-Napoca and 8,450 places in the county. In the same period, the tourist arrivals increased by 42 % in Cluj-Napoca and by 44 % in the county. The number of overnight stays also increased by 34 % and, respectively 33 %. In 2016, Cluj-Napoca was visited by 371,505 tourists meaning 1.15 tourists/inhabitant, while the county registered 498,500 visitors, meaning 0.69 tourists/capita. The number of overnight stays accounted for 704,921 in Cluj-Napoca and 952,900 in the county. The regression linear models proved that the variation of the number of places has a low effect on the number of arrivals and overnight stays both in the city of residence and in the county. But a strong relationship is between the number of arrivals and overnight stays, (r= 0.990). As a final conclusion, the higher and higher number of Romanian and foreign visitors in Cluj-Napoca and the county of Cluj is explained by the diversified offer in terms of natural, historical and cultural patrimony, accommodation units and places, hospitality, high quality services which reflect a good tourism management and marketing.

Key words: *trends, tourism, attractions, offer, demand, Cluj-Napoca municipality, the Cluj County, Romania*

INTRODUCTION

Romania's tourism has registered an important development during the last decade attracting more and more tourists, but there are still differences from a region to another regarding the demand/offer ratio. Despite of its growth in the recent years, the tourism contribution to GDP is still a low one. The tourism income comes mainly from mountain tourism, seashore tourism, agro-tourism, spa and medical tourism, special cultural, religious and sport events, despite that Romania has a diversified and high natural and cultural potential for the most different tourism activities.

From a region to another and from a city or village to another, there are strengths and weaknesses which could be improved in the field of tourism, mainly regarding its infrastructure and service quality [3].

Tourism infrastructure must be correlated quantitatively and qualitatively with the tourist demand and expectation regarding the price/quality ratio [2].

The access to the tourist destination, accommodation structure, its capacity and lodging quality, facilities for entertainment at the destination are still the main problems which must be solved in Romania's tourism.

Investments have a low percentage in tourism sector compared to other branches of the economy. In 2016, Romania invested RON 14.7 billion in Travel and Tourism, representing 8.1 % of the total investment in the economy (USD 3,364.9 Million). [29].

The peculiarities of a tourist destination must be analyzed in the local context, by means of tourism offer and demand using appropriate methods to reach accurately results [13].

Transilvania is a special region of Romania as mentioned by Georg Reicherstorffer in his book "Choorographia Transylvaniae" published in 1532 in Vienna: *„Transilvania is this too proud and rich region is too humble in all things which are in the benefit of men, in gold and silver and in salt mines, from which tear by year it is developed an imense treasure with hills covered by vineyards and everywhere a lot of cattle and sheep flocks ... Do not suspect someone else in Europe is another province equal by wealth and beauty".* [15]

Cluj County is an area which offer a diversified supply of tourist attractions and allow a large variety of tourism forms to practice. The natural resources: the beautiful landscapes in the mountains, plains, hills, valleys, caves, rivers, forests, the sources of thermal and mineral waters are favorable for the development of leisure, recreation, spa tourism, climate tourism (high air ionization and aerosols in the salt mines), mountain tourism (walking, climbing, caving, hiking, hunting), sport tourism (skiing, and skating), extreme tourism (cycling, river rafting, paragliding) and rural tourism and agro-tourism.

The cultural heritage is also diversified from the archeological sites, to museums, charming villages, folk traditions (costumes, music, dance, gastronomy), religious fests, etc. are of high attraction both for Romanian and foreign tourists [14].

In this context, the purpose of the paper was the analysis of the tourism offer in terms of the natural and cultural heritage, as well as accommodation capacity versus the demand of tourism in terms of number of tourist arrivals and overnight stays in the City of Cluj-Napoca and in the Cluj County.

These destinations were chosen because Cluj area is very dynamic from an economic point of view, and the richness of cultural objectives and events have attracted more and more tourists year by year. The paper combine in a harmonious manner both the cultural, ethnographic, and natural attractions with the concrete status of infrastructure, mainly regarding the number of units for tourist accommodation and their structure as well as the number of places (beds) available in the city and in the county. The correlation and regressions models between the number of places, the number of tourist arrivals and the number of overnight stays are especially used in order to characterize the relationship between tourism and demand.

The analysis is carried out in the period of the last decade, 2007-2016, based on the empirical data offered by the National Institute of Statistics and its branch at the level of the Statistical Division of the Cluj County.

MATERIALS AND METHODS

In order to characterize tourism and its trend in the Municipality of Cluj and the Cluj County, in the paper it was used a large range on indicators as follows: indicators regarding the geographical position, demographical and economic status, tourist attractions, tourism offer in terms of the number of units of accommodation with tourist function, the number of places exiting in these units, the number of places-days, tourism demand in terms of the number of tourist arrivals and the number of overnight stays.

The empirical data were provided by the National Institute of Statistics Tempo online data base and also by the Statistical Division of the Cluj County.

The period of reference was 2007-2016.

The methodology varied depending on the goals of the paper.

For analyzing the dynamics of the indicators mentioned above it was used the index method, in its variant of fixed basis Index, $I_{FB} = (X_n/X_0)100$, where X_n is the variable X in the years n= 1,2,...i, X_0 is the value of the variable X in the year zero.

The structure of various indicators was

established according to the formula: $S_{\%}= (X_i/X_T)$ 100, where X_i = the value of the variable i= 1,2, ...k, and X_T= the sum of the values of all the variables k.

In order to establish the relationship between tourism offer and demand, there were used linear regression models as well as the coefficient of determination and the Pearson coefficient of correlation for the following three pairs of indicators as follows:

(i)the number of places in the accommodation units with tourist function and the number of tourist arrivals;

(ii) the number of places in the accommodation units with tourist function and the number of overnight stays;

(iii)the number of tourist arrivals and the number of overnight stays.

The data processing was assured by the Excel facilities, for calculating the statistical main parameters of mean, standard deviation and coefficient of variation, the ANOVA, F test and Sign. F, and the values parameters "a" and "b", their interval of confidence, and the t test and p-value for 0.05 (95%).

The results were tabled, graphically illustrated and interpreted. Finally, the main ideas resulting from this research work were drawn.

RESULTS AND DISCUSSIONS

Brief presentation of the Cluj County and Cluj-Napoca Municipality

The Cluj County is situated in the North-Western part of Romania, between the paraleles 47°28'44' in North and 46°24'47' in South, respectively the meridians 23°39'22' in West and 24°13'46' in East. The county has a surface of 6,674 square kilometers including a part of the Apuseni Mountains, the Somes Highland and the Transilvanian Plain.

The archeological excavations proved that in this area existed an old civilisation well integrated in the Europe culture and life. It is about the neolitic settlements, as well as the old Geto-Dacian culture as mentioned by the Greek historian Herodot in the 2nd century A.D.

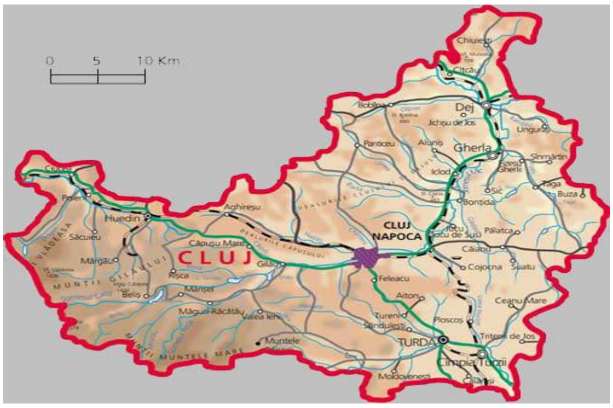


Photo 1. The map of the Cluj County
Source: www.google.ro; zarnesti.net

The county has a large variety of landscapes, relief forms and nature monuments. One third of its surface is covered by mountains, and the remaining is represented by hills and just a few by plains.

The climate is a moderate continental one with cold summers and hard winters, the average temperature in July varying between 12 and 23 degrees, and in winter, more exactely in January between -2 and -8 degrees.

The main hydrographic net is represented by the Rivers Somes Mic, Aries and Cris Repede and also by the lakes from the natural rezervations. The mountains are covered by virgin forests mainly of coniferous species, but also by pastures and meadows.

Across the time, the economy in this area has been quickly developed grace to the advantageous geographical position, rich resources of raw materials and labor, easy communication ways and facilities, and a huge capacity of adaptation to the new challeanges and opportunities imposed by the industry and trade development.

In 2015, the county had over 702,174 inhabitants, of which 460,189 (65.5 %) in the urban area. The active occupied population accounts for 352,600 persons, meaning 50.2 % of the total population. The active population has jobs in various field of activities such as: 22.1 % in industry, 15.7 % in trade, 14.5 % in agriculture, 6.6 % in transportation, 5.4 in education, 5.4 % in information and communications and 2,.46 % in hotels and restaurants, tourism and travel industry.

The economy of the county and mainly of the municipality of Cluj-Napoca has exploded mainly after 1989, when the private sector has become the main supplier of jobs, production, and business. Many foreign investors came here to develop their business and found a favorable climate, so that the economy in the area has become one of the most dynamic and prosperous one in Romania.

In 2016, the county had 114,295 ha cultivated area, of which 63.6 % cereals, 6.1 % potatoes, 5.5 % oleaginous plants, 4.8 % vegetables. The agricultural production value totalized Lei 1,487,910 million, of which 55.47 % vegetal production, 43.70 % animal production, and 0.83 % services.

Investments made in the county reached Lei 4,836 million in the year 2015. Of the total investments, about Lei 145 million (3 %) were allotted for the development of travel and tourism in the county.

The GDP achieved by the Cluj County accounted for Lei 31,178.2 Million in the year 2015, being by 69.25 % higher than in 2007, when it accounted for Lei 18,420.6 Million.

The GDP/inhabitant increased from Lei 26,055/capita in the year 2007 to Lei 43,257/capita in the year 2015 meaning an increase of 66.02 %. [25].

Tourist attractions in the Cluj County

There are many places in the Cluj County were tourists could enjoy the visit and find recreation.

Hoia - Baciu Woods are in the proximity of Cluj-Napoca at 5 miles West. It is about of a forest area suitable for relaxation and walks.

The Turda Salt mine is 23 miles South East of Cluj-Napoca. It is a real museum including salt deposits dated 13.6-13.4 million years ago. Its surface is 45 square kilometers and the salt layer has an average thickness of about 250 meters. The salt was exploited under the Roman occupation in Dacia and later on since 1690 under the Austrian Empire. The salt mine was closed in 1932 and since 1992 it was open to the public, getting the status of a genuine history museum. A part of the gallery is used for cheese storage. The salt mine is an important historical and tourist attraction being visited by more and more tourists every year. Inside the salt mine, there are Franz Jozef Gallery, the echo room, the Crivac Hall, the old extraction well, Rudolf Mine, Terezia Mine, Anton Mine, which could be admired using the modern elevator. The salt mine offers various entertainment facilities such: an amphitheater for concerts of 180 heated places, minigolf, bowling, sport terrains, tennis and billiard tables, a wheel with six gondolas and 48 places, games for children, a small lake with rowing boats, and also Ghizela Stationary destined for treatment (halotherapy) [19, 20, 31].

Turda Wine Cellars offer to tourists short visits including walks in the vineyard, visit of the wine cellars, wine tasting sessions and also the organization of private events. [32].

The Sic (Szek) Village, situated 25 miles in the North Eastern part of Cluj-Napoca, is a charming small locality lived by Hungarians and Saxons, where tourists may admire the old traditions well preserved such as: the beautiful traditional folk costumes, the folk dance and music, the Tuesday Market, the Bartholomew's Day on August 24, and also could have accommodation in a guest house of 34 seats capacity and meals in a restaurant with 60 places [34].

The Apuseni Nature Park is situated at 45 miles South West of Cluj-Napoca. The mountains are very charming and could be easily explored by tourists who are interested to discover the beauty of the forests and the peaks, or the underground world by caving. In this area, there are about 1,500 caves, about 80% of the total karstic rocks. The most known cave is *Scarisoara Ice Cave,* a national natural monument in the Apuseni Mountains, being the biggest underground glacier in Romania, and on the 2nd position in Europe. Scarisoara Cave has a glacier of 3,000 years old and 75,000 cubic meters, which belongs to the speleological reservation [26].

The Apuseni Motzi Villages are full of charm, showing their traditions to visitors. They are places where tourist could find tranquility and enjoy life in the country side, tasting traditional food and participating to the jobs in the field. [7].

It is about the villages situated in the Apuseni Mountains (Măguri-Mişel, Beliş, Băişoara, Valea Drăganului, Răchiţele, Ciucea, Poieni), in the Depresiunea Huedin (Sâncrai, Izvoru Crişului, Călăţele, Mărgău, Râşca), in the Podişul Someşan (Borşa, Vultureni, Panticeu, Bobâlna, Vad), and in the Transylvania Plane (Mociu, Frata, Taga, geaca, Năsal, Cătina) [17, 33].

The Cluj county has more than 20 protected natural areas and natural rezervations such as: Cheile Turzii, Suatu, Lacul Stiucii, Valea Legii.

Also, other important tourist attractions are the balneo-resorts such as: Cojocna, Baita, Turda, Ocna Dej baths and the Vladeasa, Gilau, Tarnita and Trascau Mountains. The Cluj Faget Hill, the valleys of Visag, Draganului, Racatau and the Rachitele waterfall attract many tourists as well.

The rich and varied anthropic resources are represented by the cultural, historical and religious items and also by beautiful villages where traditions are well preserved and charming cities [24].

In the Cluj County are preserved many folk traditions and take place every year various cultural and artistic events, among which the most important ones are: the „Ion Cristoreanu" National Festival, The 'Serbarile Transilvane' Festival of culture and folk traditions, the "Golden Peacock" International Folk Festival for Children, the "Musical Autumn" with the support of the "Transilvania Philarmonique", the Men Folk Dance Festival of Transilvania, the Fair of folk handicrafts, and the Village Sons Folk Celebration. [9].

The City of Cluj-Napoca is one of the main and old cities situated in Transilvania region of Romania. Its origin goes back 200 years A.D in the settlement of Napoca in the old country Dacia.

From an etymological point of view, the name of the city could be translated "the city on the warm river"(Na =water, Po= source and Ca= warm water), justified by the fact that the city is really situated in an area full of thermal waters [12].

Its existence is attested by documents in the year 1173 AD. Cluj-Napoca was considered the unofficial capital of the Great Principality of Transilvania under the Austrian Empire between 1790-1867.

Photo 2. Cluj-Napoca, The National Theater
Source: www.google.ro, romaniatourism.com

It is situated at about 458 km distance of Bucharest, the capital of the country, 460 km of Budapest, 464 km distance of Belgrad, and 651 km of Vienna.

It has 179.5 km² area and it is placed at an altitude of 410 m. It has a population over 330,000 inhabitants, being the 2nd city in Romania after Bucharest. Including the metropolitan area, it has over 420,000 inhabitants.

At present, the city is one of the most important industrial, academic, cultural and business cities of Romania.

The city of Cluj is an important economic center, coming on the 2nd position after the Capital of Romania [4].

A comparison between the two cities in the year 2015 pointed out that the population living in Cluj- Napoca and in the adjacent localities represented 17.7 % of the population of the capital. In Cluj-Napoca there were employed 220 thousand people, representing 24.3 % of the number of employees in the capital. The average net salary in Cluj-Napoca was Lei 2,060, meaning 80.5 % of the one earned in Bucharest. The GDP/capita in Cluj-Napoca was Euro 20,900/inhabitant accounting for 48.3 % of the one achieved in Bucharest. Cluj-Napoca export value per inhabitant was Euro 1,136, representing 34.1

% of the one carried out in the capital. The number of tourists visiting Cluj-Napoca was over 360, 000, representing 24.8 % of the number of Bucharest visitors [1].(Table 1).

The turnover achieved in Cluj-Napoca in 2016 accounted for Lei 53,366 Million, being by 75.92 % higher than in 2007. The contribution to various sectors of activity to the total turnover of the city was the following one: trade 38.62 %, industry 22.43 %, buildings 9.38 %, transportation 8.38 %, hotels and restaurants 1.86 %.

All the sectors of activity followed a general increasing trend, except the years 2008 and 2010 when the economy was affected by the economic crisis, but starting from the year 2011, the economy has recovered registering a higher and higher growth rate from a year to another. Comparing the absolute figures of turnover achieved in the year 2016 with the turnover level in 2007, one may easily notice that the highest increase was achieved by Hotels and restaurants, (+142.29 %), followed by transportation (+100.67 %), industry (+64.26%), trade (+48.97 %) and buildings (+20.97).(Table 2).

Table 1. Cluj-Napoca versus Bucharest in terms of the key economic indicators in 2015

	Population (Thousand)	Population including the adjacent localities (Thousand)	Employees (Thousand)	Average net salary Lei/employee/ Month	GDP/capita (Thousand Euro/capita)	Export Value/capita (Euro/capita)	Number of Tourists (Million)
Bucharest	1,883	2,121	904	2,556	20.9	3,333	1.45
Cluj-Napoca	325	377	220	2,060	10.1	1,136	0.36
Share of Cluj-Napoca (%)	17.2	17.7	24.3	80.5	48.3	34.1	24.8

Source: [1].

Table 2. The dynamics of turnover in the city of Cluj-Napoca by main sectors of activity, 2007-2016 (Lei Million)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2016/2007 %
Turnover, Total	30,335	37,934	35,356	36,604	38,370	37,704	39,967	42,442	47,905	53,366	175.92
Trade	13,838	16,041	12,790	12,607	14,097	14,960	15,592	16,236	17,326	20,615	148.97
Industry	7,289	9,269	10,615	13,136	11,471	8,122	8,257	9,149	10,639	11,973	164.26
Buildings	4,162	5,414	4,889	3,639	3,925	4,481	5,113	4,481	5,840	5,010	120.37
Transport	2,230	1,660	1,515	1,639	2,182	2,324	2,829	3,438	4,110	4,475	200.67
Hotels and restaurants	409	487	454	467	516	572	618	673	975	991	242.29
Share of Hotels and restaurants (%)	1.34	1.28	1.28	1.28	1.34	1.52	1.55	1.59	1.83	1.86	-

Source: Own calculations based on the data provided by the Statistical Division of the Cluj County, 2018 [28].

Cluj-Napoca is well known for its higher education institutions, which account about 55,000 students of which over 30,000 attend the courses of the Babeș-Bolyai University, the largest in the country. About 13,000 students are enrolled at the Technical University, 6,000 at the University of Medicine and Pharmacy and 5,000 at the University of Agricultural Sciences and Veterinary Medicine, also the University of Art and Design [10].

Tourist attractions in the City of Cluj-Napoca

Cluj-Napoca is a cultural city grace to its historical and cultural places including: vestiges of the past in the old Dacia and the medieval era, monuments, museums, palaces, libraries, theaters, exhibitions, cultural events organized by its specialized institutions and local authorities.

Among the most important cultural institutions there are: the Romanian Opera House which was founded in 1919, and since that time, here there were played more than 200 titles of operas, operettas and ballets performed by high value artists well know in

Europe and other continents.

Also, the National Theater "Lucian Blaga", the State Hungarian Opera House, the State Hungarian Theater, the Academy of Music "Gh. Dima", and the "Philarmonica Transilvania" are other important institutions in the cultural life of the city [27].

The National Art Museum founded in 1951, hosted by the marvelous Banffy Palace, a jewel of baroque architecture, exhibits a rich collection of art masterpieces belonging to the great Romanian artists such as Ștefan Luchian, Theodor Aman, Nicolae Grigorescu, Nicolae Tonitza, Dimitrie Paciurea, Theodor Pallady, but also of foreign artists such as Constantin David Rosenthal and Karl Storck [21].

In the city there are other important museums such as: The National Museum of Transilvania, the Museum of Pharmacy, The Village Museum, The Etnographic Museum of Transilvania, Emil Racovita Speleology Institute & Museum, The Museum of Mineralogy, and the Zoological Museum.

In the Union Square, in the middle of the city, it is the Saint Michael Church, built in the middle of the 14th century and the monument of the King Matei Corvin, which have become symbols of the city.

Also, in the Union Square, there are ruins of the buildings belonging to the Roman City of Napoca in the 2nd and 3rd centuries A.C. On the occasion of the archeological excavations made in the year 1822, 1994 and 2008, there were discovered Roman and medieval ruins and also neolitical vestiges [18].

The Tailor's Tower and Wall of defend are among the least fortification towers belonging to the old medieval fortress of Cluj [8].

The city has many churches among which the most important are: the Calvinist Reformed Church, dated since the year 1416 and built in a late gothic architectural style, St. Peter and Paul Cathedral, another gothic church dated since 1848, the Franciscan Monastery and Church, and the New Synagogue.

The city has an well known "Alexandru Borza" Botanical Garden which was founded in 1920 and has 14 ha surface where over 10,000 plant species from all over the world are grown and exhibited. Here, the Japanese garden and the Roman Garden, the Ceres statue and the plants cultivated in the Romanian agriculture at present are among the most important tourist attractions [23].

In 2015, Cluj-Napoca was the "European capital of Youth", organizing over 1,100 events and 3,500 activities which have attracted a by 21 % more tourists [5].

In Cluj-Napoca there are annually organized a series of important festivals such as: ClujShorts-International Short Film Festival, Music-Jazz in the Central Park, Music-Electric Castle Festival (Banffy Castle), Music-Untold Festival, Musci-Delahoya (Valea Garbaului, Hoia), Music=Mioritmic, Art- Transilvania International Music and Art Festival (TIMAF), and Film -Comedy Cluj-International Film Festival [22].

Due to its valuable and unique traditions, customs, institutions and events, the city of Cluj-Napoca candidates as the European capital of culture in the year 2021 [6].

Regarding other cities of high attraction in the Cluj County, we can mention:

-In Dej City: the Samum Roman Castrum, the Dej Municipal Museum, the Protestant Church, The Franciscan Monastery and Church St. Anton de Padova, the "Lupa capitolina" statue, the Palace of Justice, the Greek-Catholic Church, the Heroes Obelisque, the ruins of the Cornis Castle [16].

-In Turda City: the Protestant Church with Tower (the 15th century), the Roman-Catholic Church (the 16th century), the Fortified Church Turda Noua, the Franciscan Monastery (the 18th century).

Trends in tourism in Cluj-Napoca Municipality

The tourism offer in terms of accommodation capacity.

The number of tourist units with accommodation function in the Municipality of Cluj-Napoca increased year by year in the analyzed period. In the year 2017, the city had 111 units for tourists accommodation, by 81.96 % more than in the year 2007.

In the year 2007, in the structure of the accommodation units, the main positions were occupied by: hotels (11 units, 40.9 %), tourist villas (11 units, 18 %), tourist guesthouses (10 units, 16.36 %) and agro-tourist guesthouses

(1 unit, 1.63 %).

In the year 2017, the structure was the following one: hotels (46 units; 41.44 %), tourist guesthouses (48 units; 43.24 %), tourist villas (8 units; 7.2 %), hostels (7 units; 6.3 %) and agro-tourist guesthouses (1 unit, 0.9 %).

The number of places (beds) in accommodation units for tourists has increased year by year, so that in the year 2017, in Cluj-Napoca, there were 6,216 places, by 74.02 % more than in the year 2007 (Fig.1.)

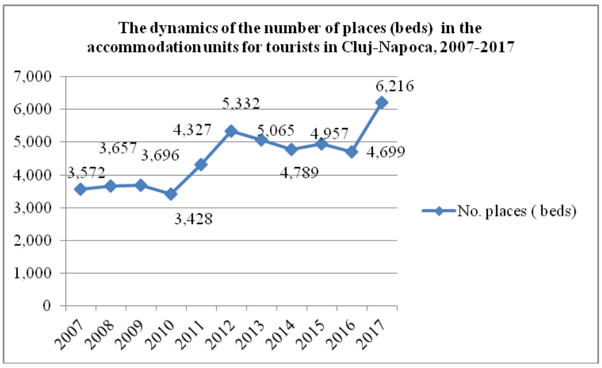


Fig.1.The evolution of the number of places (beds) in the units with function for tourist accommodation in Cluj-Napoca, 2007-2017

Source: Own design based on the data provided by The Statistical Division of Cluj County, 2018 [28].

By type of the main accommodation units, the situation was the following one in the year 2007: 75.90 % places in hotels, 8.23 % places in tourist villas, 6.43 % in tourist guesthouses and 0.36 % in agro-tourist guesthouses.

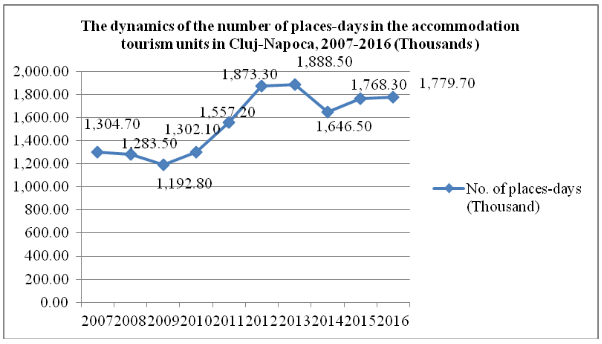


Fig.2.The evolution of the number of places-days in the units with function for tourist accommodation in Cluj-Napoca, 2007-2016 (Thousands)

Source: Own design based on the data provided by The Statistical Division of Cluj County, 2018 [28].

In the year 2017, the hotels remained on the top position with 72.15 % market share, the tourist guesthouses had 18.67 % market share, the tourist villas 4.29 % and hostels 2.94 %.

The number of places-days also increased by 34.40 % from 1,304,780 places-days in the year 2007 to 1,779,734 places-days in the year 2016 (Fig.2.).

The tourism demand.

The number of tourist arrivals followed an ascending trend from 261,343 arrivals in the year 2007 to 371,505 arrivals in the year 2016. This means by 42.15 % more tourist arrivals than in 2007. (Fig.3.)

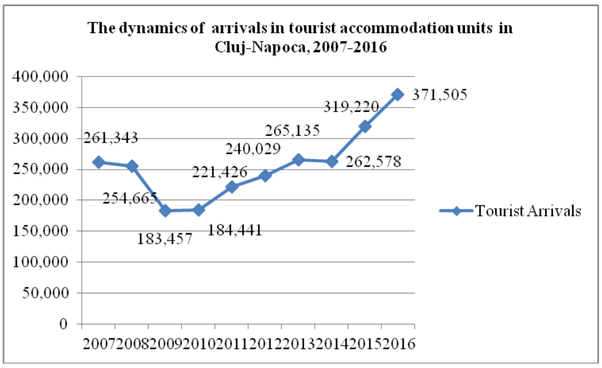


Fig.3.The evolution of the number of tourist arrivals in Cluj-Napoca, 2007-2016

Source: Own design based on the data provided by The Statistical Division of Cluj County, 2018 [28].

In 2016, the number of tourists was by 16.37 % higher than in 2015, reflecting that Cluj-Napoca is a city of high attraction for visitors, both from Romania but also from various countries.

Of the total number of tourists in 2016, a number of 99,131 were foreigners, representing 26.68 %. The foreign tourists came from Hungary (14,903 tourists, 15 %), Germany (11,717 tourists, 11.81 %), Italy (9,766 tourists, 9.85 %), France (7,293 tourists, 7.35 %) and Poland (6,270 tourists, 6.32 %).

This was due to the increasing importance of the City of Cluj-Napoca as a business center and also as host and organizer of various events such as the Untold Music Festival, which attracted about 30,000 foreign tourists, representing 30.26 of the total number of foreign visitors. Also, another important event of high interest for tourists is Transylvania

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

International Film Festival TIFF [34].

In 2017, the city of Cluj-Napoca carried out a record of tourist arrivals, that is over 542,000 visitors, of which 22 % foreigners. Most of them were from Hungary (18,189 tourists, 15.28 %), Germany (14,722 tourists, 12.36 %), Italy (10,832 tourists, 9.09 %), United Kingdom (8,095 tourists, 6.80 %), France (7,794 tourists, 6.54 %), and Poland (6,313 tourists, 5.3 %) [11].

In general, there are three reasons why the Romanian tourists are attracted to come to Cluj-Napoca are the following ones: to visit friends and relatives and shopping (33.5 %), to attend various events, mainly concerts and festivals (17.1 %) and for recreation (16%). The foreign visitors are mainly interested of recreation (35.7 %), of cultural events (15.8 %), medical treatments, visits to friends and relatives and shopping (16.4 %). These aspects were found by an important field survey achieved on a sample of tourists in June 2015- June 2016 [28].

Tourism density, as a ratio between the number of tourists and the resident population, followed a continuous growth rate. It in the year 2011, the tourism density in Cluj-Napoca was 0.71 tourists per inhabitant, in the year 2016, the city recorded 1.15 tourists/inhabitant, meaning by 61.97 % more. And this happens under the condition that the population of Cluj-Napoca is increasing, the city, being the only county residence, besides Timisoara, where the population have a positive growth rate [1].

The number of overnight stays registered also an ascending trend. In 2016, the number of overnight stays in the city of Cluj-Napoca accounted for 704,921, being by 44.08 % higher than in the year 2007.(Fig.4.)

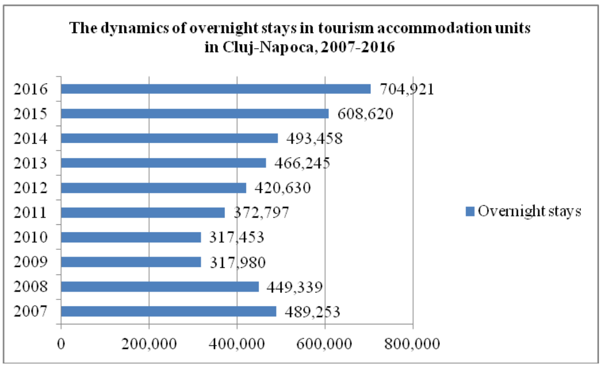


Fig.4.The evolution of the number of overnight stays in Cluj-Napoca, 2007-2016

Source: Own design based on the data provided by The Statistical Division of Cluj County, 2018 [28].

The statistical parameters in terms of mean, standard deviation and coefficient of variation for the analyzed indicators: number of places, number of places-days, tourist arrivals and overnight stays are presented in Table 3.

Table 3.The statistical parameters for number of places, number of places-days, tourist arrivals and overnight stays in the city of Cluj-Napoca in the period 2007-2016

Statistical parameter	Number of places	Number of places-days	Tourist arrivals	Overnight stays
Mean	49,738	1,559.66	256,379.90	464,069.60
St.Deviation	876.37	268.37	57,084.13	121,874.29
Coeff. of variation (%)	1.76	17.20	22.26	26.26

Source: Own calculation based on the data provided by The Statistical Division of Cluj County, 2018 [28].

Relationship between tourism offer and demand.

Regression of tourist arrivals depending on the number of places in accommodation units for tourist reception is presented in Fig. 5. The linear regression model, $y = 40.554x + 79882$, where Y= the number of tourist arrivals, the dependent variable, and X = the number of places, the independent variable, reflects that for an increase of one place in the accommodation units for tourist reception will determine an increase by 40.554 of the number of tourist arrivals.

However, the determination coefficient, $R^2 = 0.2536$, reflects that only 25.36 % of the variation of the number of tourist arrivals is due to the variation of the number of places. Therefore, there are other factors which influence the number of arrivals such as the reason why the tourist would like to visit the city of Cluj-Napoca, their motivation for doing this, the cost of their travel, accommodation, board, entertainment etc.

The coefficient of correlation r = 0.503 reflects that between the number of tourist arrivals and the number of places in accommodation units for tourist reception is a positive and enough strong relationship.

The regression model is available as F = 2.718 much higher than its table value, and Sign. F = 0.1378.

The value of "a" parameter is situated in the interval - 166,915.5632 < 79,882.24 < 329,680.054 for P=0.05 (95%), and the value of " Intercept X1" is situated in the interval - 16.16895 < 40.5536 < 97.2762 for P= 0.05 (95%).

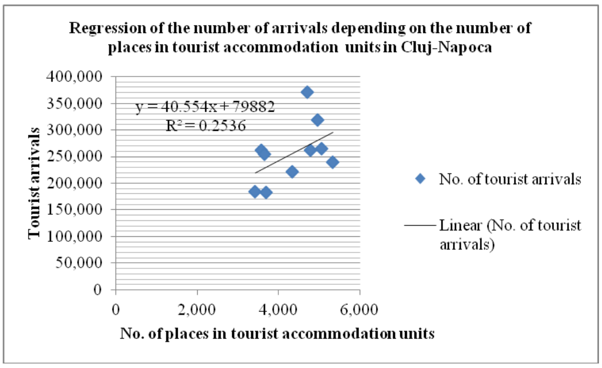


Fig.5.Regression of the number of arrivals depending on the number of places in tourist accommodation units in Cluj-Napoca, 2007-2016

Source: Own design based on the data provided by The Statistical Division of Cluj County, 2018 [28].

Regression of overnight stays depending on the number of places in tourist accommodation units was represented by the following econometric model: Y = 81.161x + 110841, where Y = overnight stays, the dependent variable and X = the number of places in tourist accommodation units. (Fig.6). The regression model shows that an increase of the number of places in accommodation units for tourists could determine a growth by 81.151 of the number of overnight stays. The value of the coefficient of determination, R^2 = 0.2228 reflects that only 22.28 % of the variation of the number of overnight stays is caused by the variation of the number of places, and the difference of 77.72 % is caused by other factors.

The coefficient of correlation r = 0.472 reflects that between the number of overnight stays and the number of places in accommodation units for tourist reception is a positive relationship of a middle intensity.

The regression model is available as F = 2.29386 much higher than its table value, and Sign. F = 0.16834.

The value of "a" parameter is situated in the interval - 433,354.63 < 110,841.3315 < 655,037.2998 for P=0.05 (95%), and the value of "Intercept X1" is situated in the interval - 42.41197 < 81.16085 < 204.73368 for P= 0.05 (95%).

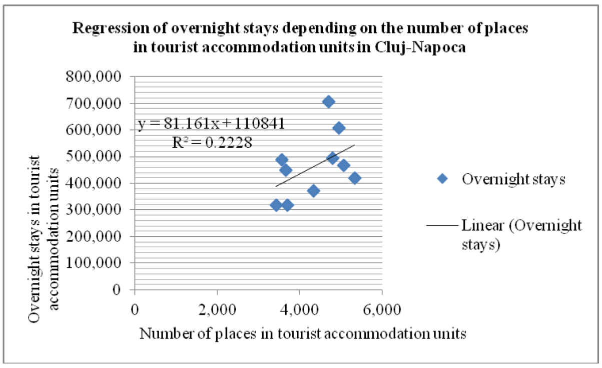


Fig.6.Regression of the number of overnight stays depending on the number of places in tourist accommodation units in Cluj-Napoca, 2007-2016

Source: Own design based on the data provided by The Statistical Division of Cluj County, 2018 [28].

Regression of overnight stays depending on the number of tourist arrivals is confirmed by the linear econometric model: Y = 2.1231x - 80245, where Y= number of overnight stays and X= tourist arrivals. For an increase of one arrival, the number of overnight stays will grow by 2.1231. The strong relationship between this two indicators is also attested by the value of R square, R^2 = 0.9889, which reflects that 98.89 % of the variation of the overnight stays is caused by the variation of the number of tourist arrivals (Fig.7).

The correlation coefficient is very high, r = 0.994 confirming the strong and positive relationship between the two analyzed indicators. Also, F = 710.7584 is higher than the tabled value and Sign. F = 4.2153. Also, the parameters " a" and "b" are situated within the interval of confidence.

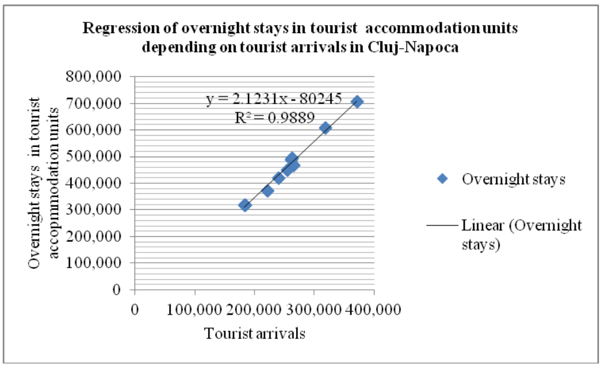


Fig.7.Regression of the number of overnight stays depending on the number of tourist arrivals in Cluj-Napoca, 2007-2016
Source: Own design based on the data provided by The Statistical Division of Cluj County, 2018 [28].

Trends in tourism of the Cluj County.

The tourism offer in terms of accommodation capacity.

The number of tourist units with accommodation function in the tourists increased by 34.12 % from 211 units in the year 2007 to 283 units in the year 2016. The share of the main types of accommodation units was the following one:
-in the year 2007: hotels 45 (21.32 %), tourist villas 33 (15.63 %), tourist guesthouses 16 (7.58 %) and agro-tourist guesthouses 94 (44.54 %);
-in the year 2017: hotels 64 (22.61 %), tourist guesthouses 64 (22.61%), agro-tourist guesthouses 121 (42.75 %) and tourist villas 12 (4.24 %).

The number of places (beds) in accommodation units for tourists increased by 19.51 % from 7,070 places in 2007 to 8,450 places in 2017 (Fig.8).

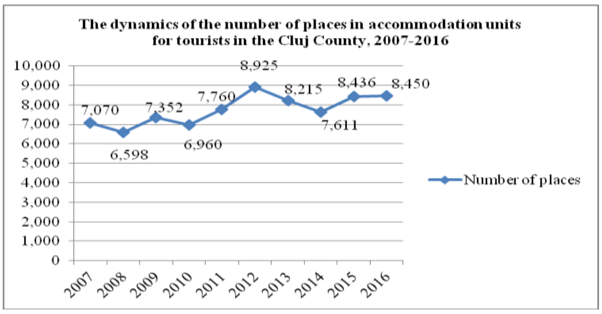


Fig.8.The dynamics of the number of places (beds) in tourist accommodation units in the Cluj County, 2007-2016
Source: Own design based on the data provided by the National Institute of Statistics Tempo-online data base, 2018 [25].

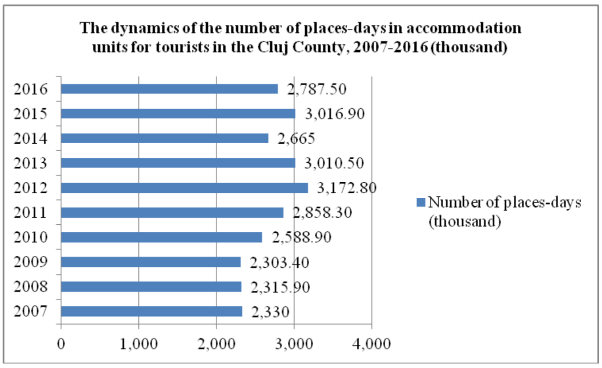


Fig.9.The dynamics of the number of places-days in tourist accommodation units in the Cluj County, 2007-2016
Source: Own design based on the data provided by the National Institute of Statistics Tempo-online data base, 2018 [25].

The number of places-days increased by 19.63 % from 2,330 thousand places-days in 2007 to 2,787.5 thousand places-days in 2016.(Fig.9.)

The tourism demand.

The number of tourist arrivals has also increased from 372,000 visitors in 2007 to 498,500 visitors in 2016, meaning by 34 % more than in the previous year of the analysis (Fig.10).

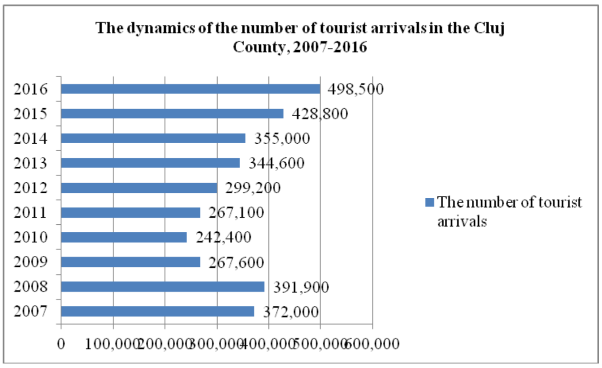


Fig.10.The dynamics of the number of tourist arrivals in the Cluj County, 2007-2016
Source: Own design based on the data provided by the National Institute of Statistics Tempo-online data base, 2018 [25].

Tourism density in the County of Cluj increased by 32.69 % from 0.52 tourists/inhabitant in 2007 to 0.69 tourists per inhabitant in 2016. And this has happened under the condition that the population of the Cluj Country has had an ascending trend from 706,855 inhabitants in 2007 to 722,438 inhabitants in 2016 (+2.20 %).

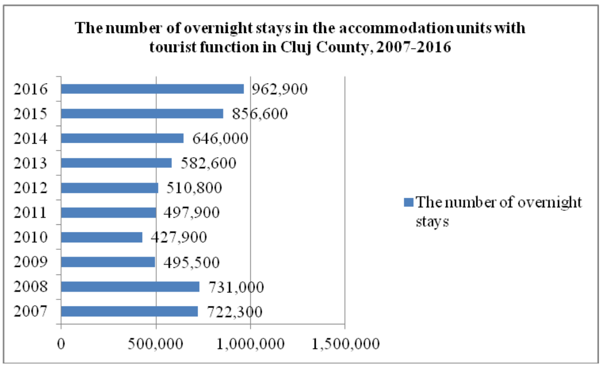


Fig.11.The dynamics of the number of overnight stays in the accommodation units with tourism function in the Cluj County, 2007-2016

Source: Own design based on the data provided by the National Institute of Statistics Tempo-online data base, 2018 [25].

The number of overnight stays increased by 33.3 % from 722,300 in the year 2007 to 952,900 in the year 2016. However, in the years 2009, 2010 and 2011, the number of overnight stays registered a decline due to the economic crisis which limited the tourist flow and the duration of stay (Fig.11).

The statistical parameters in terms of mean, standard deviation and coefficient of variation for the number of places, the number of places-days, tourist arrivals and overnight stays in the Cluj County are shown in Table 4.

Table 4.The statistical parameters for number of places, number of places-days, tourist arrivals and overnight stays in the Cluj County in the period 2007-2016

Statistical parameter	Number of places	Number of places-days (Thousand)	Tourist arrivals	Overnight stays
Mean	7,737	2,007	346,710	643,350
St. Deviation	756.25	317.65	80,462.40	173,910.73
Coeff. of variation (%)	9.77	1.58	23.20	27.03

Source: Own calculation based on the data provided by the National Institute of Statistics Tempo-online data base, 2018 [25].

Relationship between tourism offer and demand.

Regression of tourist arrivals depending on the number of places in accommodation units for tourist reception was reflected by the linear econometric model: Y = 28.84x + 123558, where Y= the number of tourist arrivals and X = the number of places. It shows that an increase of one place in the tourism accommodation units will determine an increase by 26.84 of the number of tourist arrivals. The determination coefficient, R^2 = 0.0735, reflects that only 7.35 % of the variation of the tourist arrivals is caused by the number of places (Fig.12).

Therefore, the remaining of 92.65 % is determined by other factors. Also, the coefficient of correlation, r= 0.271 has a low value, reflecting that between the number of tourist arrivals and the number of places is a weak relationship (Fig.12).

The regression model is available as F = 0.6344 much higher than its table value, and Sign. F = 0.44873.

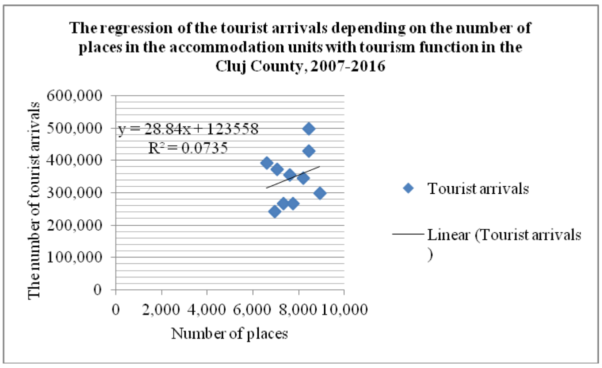


Fig.12.The regression of the number of tourist arrivals depending on the number of places in the accommodation units with tourism function in the Cluj County, 2007-2016

Source: Own design based on the data provided by the National Institute of Statistics Tempo-online data base, 2018 [25].

The value of "a" parameter is situated in the interval - 525,280.1911 < 123,558 < 772,396.85 for P=0.05 (95%), and the value of "Intercept X1" is situated in the interval - 54.65649 < 28.8395 < 112.33556 for P= 0.05 (95%).

Regression of overnight stays depending on the number of places in tourist accommodation units is shown by the linear model: Y = 50.229x + 254,692, where Y= the number of overnight stays and X = the number of places. It proves that a change of one place in the tourism accommodation units will determine an increase by 50.22 of the number of overnight stays. The value of R^2 = 0.0477 shows that 4.77 % of the variation of the number of overnight stays is caused by the variation of the number of places. This means that there are other factors which influence the variation of the number of overnight stays. The coefficient of correlation, r= 0.218 also reflects a weak relationship between the number of overnight stays and the number of places (Fig.13).

The regression model is available as F = 0.4007 higher than its table value, and Sign. F = 0.5443.

The value of "a" parameter is situated in the interval - 1,167,067.128 < 254,692 < 1,676,450.859 for P=0.05 (95%), and the value of "Intercept X1" is situated in the interval - 132.73044 < 50.229 < 233.18875 for P= 0.05 (95%).

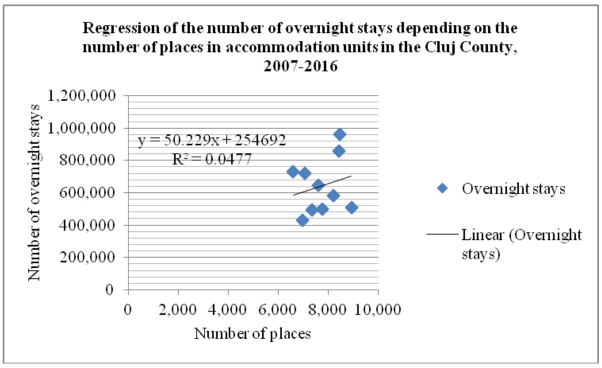


Fig.13.The regression of the number of overnight stays depending on the number of places in the accommodation units with tourism function in the Cluj County, 2007-2016

Source: Own design based on the data provided by the National Institute of Statistics Tempo-online data base, 2018 [25].

Regression of overnight stays depending on the number of tourist arrivals is synthesized by the econometric liner model Y = 2.1309x - 95,465, where Y= the number of overnight stays and X = the number of tourist arrivals. It shows that an increase by one of the number of tourist arrivals will determine an increase by 2.1309 of the number of overnight stays in the Cluj County.

Between these two indicators is a strong and positive relationship, as confirmed by R^2 = 0.972, attesting that 97.20 % of the variation on the number of tourist arrivals will have a deep impact on the variation of the number of overnight stays.

The coefficient of correlation, r= 0.985 also reflects a positive a very high link these two indicators (Fig.14).

The regression model is available as F = 277.8417 higher than its table value, and Sign. F = 1.69682.

The value of "a" parameter is situated in the interval - 200,123.693 < -95,464.95086 < 9,193.7909 for P=0.05 (95%), and the value of "Intercept X1" is situated in the interval 1.83612 < 2.13093 < 2.42573 for P= 0.05 (95%).

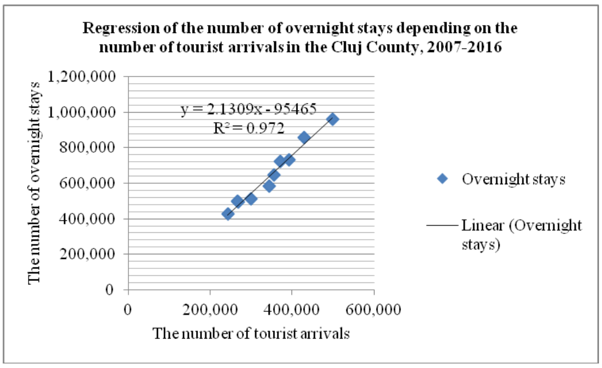


Fig.14.The regression of the number of overnight stays depending on the number of tourist arrivals in the Cluj County, 2007-2016

Source: Own design based on the data provided by the National Institute of Statistics Tempo-online data base, 2018 [25].

CONCLUSIONS

The paper analyzed the main trends of tourism in one of the most important cities of Transilvania, Cluj-Napoca and the Cluj County. The research revealed the richness and variety of natural, historical and cultural tourist attractions, the development of the accommodation capacity in terms of the number of units for tourism reception and the number of places (beds), all these reflecting the offer at the local level. Also, the study pointed out the tourism demand in terms of the number of tourist arrivals and overnight stays.

The results reflected the dynamism of tourism infrastructure in terms of accommodation units and number of places. The growth rate in the analyzed period 2007-2016, being higher in the municipality of Cluj-Napoca compared to the Cluj County.

In Cluj-Napoca, the increase was 81.9 % for the number of units with tourist accommodation function increased and 74 % for the number of places, while at the county level, the growth rates were 35 % for the number of units and 20 % for the number of places. In 2016, in Cluj-Napoca there were 6,216 places while in the county there were 8,450 places.

The number of tourist arrivals and overnight stays increased year by year, except the years 2009 and 2010 when the economic crisis affected tourism not only in Romania but also in Europe and at the world level. But, since 2011, the trend was continuously an ascending one. In the period 2007-2016, the increase of the number of tourist arrivals and overnight stays in Cluj-Napoca accounted for 42 % and respectively 44 %, while at the county level, the growth rates were 34 % and respectively 33 %.

In 2016, Cluj-Napoca received 371,505 tourists, much more than its population, reflecting a tourism density of 1.15, meaning 1.15 tourists/inhabitant, while at the county level, there were recorded 498,500 tourists arrivals, meaning a tourism density of 0.69.

In 2016, the number of overnight stays in Cluj-Napoca reached the record of 704,921 while at the county level it was 952,900.

The analysis of the relationship between the number of places and the number of tourist arrivals and the number of overnight stays, proved a high relationship both at the municipality level and at the county level between the number of tourist arrivals and the number of overnight stays (r= 0.994 and respectively r= 0.985.

The linear regression models proved that the variation of the number of places in Cluj-Napoca is responsible just for 25 % of the variation of tourist arrivals and 22 % of the number of overnight stays.

At the county level, it was found a similar situation, more exactly, the variation of the number of places determines just 7.35 % of the variation of the tourist arrivals and 4.77% of the variation of the number of overnight stays.

Therefore, there are other reasons why the number of tourist arrivals increased, and we must think of the high attraction of the visitors to discover and learn more about the natural, historical and cultural patrimony of Cluj-Napoca and the Cluj County.

The interest for this part of Transilvania region of Romania has continuously increased both from the side of Romanian visitors, but also from the side of foreign tourists. In 2016, the foreign tourists accounted for 25 % of the total number of arrivals. They are represented mainly by Hungarians, Germans, Italian, French, British and Italians.

As a final conclusion, the tourism development in Cluj-Napoca and the Cluj County is an example of tourism management and marketing, the promotion of the local values, the diversification of the tourism offer and the high quality of tourist services have had a deep impact of the increased number of visitors.

ACKNOWLEDGEMENTS

The authors acknowledge the Statistical Division of the Cluj County and the National Institute of Statistics for the data provided to set up this research work.

REFERENCES

[1]Amariei, R., 2016, Bucharest versus Cluj. Is Cluj a rival for the Capital? (Bucureşti vs Cluj. Se conturează un rival pentru Capitală?), Capital, 25 feb 2016, http://www.capital.ro/bucuresti-vs-cluj-se-contureaza-un-rival-pentru-capitala.html, Accessed January 26, 2018.

[2]Butler, R.W., 1980, The Concept of Tourist Area Cycle of Evolution: Implication for Management of Resources, Le Géograph Canadien/Canadian Geographer, 24(1), pp. 5-12. http://onlinelibrary.wiley.com/doi/10.1111/j.1541-0064.1980.tb00970.x/full, Accessed January 25, 2018.

[3]Coros, M.M., Negrusa, A.L., 2014, Analysis of Romania's and Transilvania's tourist supply development and performance, Amfiteatru economic, Vol. XVI • Special No. 8 • November 2014, pp.1312-1326.

[4]Cosma, S.A., 2006, Tourist destination Cluj-Napoca,

Romania, Studia Universitatis Babes-Bolyai, Negotia, LI, 2, pp.51-73

[5]Cluj-Napoca is the European capital of the Youth in 2015, (Cluj-Napoca este capitala europeana a tineretului in 2015), http://www.mediafax.ro/cultura-media/cluj-napoca-este-capitala-europeana-a-tineretului-in-2015-10347965, Accessed February 4, 2018.

[6]Cluj-Napoca-History and culture in the heart of Transilvania (Cluj-Napoca- istorie si cultura in inima Transilvaniei), https://www.historia.ro/sectiune/travel/articol/cluj-napoca-istorie-si-cultura-in-inima-transilvaniei, Accessed February 4, 2018

[7]Cluj - Napoca (Kloozh' Nah poh' kah), Romania Natural and Cultural, http://romaniatourism.com/cluj-napoca.html#attractions, Accessed January 25, 2018.

[8]Cluj-Napoca, Wikipedia, https://ro.wikipedia.org/wiki/Cluj-Napoca, Accessed February 4, 2018

[9]Festivals, fairs and folk events in Ardeal (Festivaluri, targuri si manifestari folclorice in Ardeal), https://www.gazetadeagricultura.info/dezvoltare-rurala/611-obiceiuri-si-traditii/13711-festivaluri-targuri-si-manifestari-folclorice-in-ardeal.html, Accessed January 4, 2018.

[10]How many students are in fact in Cluj (Câţi studenti sunt, de fapt, la Cluj), 2017, Monitorul de Cluj, http://www.monitorulcj.ro/actualitate/58436-legendara-suta-de-mii-de-studenti-de-la-cluj-e-acum-50000#sthash.3oxsLMx5.dpbs, Accessed February 4, 2018.

[11]Loghin, A., 2018, Record of tourists in Cluj-Napoca- the city preferred by over 540,000 tourists in 2017, Cluju.ro, 3 January 2018, https://cluju.ro/record-de-turisti-in-cluj-napoca-orasul-preferat-in-2017-de-peste-540-000-de-calatori/, Accessed February 25, 2018.

[12]Miulescu, N., Diaconu, T., Dacia- Țara Zeilor (Da. Kșa -Țara Zeilor), Obiectiv Publishing House, Craiova, See what does Cluj mean in the old Romanian language. But Napoca. Ebullition .. sound made by water at the boiling temperature (Vezi ce înseamnă Cluj în limba română veche. Dar și Napoca. Clo.J' … Clo.cot…zgomot făcut de apa încălzită până la temperatura de fierbere), Mistere Romania.info, 2016, https://mistere-romania.info/2016/03/stire-vezi-ce-inseamna-cluj-in-limba-romana-veche-dar-si-napoca/, Accessed January 24, 2018.

[13]Nekka, H., 2009, The case method (in French), course at Workshop Collège Doctoral es sciences de gestion - AUF, intervention march 2009, Bucharest, Romania.

[14]Plesoianu, D., Guraliuc, C., 2016, Natural resources and anthropogenic factors of tourism development in Cluj,
Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 16, Issue 4, 2016, pp.261-265.

[15]Reicherstorffer, G., 1532, Chorographia Transylvaniae, quae Dacia olim appellata, aliarumque provinciarum & regionum succincta descriptio & explicatio, Vienna.

[16]Romania - Transilvania - Dej - Cluj County Presentation (Judetul Cluj - Prezentare), http://www.cazaretransilvania.ro/Menu/dej-prezentare-obiective_turistice-cazare-harta-atractii_turistice-dej.html, Accessed January 4, 2018.

[17]Romanian Academy, Cluj-Napoca Team of Georgraphy, 2006, Sectorial study – tourism, www.cjcluj.ro, Accessed December 10, 2017.

[18]Ruins of Roman buildings (Ruine de construcții romane), http://orasulcluj.ro/unde-iesim/obiective-turistice/situri-arheologice/ruine-de-constructii-romane/, Accessed January 24, 2018.

[19]Salina-agrement, http://salinaturda.eu/salina-agrement/, Accessed January 25, 2018

[20]Salina Turda, Wikipedia, https://en.wikipedia.org/wiki/Salina_Turda, Accessed January 4, 2018.

[21]The Art Museum in Cluj-Napoca (Muzeul de arta Cluj-Napoca), https://www.macluj.ro/, Accessed February 4, 2018

[22]The Best Festivals in Cluj-Napoca Romania, https://theculturetrip.com/europe/romania/articles/the-best-festivals-in-cluj-napoca-romania/, Accessed January 24, 2018.

[23]The Botanical Garden Cluj-Napoca (Gradina Botanica din Cluj-Napoca), Wikipedia, https://ro.wikipedia.org/wiki/Gr%C4%83dina_Botanic%C4%83_din_Cluj-Napoca, Accessed February 4, 2018

[24]The Cluj County (Judetul Cluj), Wikipedia, https://ro.wikipedia.org/wiki/Jude%C8%9Bul_Cluj, Accessed January 4, 2018.

[25]The National Institute of Statistics Tempo-online data base, 2018

[26]The Scarisoara Ice Cave, the biggest underground glacier in Romania, https://travelguideromania.com/scarisoara-ice-cave-biggest-underground-glacier-romania/, Accessed January 25, 2018

[27]The Romanian Opera House in Cluj-Napoca (Opera Română din Cluj-Napoca), https://ro.wikipedia.org/wiki/Opera_Rom%C3%A2n%C4%83_din_Cluj-Napoca, Accessed February 4, 2018

[28]The Statistical Division of the Cluj County, 2018

[29]Toader, V., Negrusa, A.L., Cosma, S.A., Bolog, C., Oprea, M.G., Lazin, M., Rus, R., 2016, Analysis of tourists' behaviour in Cluj-Napoca, Romania, Conference Paper, 9 pages, https://www.researchgate.net/publication/321489715, Accessed January 25, 2018.

[30]Travel & Tourism Economic Impact, Romania, 2017, World Travel and Tourism Council.

[31]Turda Salt Mine – A real museum of salt mining in Transylvania, www.SalinaTurda.eu, Accessed January 25, 2018

[32]Turda Wine Cellars, Crama Salina Turda, http://cramalasalina.ro/en/tasting.html, Accessed January 25, 2018

[33]Tugui, O., Funar, S., 2010, Underlying the Rural and Natural Attractivity Factors of a Mixed Tourist Destination – Analysis of the Stakeholders in the Case of Cluj County, Bulletin UASVM Horticulture, 67(2)/2010, 253-260

[34]Welcome to the homepage of Szek, http://www.szek-sic.ro/en/, Accessed January 25, 2018

[35]Western Romania city reports more tourists than inhabitants in 2016, 2017, Ro Insider, 24 April 2017, https://www.romania-insider.com/western-romania-city-reports-tourists-inhabitants-2016/,Accessed February 25, 2018.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE QUALITATIVE ASSESSMENT OF THE SPRING BARLEY GERMPLASM COLLECTION FROM ARDS TURDA

Ioana PORUMB[1,2], Florin RUSSU[1], Ana –Maria VĂLEAN[1,2], Cristina STANCĂ MOISE[3], Ioan ROTAR[1]

[1]University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Calea Mănăştur 3-5, Cluj-Napoca 400372, Romania, E-mail: ioanaporumb18@yahoo.com, rusuuflorin@yahoo.com, rotarioan52@yahoo.com
[2]Agricultural Research and Development Station, 27 Agriculturii Str., Turda City, Cluj County, Romania, Phone: 0264311680, Emails: ioanaporumb18@yahoo.com, pacurar.anamaria@yahoo.com
[3]Universitatea "Lucian Blaga" din Sibiu, Faculty of Agricultural Sciences, Food Industry and Environmental Protection, Sibiu, Romania, Phone: 0040269234111, Fax: 0040269234111, E-mail: cristinamoise1@yahoo.com

***Corresponding author*:** rusuuflorin@yahoo.com

Abstract

The success of the amelioration experiments is closely connected to the coefficient of variation found at the genetic material level. The working collections of the amelioration programs don't intend to conserve the whole existent diversity at the level of a species, just to a useful portion of it, adapted to the specific ecological zones to each amelioration program. In this idea, the assessment of diversity and genetic stability of the genotypes with different provenances is an important step into the breeding experiments. To obtain some information regarding the coefficient of variation and stability of some qualitative parameters of spring barley namely protein content, starch and TKW, they were analyzed 185 genotypes from the breed assortment of spring barley from ARDS Turda in two years of cultivation.

***Key words*:** *spring barley, protein, starch, TKW, coefficient of variability*

INTRODUCTION

The main directions towards the amelioration of the spring barley with two rows from ARDS Turda, are the growth of the productivity and quality of the new cultivars. The qualitative amelioration implies two objectives, that form the main areas of use of the barley, namely animal feeding and the alcohol industry, often beer.

The qualitative amelioration for the beer industry is very complex including reaching many chemical requirements for the grains (protein content, starch, protein factors and amino acids) and of qualitative criteria of the malt (Bishop index, protein content, Kolbach index and so on). The new cultivars's improvement that have as target animal feeding, implies the qualitative and quantitative growth of protein content.

The negative correlation between bean production and protein content both to wheat and barley [5], it's preferable in the case of beer barley and less beneficial to the feed forms of barley or in the case of the wheat destined to the bakery industry.

Between the numerous requirements towards the quality of the barley destined beer, the appreciation of the protein and starch content, lead the direct factors in the cultivars's amelioration for beer industry.

An indirect factor in the quality appreciation of beer barley is the size and uniformity of the grains. The size of the grains is directly associated with their weight reflected in the mass of a thousand grains.

Therefore, the qualitative assessment of the spring barley germplasm at least through those three indicators above, stands for an essential stage in choosing the genitors for the success of cross breeding experiments and the amelioration of beer barley.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

MATERIALS AND METHODS

For this study within the spring barley collection from ARDS Turda there was chosen a number of 185 genotypes represented by older cultivars and lines obtained in the first 15 years from the creation of the amelioration program in Turda.
Besides this older germ-plasm it was analyzed also an important number of new spring barley genotypes.
Each genotype was sowed on five rows each 1m long, 30cm between the rows. The sowing experiment was made normal in perfect era for this type of cultivation in Transilvania, namely spring time, at the beginning of March. The crop rotation of the amelioration field is since 3 years ago corn- peas-barley. The fertilization system is balanced and constant from a year to another using only nitrogen based fertilizer with doses between 100-120 kg s.b/ha. The fertilization is done once in the spring time shortly after the plants risen.
For the chemical analysis there were extracted three samples from the seeds quantity corespondent to each genotype of every year. The determination of protein and starch content was made with the spectrometer Tango NIR. To determine the TKW they were made 10 determinations for each genotype and for each year based on the weight of the bgrains/ear.

RESULTS AND DISCUSSIONS

An important component of the production with direct implications towards the quality of the grains destined beer, is the TKW. To this attribution there is closely connected the size of the embryo and also the quantity of backup substances accumulated inside the bean, mandatory to provide a good germination and in the same time a superior germinative energy. To produce quality malt, the germinative energy is an primary factor as importance.
The reduced values of the variability coefficient from the two years of about 6% respectively 5% (Table 1) reflects a reduced grade of variation of the genotypes regarding this important quantitative trait of the production. The differences pronounced between the minimum and maximum values of the two years put in light the existence of an important difference between the 185 analyzed genotypes.
In many works from the speciality literature [2] there is mentioned that despite the weight of the grains/ear, number of grains/ear, numbers of tillers and production in general, TKW is the least affected by the environmental conditions having the highest stability. Even though all these studies indicate the high stability of this attribute, they don't exclude the importance of the environment in the phenotypic expression. The results from the our study indicates a quite important impact of the environment in TKW expression, if we compare the environments of the two years. Also the averages show that between the 185 genotypes prevail the forms with bigger grains (talking about genotypes subject to breeding processes). Even if the differences between the average values of the two years are quite important, the variation coefficients's values are quite close suggesting yet the idea of TKW stability.
Other two quantitative traits polygenic controlled with major implications in beer industry, the proteic and starch content are presented in table 1. The reduced differences between the averages and the values of variation coefficient of the two years reflect the stability and considerable involvement of the genotype in the control of protein content. The variation coefficients among with the differences between minimum and maximum show that through those 185 genotypes exists important differences of protein content. Thereupon, we can affirm that between these genotypes there can be identified formes that could be used to ameliorate the protein content in a way or another.
The views regarding protein content stability are diversified but lately they come together to the idea that the genotype is the most implied in the control above protein content. These affirmations come off also from our study. Bude and Mihăilescu [1], underlines the genotype involvement in protein content

conditioning for barley.

The variability parameters at the other important qualitative character about barley grains destined to the beer industry namely starch content are presented in table 1. As well as in the case of proteins and in the case of starch it can be remarked the same reduced difference between the averages of the two years. The small values of the variability coefficients, reflects a weak differentiation between the genotypes. However the large lapse between the minimum and maximum values show the fact that between the studied genotypes exists an important variation that could be used in improving the starch content.

Table 1. Variability parameters for TKW, protein and starch on 185 genotypes from the spring barley collection (ARDS Turda 2016, 2017)

	Traits	2016					2017				
		Count	$\bar{x}$	Min.	Max.	CV %	Count	$\bar{x}$	Min.	Max.	CV%
1	TKW (g)	185	44.20	35.80	51.20	5.88	185	55.01	48.33	63.13	4.71
2	Protein (%)	185	11.77	9.41	14.89	7.30	185	11.14	9.17	14.05	7.70
3	Starch (%)	185	57.05	52.72	63.81	3.60	185	56.53	53.43	59.42	2.18

x- mean, Min. - minimum, Max. – maximum, CV % - coefficient of variation
Source: Own results.

To identify the most valuable genotypes facing the stability of the 3 quantitative traits has grain made the correlation of annual values of the two experimental years, as a quantification measurement of repeatability. The small variation amplitudes of annual values offers an important information regarding the stability. We can affirm that the correlation coefficient value (r) suggests indirectly the heritability of the attribute itself, the superior values close to 1 indicate a high heritability.

Figure 1 presents the behavior of the genotypes in terms of annual correlation values of TKW.

The quantitative nature of this trait determines a different relationship of the genotypes at additive level in the interaction with the environment, this being reflected in the fluctuation of the values from a year to another. Between the 185 genotypes they can be identified types that have a high stability grade, registering reduced variations of the TKW but with values over the average of the two years, these ones being marked with red. These genotypes will be used in different hybrid combinations as valuable genitors to the improvement the TKW stability to the new cultivars.

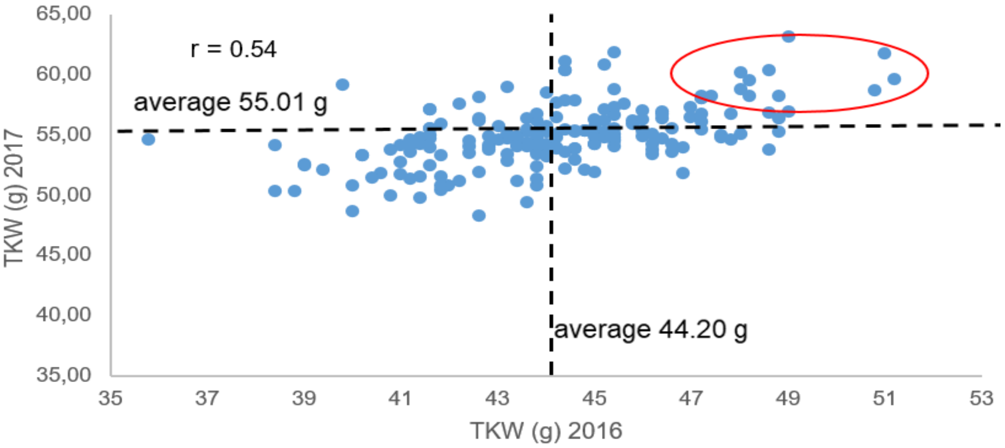


Fig. 1. Corelation (r) between the anual values (2016 and 2017) for the TKW in barley genotypes 185 as a measure of repetability trait
Source: Original.

The reaction of the genotypes regarding the accumulation of proteins in the grain in the two years is presented in Figure 2. As in the case of TKW also in the situation of proteins it can be remarked a different behavior of the genotypes regarding the genetic factor implication in phenotypic expression. Thereby, in the group of genotypes analyzed they can be identified variants with a pronounced stability (the ones in the red zone) and with values under the average of the two years corespondent to the requirements of the beer factories. Besides all these varieties with a superior stability it is remarked types less stable that could be ameliorated throughout a system of simple or complex hybrids to reduce the stability of protein content.

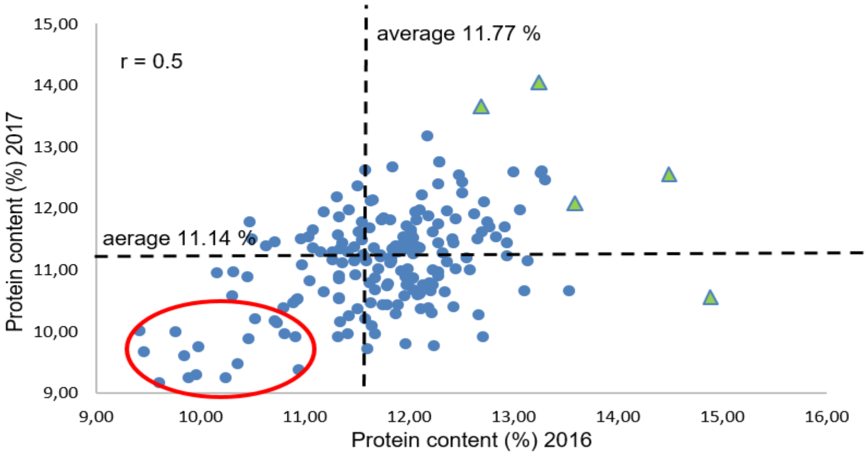


Fig. 2. Corelation (r) between the anual values (2016 and 2017) for the protein content in barley genotypes 185 as a measure of repetability trait
Source: Original.

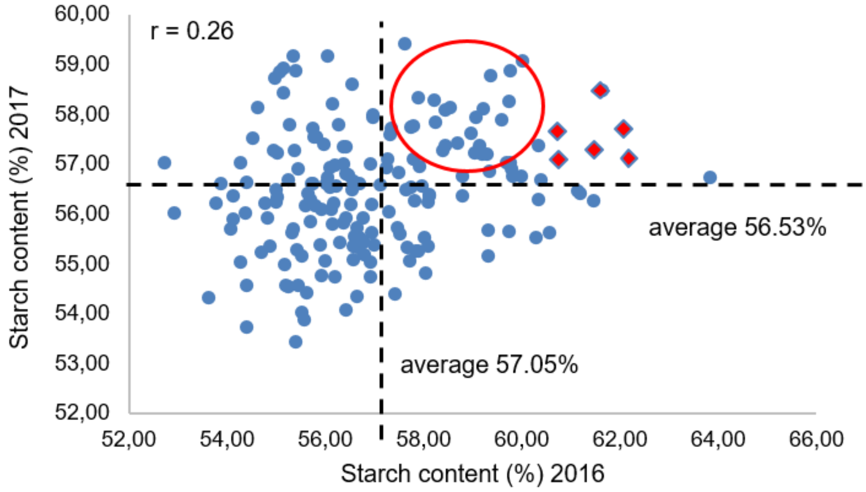


Fig. 3. Corelation (r) between the anual values (2016 and 2017) for the starch content in barley genotypes 185 as a measure of repetability trait
Source: Original.

The genotypes that present a good fixation at genetical level of the starch content (those put in the inside of Figure 3, and didn't register oscillating values from a year to another, makes potential valuable genitors to qualitatively breeding the beer barley. In another study done in Turda on a higher number of genotypes they were obtained similar values of the correlation coefficient "r" of 0,27 [4]. Above it was assumed that the repeatability grade of the values reflects indirectly the heritability largely. Based on this reason we can say that the results of our study are in concordance with the results of other experiments done at Fundulea on different breeds of barley and winter barley and spring barley that mention similar contributions of the genotype of 20-30% in the accumulation of starch [3].

CONCLUSIONS

The appreciation of the potential of the genotypes from the assortment of varieties, makes a first step in the qualitative amelioration of spring barley. The variation coefficient values and variation amplitude correspondent to the content of protein in the studied material. The correlation coefficients of the annual values in 2016 and 2017 of 0.54 in the case of TKW and 0.5 for protein, suggest that there is considerable stability of these properties in the analyzed germplasm. From the data of this study it appears that in the phenotypic control of the starch content, an important role alongside the genotype is also the environment, all of which are reflected in the lower values of the correlation coefficient of the annual determinations of 0.26.

REFERENCES

[1]Bude, A., Mihăilescu, A., 1982, Aspecte privind genetica și ameliorarea conținutului și calității proteinei la orz și orzoaică. Probleme de genetică teoretică și aplicată, XIV, 2 , ICCPT Fundulea.
[2]Hadjichristodoulou, A., 1990, Stability of l000-grain weight and its relation with other traits of in dry areas. Euphytica 51 (1): 11-17, Kluwer Academic Publishers. Printed in the Netherlands.
[3]Neguț, L.E., 1982, Rolul genotipului în realizarea principalilor parametrii de calitate ai boabelor la orz și orzoaică. Probleme de genetică teoretică și aplicata, Vol. XIV, 4, pag. 313, I.C.C.P.T. Fundulea.
[4]Russu, F., 2015, Studiul unor cultivare de orz de primăvară cu două rânduri în sistem concurențial și neconcurențial. Teză de doctorat. Universitatea de Stiinte Agronomice si Medicina Veterinara Cluj-Napoca.
[5]Simmonds, N. W., 1995, The relation betwen yield and protein in cereal grain. Journal of the Science of Food and Agriculture 67 (3):309-315.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

SMALL FARMERS, THEIR POSITION AND SUPPORT WITHIN THE CAP – CASE OF SLOVAKIA

Ľubica RUMANOVSKÁ, Jarmila LAZÍKOVÁ, Ivan TAKÁČ

Slovak University of Agriculture in Nitra, Faculty of European Studies and Regional Development, Tr. Andreja Hlinku 2, 949 76 Nitra, Slovak Republic, Phone: + 421 (37) 6415603, Emails: lubica.rumanovska@uniag.sk, ivan.takac@gmail.com

Corresponding author: lubica.rumanovska@uniag.sk

Abstract

The small farmers are an important element of sustainable agricultural production, multifunctional agriculture and rural development. It is the predominant mode of agricultural production in the world. Despite its predominance in the agricultural structure, small farming encounters several difficulties. Therefore, it is hard to imagine functioning of small farms without subsidies for production, especially direct area payments. The aim of the paper is to identify the development trend of small farmers in Slovakia and to point out their needs in the Slovak agricultural business environment. Based on the results we can expect a further increasing trend of number of small farmers in Slovakia. Therefore, we need to take into consideration their support and elimination of barriers in the Slovak environment, e.g. to improvement the access to the land, support of the business of the beginning farmers, improvement the possibilities to use the project support, improvement the access to the credits and improvement the access to the non-project measures. The adopted measures should be prepared carefully with the aim to eliminate the misuse the financial effect providing to support of agricultural business.

Key words: *small farmers, predominant mode, sustainability, forecast, CAP EU, project and non-project measures*

INTRODUCTION

The EU farming sector has undergone major structural changes over recent decades. The agricultural structural changes in land ownership, farm size and age composition of farmers have been understood to have a significant impact on the efficient use of agricultural resources [3]. Family farming is the predominant mode of agricultural production in the world. Family farms produce about 80 percent of the world's food in value terms, and collectively they are the largest source of employment worldwide [7]. Indeed, family farming is the most common business model in small-scale agriculture. Small farms are perceived to be diversified and to contribute more to environmental sustainability, preservation of traditional values, and economic resilience than large farms [6,19]. The importance of small farms is given that the unique and substantial contribution of small and family farms to the production of food and public goods, as well as ensuring balanced rural development, where large incorporated farms account for only a small proportion of the global farm system [21].

Despite its predominance in the agricultural structure, small and family farming encounters several difficulties in remaining economically viable, such as expensive land cost, low farm efficiency and productivity, high input prices, lacking accessibility of credit or other financial resources, weak bargaining power within the supply chain, fluctuating market prices and being particularly vulnerable to climate change [8] and particularly the rapid ageing of the farmer population and the scarcity of young farmers entering the profession [22]. The small-scale agricultural countries encounter several structural problems, Some studies indicate that, compared to their older counterparts, young farmers have more potential to improve farm competitiveness and achieve better social viability for rural communities. Moreover, young farmers can also promote a wider range of rural socio-economic activities, such as food safety, rural tourism, conservation of traditions and cultural heritage, awareness of the negative effects of farmland abandonment, and participation in local associations [7]. Therefore, the renewal of farming generations has become an urgent need for the adjustment of the EU agricultural sector regarding the small-holding farming world [4,10]. The EU Common Agricultural Policy aims also to reallocate resources to those producers with better capability of maximizing farm productivity and profitability. A particular structural challenge concerns the future development of small and family farms [5,21].

There is missing uniform terminology of small farmers among the states as well as in the international organisations. Family farms are equated to small farms by various authors [1,2]. According to the Food and Agricultural Organization's (FAO) definition, family farm is an agricultural holding which is managed and operated by a household and where farm labour is largely supplied by that household [7].

Smallholders are small-scale farmers, pastoralists, forest keepers, fishers who manage areas varying from less than one hectare to 10 hectares. Smallholders are characterized by family-focused motives such as favouring the stability of the farm household system, using mainly family labour for production and using part of the produce for family consumption [8]. According to the Small Farmers Scheme of the EU there is no strict definition of small farmer. The scheme is available to the farmers wishing to participate in the Small Farmers Scheme and receiving an annual payment fixed by the Member State of between €500 and €1,000, regardless of the farm's size [4]. The participants will face less stringent cross-compliance requirements, and be exempt from greening. In 2003, the European Commission adopted a recommendation 2003/361/EC concerning the definition of micro, small and medium-sized enterprises. It entered into force on January 1, 2005 and applies to all EU policies, programmes and measures for SMEs. Article 2 of the Annex of this recommendation defines a small enterprise as an enterprise which employs fewer than 50 persons and an annual turnover and/or annual balance sheet total of which does not exceed EUR 10 million.

In Slovakia, there is a special type of agricultural businessmen which is defined by the Commercial Code and by the Act no. 105/1990 Coll. on private business of citizens. It is called individual farmer (in Slovak language – samostatne hospodáriaci roľník). It is a physical person carrying out the agricultural production as a businessman personally or by the help of other persons mostly family members. The physical person has to file an application to be noted down in the evidence of individual farmers at the particular municipal office where the agricultural business will be carried out. The individual farmers employ less than 50 employees; most of them employ 0 or 1 employee. The acreage of agricultural land per famer ranges from 0.1 hectare to more than 500 ha. The land distribution is described in the Table 1.

Table 1. Land distribution cultivating by the individual farmers

Land distribution (in ha)	Number of individual farmers in %	
	2014	2015
0, 1 – 50	24.82	30.79
51 – 100	27.55	28.51
101- 500	42.59	36.84
More than 500	5.05	3.86

Source: own-processing according to the Green report of Ministry for the agriculture and rural development, 2016

The most of individual farmers (84.5% of them) received an economic profit; in average 63.3 euro per hectare of agricultural land in 2015 [9]. However, this is an influence of the support from the CAP; otherwise, the most of individual farmers would be in a loss.

For the purposes of our paper, we consider the individual farmers as the small farmers for the purposes of the Small Farmers Scheme. The aim of the paper is to identify the development trend of small farmers in Slovakia and to point out their needs in the Slovak agricultural business environment. The Slovak agriculture is characterized by a dual farm structure, with a high proportion (80 %) of small farms (usually doing business as

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

physical persons), and a small number of large farms (20 %) which usually use the legal forms of corporates or cooperatives (legal entities). Firstly, we identify development and current state of small farmers in Slovakia from 1993 – 2016 and we tried to provide a forecast for the next three years. Secondly, we identify the options of financial support providing by the European Union within the CAP. In the conclusions, there are including the proposals how to strengthen the current status of small farmers in Slovakia.

MATERIALS AND METHODS

The number of small farmers in Slovakia was observed from 1993 to 2016. The data was received from the database of Statistical Office of Slovak Republic. We provided a forecast of number of small farmers for next three years by the Statistical Analytical System (SAS) that produces 582 models for that purposes. We chose the two best models according to the criteria MAPE (Mean Absolute Percent Error), R-square taking into account also the Akaike criterion and Schwarz-Bayssian criterion. MAPE is calculated as follows:

$$MAPE = \frac{1}{N}\sum_{t=1}^{N}\left|\frac{y_t - \hat{y}_t}{y_t}\right| \times 100$$

MAPE criterion measures the size of the error in percentage terms. The model is acceptable if the MAPE criterion is less than 10; if it is less than 5%, we can state the high quality of the model.

R-square is calculated as follows:

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}\left(y_i - y_{average}\right)^2}$$

R-square measures the proportion of variance explained by the model. R-square ranges from 0 to 1 and the R-square with the values close to one points out the most appropriate models.

The values of Akaike criterion and Schwarz – Bayssian criterion are useful when comparing models. The model with the lowest value is the best model among all compared models.

Akaike criterion can be calculated as follows:

$$AIC = 2k - 2\ln(L)$$

where k is the number of estimated parameters in the model and L is the maximized value of the likelihood function characterised as follows: L = P(x|Θ, M); M is the model of data x and Θ is the parameter values that maximize the likelihood function.

Schwarz – Bayssian criterion is close to the AIC where the lowest value is preferred and is calculated as follows:

$$BIC = \ln(n)k - 2\ln(L)$$

where n is the number of observations and k is the number of estimated parameters in the model and L is above-mentioned.

RESULTS AND DISCUSSIONS

1.Small farmers in Slovakia, their current state and development

Small farmers as the physical persons could do their business in agricultural production in Slovakia from 1st July 1991 when the Act on private business of citizens and its amendment entered into force. However, we observe their development from 1993 when the Slovak Republic received its independence. The development of small farmers in Slovakia is documented in the Figure 1.

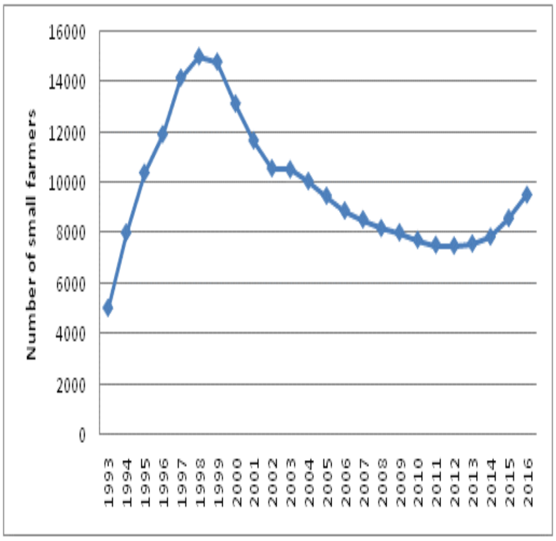


Fig. 1. Development of small farmers in Slovakia 1993 – 2016.

Source: own calculation by the sources of Statistical Office of SR, 2017

The development trend was caused by the economic changes oriented to creation of market economy, especially restitution of land, privatisation in agriculture and transformation of agricultural cooperatives.

The second increasing of small farmers (but much smaller than from 1993) was in 2003 - 2004 when the second restitution act no. 503/2003 Coll. on restitution of land ownership entered into force. The last increasing of small farmers was observed in 2013 – 2014 when the credit for agricultural businessmen called "My land" was created. It enabled to finance the purchase of agricultural land to farmers. The agreement between Ministry of Agriculture and Rural development of SR and Slovak Guarantee and Development Bank enabled to purchase the agricultural land to farmers by credits with preferable interest rate. From 2016, there is a new version of credit for agricultural businessmen oriented also to young farmers who do not have enough capital for credit guarantee. Another reason of increasing the number of small farmers in Slovakia is an implementation of new system of direct payments which is created by the multicomponent system of supports. It points out the sustainable improvement of rural environment and support of young farmers. Moreover, the economic profit of agricultural businessmen including the small farmers in Slovakia in the last years was a motivation factor for doing business in agriculture.

Based on this development trend, we tried to provide a forecast for next three years. The results of the forecast are documented in the Table 2 and 3.

Table 2. Forecast of number of small farmers in Slovakia 2017 - 2019

	1st model		
Year	Predicted value	Upper 95% confidence	Lower 95% confidence
2017	10,523	11,171	9,874
2018	11,404	13,140	9,667
2019	12,258	15,507	9,009

Source: own calculation,2018

We used two combined models, each one is a combination of three others models. The first model (ARIMA(2,1,1)(0,1,1)s; ARIMA (2,1,1)(1,1,0)s a ARIMA (3,1,1)(0,1,0)s) is a combination of three best models by the MAPE indicator. The second model (Winters Method – Additive, Damped Trend Exponential Smoothing and ARIMA (3,1,1) (1,1,0)s) is a combination of three best models by the R-square indicator.

Table 3. Forecast of number of small farmers in Slovakia 2017 - 2019

	2nd model		
Year	Predicted value	Upper 95% confidence	Lower 95% confidence
2017	10,451	11,118	9,784
2018	11,332	12,891	9,773
2019	12,240	14,969	9,511

Source: own calculation,2018

These combined models were selected on the indicators presented in the table 4 and described in the chapter of material and methods.

Table 4. Indicators for evaluation of model quality

Models	MAPE	R-Square	Akaike Criterion	Schwarz – Bayssian Criterion
1st model	3.67975	0.944	284.582	287.855
2nd model	3.35673	0.958	305.573	309.107

Source: own calculation,2018

The model is acceptable if the MAPE criterion is less than 10. We chose the model with the smallest value of MAPE and both models have MAPE under 5%, which indicates a good model quality. The values of Akaike criterion and Schwarz – Bayssian criterion are useful when comparing more models. The model with the lowest value is the best model among all compared models. In Table 3, there are two best models according to these criteria. The R-square characteristic is more than 90 percent that confirms the good model quality.

According to the results of Table 2 and Table 3, there are only small differences in the models; however, we can state that the second model (Table 2) is the better for providing a prediction of development of the small farmers. However, the second model has the higher values of Akaike and Schwarz – Bayssian criterions; there are better values of MAPE and R-square that we consider as more important indicators for evaluation of model quality. When evaluating the model quality, we can take into account also the lower and upper confidence of the predicted values. In the second model, there is the smallest interval of confidence (in 2018 and 2019). According to the above compared criteria we prefer the predicted values of the second model as the more reliable one.

Based on the results we can expect a further increasing trend of number of small farmers in Slovakia. In that the small farmers are an important element of agricultural business and rural development [19,21], we need to take into consideration their support and elimination of barriers in the Slovak environment. However the adopted measures should be prepared carefully with the aim to eliminate the misuse the financial effect providing to support of agricultural business. For that purpose we analysed the number of small farmers who were registered in a particular year and who were erased from the register, especially those who was registered and erased in the same year. The results are documented in the Table 4.

The number of registered and erased small farmers in the same year has again an increasing trend in the last years. At the beginning of the observed period, the high number of registered and erased small farmers in the same year could be explained by the absence of business skills and expertise to be successful in the agricultural business. Moreover, the integration on the internal market of the EU causes the agricultural business environment more difficult for starting of successful agricultural business. However, the increasing trend of the registered and erased small farmers in the same year during the last years is a little bit surprised. The main purpose is probably a business environment that was not stable and was influenced by the many foreign factors such as business risk because of volatility of the markets with the agricultural commodities, support system of CAP, national factors such as impact of national legislation, impact of financial and economic measures (national support, credits, insurance, taxes, etc.) and internal factors such as managerial decision-making and saving measures of businessmen [9].

Table 5. Number of registered and erased of small farmers in Slovakia in 1993- 2016

year	Number of registered small farmers	Number of erased small farmers	Number of small farmers registered and erased form register in the same year	
			Absolute Frequency	Relative frequency from the total number of erased small farmers
1993	3,250	260	58	22.31
1994	2,557	178	22	12.36
1995	1,843	319	51	15.99
1996	2,585	339	102	30.09
1997	1,129	282	11	3.90
1998	785	994	95	9.56
1999	636	2,296	86	3.75
2000	594	2,060	82	3.98
2001	646	1,750	64	3.66
2002	969	1,012	100	9.88
2003	933	1,401	114	8.14
2004	896	999	103	10.31
2005	604	992	93	9.38
2006	430	916	39	4.26
2007	349	606	25	4.13
2008	282	683	14	2.05
2009	247	526	16	3.04
2010	233	547	18	3.29
2011	269	564	51	9.04
2012	260	449	56	12.47
2013	341	413	54	13.08
2014	487	339	57	16.81
2015	1,181	446	73	16.37
2016	1,394	463	88	19.01

Source: own calculation by the Statistical Office of Slovak Republic, 2017

The financial support of the small farmers in Slovakia is necessary if they should survive; on the other hand, the financial measures should be created so that nobody was able to misuse them.

2.Options of support for small farmers

A small farm, used for agricultural purposes is not only a source of incomes and food, but also gives a chance for living in own environment, where there are own goods; house, farm, machinery, tractor, land. It is also an effective protection against exclusion from the labour market, even when one loses the other, non-agricultural workplace, which could have been even better for living and invest in machines or production assets. [15]. In order to distinguish of cultivation on agricultural land, small farms can also use less productive land, for example, to grow energy-growing plants. The authors [11,16] identified the economically efficient harvests of these plants for local use in regions of Slovakia. However, it is hard to imagine functioning of small farms without subsidies for production, especially direct payments regardless rich or power countries of the EU.

2.1.Options of financial support providing by the CAP

The CAP in the period 2014-2020 focuses on market orientation by providing income support and establishing protective network mechanisms for producers in the light of environmental protection requirements and improving support for rural development across the EU. It is important to point out the primary role of the CAP, namely to provide a policy framework that will support agricultural producers to meet the objectives of the CAP, which are:

-improving the competitiveness of the agricultural sector,

-improving the sustainability of natural resources in the longer term,

-increasing efficiency and ensuring balanced territorial development.

The CAP 2014-2020 continues on the basis of a two-pillar system. Pillar I, financed by the European Agricultural Guarantee Fund covers direct payments (direct payments, payments for good agricultural practices, redistributive payment scheme for young farmers, small farmers scheme and a voluntary coupled support) and CMO. Changes in financial support in the current programming period compared to the previous one concern direct payments, which are the main source of support for young, small and family farmers. The allocation of direct payments intended for coupled support and young farmers is at the discretion of Member States. The Slovak Republic has for the first time applied support for young farmers in the 2014-2020 programming period. The payment for young farmers is paid on the basis of a scheme for small farmers based on a simplified support scheme for primary agricultural producers with a maximum grant of up to EUR 1 250 and can be complemented with start-up aid under II. pillar. The reason for applying this payment is the age structure of farmers and the attempt to generational change in agriculture, as only 14% of farmers in the EU are under 40 years of age. The cross compliance and agricultural advisory system also remains in the 2014-2020 programming period. EU member States have the possibility to better target direct aids through optional schemes, including a redistributive payment, which allows support for decoupled payment on the first 28 ha of arable land (this is the average size of a Slovak farm or applicant), which represents up to 65% of the average payment per hectare in support of small and medium-sized farms, supplementary payments which may be up to 5% of the total amount for land allocated to less-favoured areas.

The CAP tools for support the performance and competitiveness of farms within the II. pillar includes measures related to the restructuring and modernization of farms, aid for young farmers implementing agricultural production as a business, farm advisory system, education and innovation. These tools are designed to help farmers adapt to new trends and technologies. Rural development policy 2014-2020 remains unchanged. The II piliar support is implemented in the Slovak Republic through the Rural Development Program for 2014-2020 and contains Slovakia's priorities in the use of public funds of EUR 2.1 billion for the period 2014-2020, of which 1 545 million EUR is from the EU budget and EUR 534 million from national funding.

The basic framework of the project supports RDP 2014-2020, and also includes following measures for target groups of beginning and existing small farmers:

Measure 1: knowledge transfer and innovation in agriculture, forestry and rural areas – mainly the possibility of using agricultural training services

Measure 2: Farm advisory services and farm management - allows the use of advisory services for agricultural advisers, including special advisory services for farmers, who for the first time an agricultural holding, young farmers in the areas of legislation, production, processing and sale of products and specific advice for effective business management

Measure 4: Investment in physical assets - to obtain investment support. Special attention is paid to small farmers and young farmers who implement their business plan. Supported investments relate to increased competitiveness, environmental performance, energy self-sufficiency, increase of added value and finalization of farm production.

Measure 6: Farm and business development - Relate to support for the implementation of the business plan, support for the development of small business activities for farmers, to cover the costs associated with the implementation of the business plan

Submeasure 6.1: support for starting business for young farmers

Submeasure 6.3: support for starting business and development for small farmers

Submeasure 6.4: Supporting investment in the creation and development of non-agricultural activities

Measure 9: Setting up of producer groups and organisations

Measure 17: risk management

Measure 19: LEADER

The EAFRD regulation 2014-2020 also provides for support in the field of innovation. Young farmers are indeed the future of European agriculture – they are likely to have innovative ideas, to be technology-friendly and open to new means of communication. They are also generally better trained than older farm managers. As such, they are well placed to benefit from the opportunities offered by the 'European Innovation Partnership for Agricultural Productivity & Sustainability' (EIP-AGRI). Although not specifically designed for the younger generation of farmers, Member States can include this tool in their rural development programmes to support innovation projects led by operational groups (composed of farmers, advisors, scientists, NGOs, and businesses, working in cooperation). The aim is to develop new products, processes and technologies in the agri-food and forestry sectors, at regional or national level, and generally foster competition and sustainable farming. The EIP-AGRI pools funding from two main sources: the EAFRD and, for multinational innovation projects, from Horizon 2020, the EU research and innovation programme.

Support dedicated to young farmers under Pillar II (rural development). Within the list of indicative measures proposed in the EAFRD regulation, 'Farm and business development' (Article 19) includes start-up aid for young farmers setting up an agricultural holding for the first time. It is a flat-rate payment, amounting to maximum € 70 000, paid in at least two instalments over a maximum of five years, and conditional upon the submission and successful implementation of a business plan. A new feature of the EAFRD regulation 2014-2020 is the possibility for Member States to include a sub-programme dedicated to young farmers within their rural development programmes (RDPs) and choose measures of particular relevance to this theme from a list provided in the regulation (sub-programmes can also cover other themes to which special and detailed attention must be devoted, such as small farms, mountain areas, women in rural areas, climate change mitigation/adaptation, biodiversity and short supply chains). As regards young farmers, in addition to the start- up aid mentioned above, some appropriate measures suggested are 'Investments in physical assets' (Article 17 of the EARFD regulation), with a higher support rate (up to +20%),2 'Knowledge transfer and information actions' (Article 14) and 'Advisory services, farm management and farm relief services' (Article 15), which provides for 'specific advice for farmers setting up for the first time'.

2.2.Improvements of at the national level

(a)Access to the agricultural land

The small farmers, mainly the farmers who will start their agricultural business face the fundamental problem how to receive the land or additional hectares of land. The agricultural land is a natural resource that is unique, non-recoverable and non-reproduced and it acreage is given by the state boundaries. Most of land is cultivated by the corporations or cooperatives which receive the land according to the lease or rent agreement. They cultivated less than 10% of land in their ownership but they cultivated many hundreds or thousands hectares of rented or leased land. Then, for the small farmers the access to the land is become an essential barrier to start their business in agriculture. The small farmers (if they are not landowners) have two possibilities how to receive the land – the land rent or land purchase. Both possibilities are accompanied by the barriers caused by the national legislation.

The land rent and lease is regulated by the Act no. 504/2003 Coll. on the agricultural land lease that stipulates many legislative barriers for new land leases, such as the long period of land lease contract (usually 10 – 15 years) that could terminate only by the expiration of a period; prior right of lessee to concluding the new land lease contract (it means that the present lessee has a prior right to conclude the new agreement); a duty of lessor to ask the withdrawal his/her land one year before the termination of contract, otherwise the land lease contract is renewed for at least 5 years [12,13,14].

Nowadays, the land purchase is more complicated due to the Act no. 140/2014 Coll. on the land acquisition. According to this Act the strict range of land purchaser is stipulated. However, the agricultural businessmen are preferred; there is no prefer the small farmers against the big corporations and cooperatives and the negotiation power of small farmers is missing because the land price is stipulated by the landowner according to his/her subjective opinions in the public register created by the Act for this purposes [13].

Moreover, there is a problem of enormous land fragmentation in Slovakia. The Slovak law maker adopted the Act 180/1995 Coll. that prevents the land fragmentation under the minimum size of land. However, the Slovak legislation concerning the land fragmentation is not very effective and does not prevent the land fragmentation. The Act no. 330/1991 on the land consolidation does not enable to manage the land consolidation by the public offices very well [14,20].

The Slovak law maker should consider more carefully the legislative measures when adopting the law for improvement the access to the land and takes into consideration a special status of the small farmers who want to start their business in agriculture. In addition, the land consolidation is supported also by the Programme of Rural Development 2014-2020. Therefore the legislative measure should be simplified how to realise the land consolidation to be enable to use the financial support from the Programme of Rural Development.

(b) Support for start-up a business

The intention to increase especially the number of young and small farmers is being realized by various support tools implemented within the EU CAP. For young farmers is the support for starting a business significant, since there has been observed growing trend of those who start and finish the agricultural activity in the same year (as seen in table 4). Dominantly, support should be directed at small and young farmers in order to refinance the entry costs of the agricultural business needed to start a business in order to support the willingness of farmers to set up an agricultural business entity. Support should provide capital assistance to start-up a business. For young farmers in the programming period 2014-2020 is intended measure Start-up aid for young farmers.

The European Union farming sector faces a demographic challenge a shortage of young farmers – that undermines its long-term sustainability. Many socio-economic factors, such as reduced access to land and credit, and lack of rural infrastructure, drive young people away from a career in agriculture. The EU therefore provides various forms of support and incentives to facilitate young people's entry in the farming business, most notably in the framework of the reformed Common Agricultural Policy (CAP) 2014-2020, which introduced new or strengthened measures to encourage them to set up in farming. Under the first pillar of the CAP, young farmers receive a 25% supplement to the direct aid allocated to their farm, for a

period of five years, as part of the 'Young Farmer Scheme' which Member States are obliged to implement. Under the second pillar, they have access to support co-financed under the European Agricultural Fund for Rural Development (EAFRD): a start-up grants and various economic, environmental, development and innovation measures which Member States can choose to include in their national Rural Development Programmes.
To address the demographic challenge in the agricultural sector and encourage young people to embark on a farming career, legislators have, for the first time, introduced a specific package for them in Pillar I – the 'Young Farmer Scheme' (IFS) – complementing support made available under Pillar II. Regulation (EU) No 1307/2013 on direct payments stipulates that the aim of the IFS is 'to facilitate the initial establishment of young farmers and the structural adjustments of their holdings after the initial setting up', and defines young farmers as natural persons, setting up an agricultural holding for the first time or have set up a holding in the previous five years, and who are no more than 40 years of age. Under the YFS, young farmers receive an annual 25% top-up to their basic payment for a period of five years from the date of their installation. The IFS is compulsory for Member States, which means that they are obliged to allocate up to 2% of their national direct payment envelope to these supplementary payments. They can choose to strengthen the eligibility criteria by defining further requirements (such as adequate training or submission of a business plan).

(c)**Access to project measures in the context of Rural development programme**

Based on realized research [17,18], we consider that EU financial support realized through European Agricultural Found for Rural development had positive impact on competitiveness of agricultural holdings and increase of labor productivity (significant positive impact – evaluated in economically strong holdings). Financial support allowed receivers of support to strengthen the production capacity, improve the use of factors of production and introduction of new techniques and products in short time period, which caused the maintaining and moderate increase of the competitiveness level in connection to their future activity, increase of the market share and more stable production and development in future. It is necessary to state, that not only the innovations and their introduction into production process, but also rational allocation of productive structures into the most favorable natural and production conditions and optimal combination and cohesion of main production factors use are contributing to strengthen the competitiveness of agricultural subject. Main agricultural subject are located in rural areas, which do have special structural features, as relatively low economic basis, limited business opportunities, low interface between sectors, relatively low level of knowledge transfer, because of listed features do such rural areas belong to less favorite areas to implement innovations. Therefore the support of implementation of innovation on agricultural level is the main task of government support via Programme for rural development in Slovak republic for the years 2014-2020. Such a support should lead to the creation of strong and viable agricultural sector and stable the position of small farmers in Slovak republic.

(d)Access to the credits

One of the most discussed problems of small and young farmers is missing of suitable credits for purchase of agricultural land. From 2005, the Slovak Guarantee and Development Bank has provide a credits (called “LAND”) for purchase of agricultural land mostly the rented or leased land cultivated by the agricultural businessmen according to the rent or lease contract. In 2013, the credit product “My Land” was prepared by the Ministry of Agriculture and Rural Development of the SR and provided by the Slovak Guarantee and Development Bank. The new product included a few important changes, mainly the opportunity to purchase not only complete land plots but also a co-ownership share and the option to purchase the built-up land under real estate. The co- financing was changed from 20% to 15%. The interest rate was in average 4,5% in the credit “Land” according to the policy of interest rate. The interest rate of the credit "My land" was coordinated by the Communication from the Commission on the revision of the method for setting the reference and discount rates (2008/C14/02); it was in average from 1.66% to 4.66%. In 2015, the credit "My land for young farmers" started to provide by the Slovak Guarantee and Development Bank. The co- financing is only 10%; however the credit limit is much smaller from 5,000 to 30,000 euro (in comparison with the above mentioned credits up to 250,000 (credit My land) or 330,000 euro (credit Land). The interest rate is the same as the interest rate for credit My land. Regarding the land price and land rent payment the interest rate of these credit products is high for the agricultural businessmen, mainly for the beginners in the agriculture [19].

(e)Access to direct support and non-project measures in the context of Rural development programme

Facilitate small and young farmers access to non-project measures of the Rural Development Program and support under decoupled and coupled direct payment scheme including. These include direct payments, greening, measures in the context of animal welfare, agri-environment-climate payments, and payments for ecological farming. Direct payment and greening are important source of finance for Slovak farmers, they should contribute to help mainly young and small farmers to slow the decrease of agricultural land and make the farming more attractive for young farmers. Payment for areas with natural constraints or other specific constraints and Payment within Natura 2000 for agricultural land are also important, because 50% of areas of Slovak republic belong to these areas. Payments are an irreplaceable component of efficient management to compensate the degree of land-use disadvantage that achieves lower performance parameters.

Coupled direct payment scheme and complementary national payments for young and small farmers are important to stabilize throughout the programming period and allow farmers to set up their business plan without fear of changes in the level of support. Due to the structure of agricultural businesses, there is considerable support for young farmers and small farmers in plant production, which is intended to promote fruit and vegetable, beet, hops and vine growing. Significant support measures under the common organization of agricultural markets for target groups of farmers are support measures for the common organization of the market in wine, support for fruit and vegetables and support for the beekeeping sector.

CONCLUSIONS

The importance of small farms is documented in the many publications mentioned in this study. The small farmers are an important element of sustainable agricultural production, multifunctional agriculture and rural development. They are able to be resist against the economic changes when cultivating the land in their own ownership (most of corporations and cooperatives cultivate the rented land). It follows the higher flexibility when using own production factors. Based on the results we can expect a further increasing trend of number of small farmers in Slovakia. However, it is hard to imagine functioning of small farms without subsidies for production, especially direct area payments regardless rich or power countries of the EU.

Therefore, we need to take into consideration their support and elimination of barriers in the Slovak environment, e.g. to improve the access to the land, support of the business of the beginning farmers, improvement the possibilities to use the project support, improvement the access to the credits and improvement the access to the non-project measures.

The adopted measures should be prepared carefully with the aim to eliminate the misuse the financial effect providing to support of agricultural business.

ACKNOWLEDGMENTS

This work was supported by the Grant Agency FESRD projects no. 7/2017.

REFERENCES

[1]Collier, P., Dercon,S., 2014, African agriculture in 50years: small holders in a rapidly changing world. WorldDev Vol.63, pp.92–101. [Online]. Available: http://dx.doi.org/10.1016/j. worlddev.2013.10.001 [Accessed: 2 Feb 2017].

[2]Davidova, S., Thomson, K., 2013, Family farming: A Europe and Central Asia perspective. [Online]. Available: http://www.fao.org/fileadmin/user_upload/Europe/documents/Events_ 2013/FF_EUCAP_en.pdf. [Accessed: 26 Oct 2016].

[3]De Janvry, A., Platteau, J.P., Cordillo, G., Sadoulet, E., 2001, Access to Land and Land Policy Reforms, Access to Land, Rural Poverty and Public Action, 28p.

[4]European Commission, 2016, Small Farmers Scheme, [Online]. Available: https://ec.europa.eu/agriculture/sites/agriculture/files/direct-support/direct-payments/docs/small-farmers-scheme_en.pdf [Accessed: 2 Feb 2017].

[5]European Commission, 2012, Rural development in the European union statistical and economic information, [Online]. Available: https://ec.europa.eu/agriculture/sites/agriculture/files/statistics/rural-development/2012/full-text_en.pdf [Accessed: 27 Oct 2016].

[6]FAO, 2012,.The State of Food and Agriculture 2012: Investing in agriculture for a better future. ISSN 0081-4539.

[7]FAO, 2013, Youth and agriculture: Key challenges and concrete solutions, [Online]. Available: http://www.fao.org/familyfarming-2014/en [Accessed: 3 Jan 2017].

[8]FAO, 2012, Smallholders and family farmers, [Online]. Available: http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf [Accessed: 21 Jan 2017].

[9]Green report of Ministry of agriculture and rural development, 2016, [Online]. Available: http://www.vuepp.sk/dokumenty/zelena/zelena2016.pdf [Accessed: 19 Jan 2017].

[10]Hazell, P., Poulton, C., Wiggins, S., Dorward, A., 2007, The future of small farms for poverty reduction and growth, 2020 Discussion paper No 42.

[11]Kotrla, M., Mandalová, K., Prčík, M., 2017, Regional disparities in Slovakia and The Czech Republic in the context of Sustainable growing of Energy Plants. European Journal of Sustainable Development, 6(2), 165-180.

[12]Lazíková, J., Bandlerová, A., 2017, Arrendamiento de tierras agrícolas en la República Eslovaca, Revista Anales de Legislación Argentina, Vol. 77, No. 3, pp.143 – 155.

[13]Lazíková, J., Takáč, I., Schwarcz, P., Banderová, A., 2015, Agricultural land market in Slovakia - economic and legal impacts of the Law no. 140/2014 Coll. on the land acquisition, Agricultural Economics, Vol. 61, No. 8, pp.367-376.

[14]Lazíková, J., Rumanovská, Ľ., Takáč, I., Lazíková, Z., 2017, Land fragmentation and its prevention in the Slovak legislation, Agricultural Economics, Vol. 63, (in press).

[15]Musial, W., 2013, Economic problems of small farms and their expectations for the CAP 2014-2020 reform, Social and economic problems of small agricultural holding in Europe, Vol.1, pp.16-27.

[16]Prčík, M., Kotrla, M., 2015, Targeted cultivation of the energy plants in conditions of the Slovak regions. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 15, 394-404.

[17]Rumanovská, Ľ , Lazíková, J., Fehér, A., Takáč, I. Benda, R., 2016, Innovations and competitivemess in agriculture enterprises in Slovakia, In: Innovative approaches in the management of competitiveness of business, Riga, Vol.1, pp.79-97.

[18]Rumanovská, Ľ., 2016, Impact of EU common agricultural policy 2014-2020 implementation on agriculture in Slovak Republic, Scientific papers. Management, economic engineering in agriculture and rural development. Vol. 16, No. 1, pp. 459-465.

[19]Swaminathan, M.S., 2014, Zero hunger. Science,. [Online]. Available: http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/Critical-Emerging-Issues-2016/CEI-2016-K9-FSN_Paper.pdf [Accessed: 20 May 2016].

[20]Swinnen, J., Van Herck, K., Vranken, L., 2014, Land Market Regulations in Europe,. LICOS Discussion Paper Series Vol.14. [Online]. Available: http://feb.kuleuven.be/drc/licos/publications/dp/dp354 [Accessed: 18 May 2016].

[21]Tropea, M. F., 2014, CAP 2014-2020 tools to enhance family farming: opportunities and limits,. [Online]. Available: http://www.europarl.europa.eu/RegData/etudes/note/join/2014/529051/IPOL-AGRI_NT(2014)529051_EN.pdf [Accessed: 2 Feb 2017].

[22]Wang, J.H.., 2015, Recruiting Young Farmers to Join Small-Scale Farming, A Structural Policy Perspective. [Online]. Available: http://ap.fftc.agnet.org/files/ap_policy/329/329_1.pdf [Accessed: 8 Feb 2017].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ROMANIA'S AGRICULTURE POLLUTER EFFECTS *vs.* POTENTIAL CONTRIBUTION TO A CLIMATE CHANGE RESILIENT ECONOMY

Mirela-Adriana RUSALI

Institute of Agricultural Economics – The Romanian Academy, 13, Calea 13 Septembrie, District 5, Bucharest, Phone/Fax: +40213182411; E-mail: m.rusali@yahoo.com

Corresponding author: m.rusali@yahoo.com

Abstract

The paper aims to assess the pollution level of Romania's agriculture, with emphasis on emissions of carbon gases, by analyzing the structure, trends and estimates of indicators projected in medium and long terms, according to the actual policies and targets for moving to a competitive low carbon economy in 2050. Romanian agriculture has not proved to be very intensive in terms of greenhouse gases pollution compared to the energy sector, however, being the second pollutant sector of economy, is one factor that contributes significantly to overall emissions mainly due to emissions of the livestock sector and of synthetic fertilizers use. Analysis shows potentials in 'greening' the economy in Romania, given the trends of massive reduces of emissions of greenhouse gases over the last two decades. It also underlines the crucial importance to reduce the statistics on polluting effects of agriculture provided by the potential expressed and growing of the Romanian forestry sector.

Key words: *agriculture, carbon gases emissions, climate change, resilient economy.*

INTRODUCTION

Scientific research confirms that global warming is the result of direct or indirect human activities (combustion of fossil fuels, land use change etc.) that produce excess greenhouse gases i.e. carbon dioxide (CO_2), methane (CH_4) nitrous oxide (N_2O), hydro-fluoro-carbons (HFCs), perfluorocarbons (PFC), sulfur hexafluoride (SF_6), that cause changes in the composition of the global atmosphere and natural variability of clime [1]. Their production will involve a substantial impact, although unequally, on natural resources, respectively, on soil, water, air and biodiversity, also creating a biological pressure on food security.

Climate change is a major challenge for agriculture and rural development in Romania, given that agriculture is both an emitter of greenhouse gases and therefore should contribute to the goals of climate change mitigation Europe 2020, and that is extremely vulnerable to climate change because the capacity of the rural area to provide an adequate supply of food to provide services to ecosystems, to support growth and to provide a safe living for rural communities directly depends on weather conditions.

At international level there is a large political and institutional mobilization to prevent possible risks that options for increasing productivity, as an immediate response to the signaled process that they will propagate on the natural environment, in terms of global warming. The Report on the environment, prepared annually by the European Environment Agency [3], signals the need to increase resource efficiency and preservation of natural capital elements key strategic continued through the Framework Agreement of the EU in 2014, outlining targets in the medium term in 2030 included three pillars: reduce greenhouse gas emissions by at least 40%, compared to 1990, increase by at least 27% of both energy savings and, respectively, the share of energy produced from renewable sources. The agricultural sector is one of the factors responsible to meet global demand that will be exerted by demographic pressures that FAO projected increase of 70% by 2050, by providing food, fiber and energy quantitatively and qualitatively adequate. Recent FAO estimates also point out that emissions of greenhouse gases s from agriculture, forestry and fishing sectors has doubled in the last 50 years and, without measures taken by authorities, could increase further to 30% by the year 2050 [4].

Pursuing the achievement of the goals, a long-term 'Roadmap' established targets percent reduction in emissions of greenhouse gases by 2050 compared to 1990 levels, the growth of renewable energy and energy efficiency based on the use of new resources, boosting resource productivity and decoupling economic growth from natural resource use and environmental impact, while ensuring ecological system resilience [6]. Achieving long-term strategic vision depends on meeting short and medium-term targets. Both objectives, to adapt to climate change and to reduce greenhouse gases, are important challenges for Romania, but also an opportunity, supported in part by the new rule of EU funds to encourage researches and investments compatible with the objectives of climate change policies.

In this context, the paper aims to assess the level of pollution in Romania's agriculture, with emphasis on emissions of greenhouse gases by analyzing the structure indicators and trends and estimates projected in medium and long terms, according to the relevant policies and targets.

MATERIALS AND METHODS

The study approaches an investigation into the pollution resulted from the main activities Romania's agriculture, focusing on the assessment of carbon emissions eq., based on the analysis of structural indicators and trends of the national statistics [5]. As well, based on FAO data there are presented the expected medium to long-term projections in line with the policies and the relevant objectives.

RESULTS AND DISCUSSIONS

Agricultural sector is the second largest provider of greenhouse gases polluting in Romania, after the energy sector (Fig. 1).

At EU level, Romania recorded the largest overall decline in greenhouse gas emissions from agriculture, with 53% between 1989 and 2011 [8]. While greenhouse gas emissions from agriculture in the EU-28 have fallen by about 23.1% from 1990 to 2012, the agricultural sector has cut emissions faster than carbon gases eq. emissions at macroeconomic level. The reduction of agricultural emissions at EU-28 is mainly due to the decrease in the number of animals, the improvements in good agricultural practice, the decreasing use of nitrogen fertilizers and the better management of natural fertilizers.

Romania has the fifth lowest share of greenhouse gas emissions compared to EU-28 agricultural output as a whole and by its main components - methane (CH4), nitrous oxide (N2O) and dioxide carbon (CO2) [2]. This is mainly due to the high percentage of subsistence agriculture as a result of the restitution of agricultural land and the ownership of the land after the fall of the communist regime. Because of financial constraints, these farmers who practice subsistence farming face difficulties in the mechanization effort.

At the same time, however, due to the low share of livestock production, restricted rice growing areas (both with potential sources of CH4) and the relatively low use of nitrogen-based inorganic fertilizers, the chances of increasing productivity in agriculture are limited.

According to data provided by the NIS, the total quantities of CO_2 equivalent emissions estimated from agriculture in 2005 accounted for 20.95 thou. Gg and decreased to 18.94 thou. Gg in 2011.

In comparison, removals of greenhouse gases emissions from land use and consumption sectors forests (LULUCF) (amounts of CO_2, CH_4 and N_2O) were estimated at -25.3 thou GgCO_2 eq. in 2011, up from -17.9% averaged over the period 2000-2006 to -20.2% on average in 2007-2011.

In the period 2000-2006, emissions from agriculture represented 14% of total net greenhouse gases emissions (the amounts of CO_2, CH_4 and N_2O in Gg CO_2 equivalent), including LULUCF, following a slight increase from 2007 -2011, the share of 15%.

Animal production sector was the main source of CH4 emissions from agriculture, both from enteric fermentation of livestock and from manure management.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

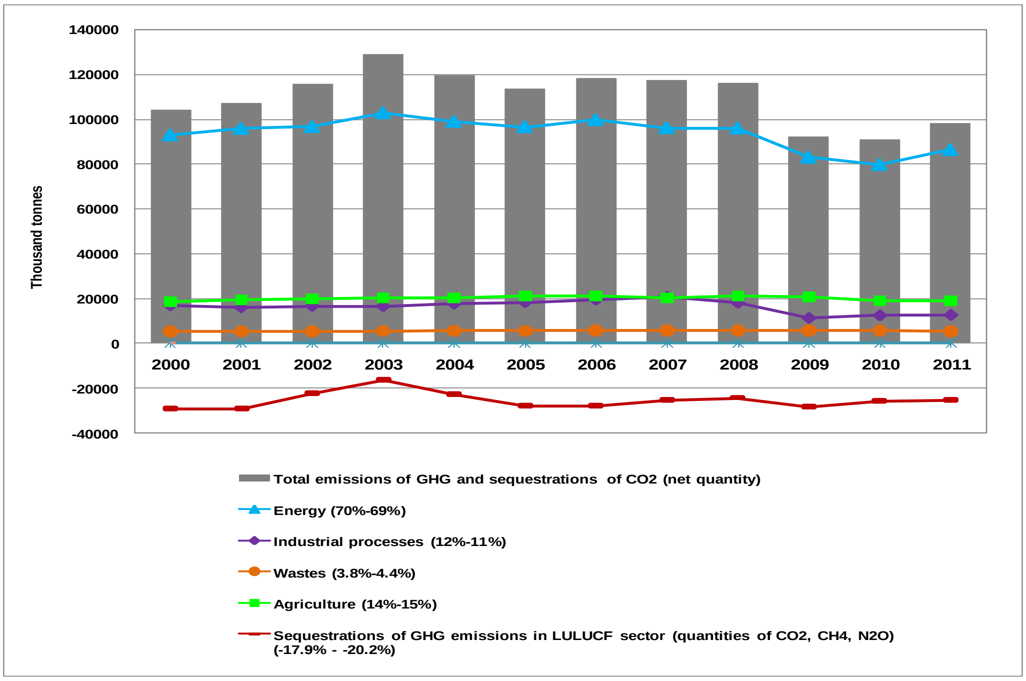


Fig.1. Greenhouse gas emissions in Romania, with effect on economy sectors, 2000-2011
Source: [5] (www.insse.ro).

The N_2O emissions from manure management (production and storage) and through agricultural land use, mainly arise due to des-nitrification that occurs after application of inorganic fertilizer or manure.

Some of N_2O and CH_4 emissions derive from field burning of agricultural residues, being also a source of NOx (oxides of nitrogen) and CO emissions.

As well, agriculture is an important source of reduction in carbon emissions through its biological capacity to sequester CO_2 and due to the availability of unproductive agricultural land that can be forested.

Nevertheless, forests have the most important role in isolating and absorption carbon emissions. This is represented in Romania by large estimated sequestration quantities of CO_2 equivalent that systematically contribute substantially to reducing the carbon balance in agriculture and other sectors.

In the structure of CO_2 equivalent in agriculture, the emissions of CH_4 from enteric fermentation of animals occupy the major share in total emissions of Romanian agriculture, which in 2012 shared 59%, followed by emissions from N_2O, accounting for 29% (Table 1).

Table 1 Carbon eq. gases emissions from agricultural activities: structure, trends and projections

Activity / Element (Gg)	**1990**	**2005**	**2007**	**2012**	**2030**	**2050**
Enteric fermentation (CO_2eq) of CH_4	12,670	6,636	6,902	5,394	6,545	6,121
Manure management CO_2eq)	4,522	3,087	3,116	2,568	3,155	3,011
Rice (CO_2eq) of CH_4	235	20	48	66	34	33
Synthetic fertilizers (CO_2eq) of N_2O	4,940	1,931	1,714	1,872	1,427	1,436
Crop residues (CO_2eq) of N_2O	1,235	1,303	630	916	1,153	1,163
Organic soils cultivation (CO2eq) of N_2O	123	123	123	123	123	123
Energy use (CO_2eq)	3,793	683	842	1,512	1,512	1,512
Total CO_2 eq. emissions of agric. (Gg)	27,635	13,834	13,434	12,568	14,066	13,517

Source: FAOSTAT, 2015 [7]

Substantial CO_2 emissions of N_2O equivalent were as well estimated after the use of synthetic fertilizers, with a 17.9 share, in 1990, but with a declining trend, down to 14.9%, in 2012, followed by emissions from manure management, which had, however, an increasing trend, respectively, from 16.4% to 20.4%.

Emissions from agricultural crop residues, although with a smaller share, recorded a volume increase of 4.5% in 1990 to an average of 8% in 2005-2012.

Compared to the CO_2 equivalent in 1990, it was observed a decrease by 57.4 % of the emissions from enteric fermentation, by 62 % of emissions from synthetic fertilizer and 80 % of the energy used in agricultural emissions of methane. It stresses that, in total greenhouse gases emission trends in agriculture has been a positive trend indicated by the decrease of 54.5% in 2012, compared to 1990 emissions, favored by:

• decline trend of livestock;

• reducing rice acreage (a potential source of methane emissions);

• reducing intensive agriculture, in particular by reducing fertilizer applications based inorganic nitrogen.

According to FAOSTAT, total CO_2 eq. emissions projections of agriculture show an increase of 1.7 % compared to 2005, but by 2030 will decrease by 49% compared to 1990, and by another two percent by the target year 2050.

Medium-term projections indicate a possible increase in CH_4 emissions by 5.6 percent compared to 1990, while in long term, down from 1.3 percent in 2030.

Meanwhile, projections for N_2O emissions show a decrease of 2.6 percent compared to 1990 and further to 1 percent by 2050.

Given the significant contribution agriculture’s emissions of the emissions from animal enteric fermentation, has been analyzed the situation regarding the evolution of emissions from livestock activities in the period 1990-2012 and the medium effects and long-term effects of the forecasted developments according to FAO data, for the target years 2030 and 2050.

The results consist in gases greenhouse in the livestock sector: structure, trends and projections, corresponding to the data of the Table 2, presents an obvious feature of developments in 1989-2012 period, showing a general downward trend in emissions of methane from animal enteric fermentation of CO_2 equivalent, coupled with the reduction of the animal categories. i.e. cattle, by -68%, sheep & goats, by -40% and pigs, by -54%.

Table 2. Emissions of gases greenhouse in the livestock sector: structure, trends and projections

Category	Element	1989	1990	2005	2006	2007	2012	2030	2050
Bovines	Thousand heads	6,416	6,291	2,808	2,862	2,934	1,989	2,781	2,571
	Gg of CH_4	442	445	228	234	239	163	229	211
	Gg of CO_2eq	9,282	9,345	4,791	4,913	5,011	3,430	4,808	4,439
Sheep and goats	Thousand heads	17,288	16,452	8,086	8,298	8,405	9,770	8,002	7,674
	Gg of CH_4	135	129	63	64	65	74	62	59
	Gg of CO_2eq	2,836	2,700	1,317	1,351	1,366	1,563	1,302	1,249
Swine	Thousand heads	14,351	11,671	6,495	6,622	6,815	5,364	6,710	6,656
	Gg of CH_4	22	18	10	10	10	8	10	10
	Gg of CO_2eq	452	368	205	209	215	169	211	210

Source: FAOSTAT, 2015 [7]

The data in Table 3 shows the evolution of the net quantities of emissions / sequestration from LULUCF (Gg CO_2 eq.) in the period 1990-2012 (selected years). Medium-term projections indicate an increase in 2030 compared with 2012 levels, of the number of cattle, by 12.6 percent, and pigs, by 11.5 percent, leading to increased CO_2 emissions equivalent, respectively, by 14.8 percent, and 11.5 percent.

Accordingly, sheep & goats will decrease by 10.7 percent, coupled with a decrease of emissions by 9.7 percent.

In the long term, by 2050, it is forecasted a decrease in all categories of animals.

Table 3. Sequestration of carbon eq, gases emissions in the LULUCF sector: structure and trends

	1990	2005	2006	2007	2008	2009	2010	2011	2012
Forest areas	172	-1,378	-12,412	-12,410	-12,409	-12,407	-12,406	-12,404	-12,402
Cultivated area	1,155	1,155	1,155	1,155	1,155	1,155	1,155	1,155	1,155
Biomass burnings	294	31	250	882	406	30	46	867	949
Total utilized agricultural area	1,621	-192	-11,007	-10,374	-10,848	-11,222	-11,205	-10,382	-10,298

Source: FAOSTAT, 2015 [7]

Compared with the target year 2030, the cattle will decrease by 3.3 percent, with 2 percent sheep and goats and pigs by 0.5 percent.

Equivalent CO_2 emissions from enteric fermentation of animals evolve accordingly, so that the cumulative drop of the categories of animals for which projections were made will be 6.4 percent.

There is noted a substantial increase in net removals of emissions / sequestration of greenhouse gases by total agricultural land use in the period 2005-2012, compared to 1990, respectively, from 1,621Gg CO_2 equivalent to -10,298 in 2012.

The major contribution to improving the carbon balance in Romania, showing a particular natural isolation capacity and absorption of emissions that forests have, offsetting emissions from soil cultivation and biomass combustion.

It has been estimated a substantial increase of forest absorption, accounting for -12,402 Gg CO_2 equivalent in the year 2012, compared to 172 Gg CO_2 equivalent in 1990.

CONCLUSIONS

Agriculture, the second pollutant sector of economy, contributes to overall greenhouse gases mainly due to emissions of the livestock sector and of synthetic fertilizers use.

Analysis shows potentials in ‘greening’ the economy in Romania, given the trends of massive reducing of greenhouse gases emissions over the last two decades. It also underlines the crucial importance to reduce the statistics on polluting effects of agriculture provided by the potential expressed and growing of the Romanian forestry sector.

Medium-term projections on FAO data indicate an increase of CO2 emissions, up to the year 2030, of 11.5-14.8 percent due to swine and cattle growth, while decrease of emissions by 9.7 percent coupled with a sheep & goats herds decrease by 10.7 percent.

In the long term, it is forecasted a decrease in all categories of animals, leading to cumulative drop of CO2 eq. emissions from enteric fermentation of animals of 6.4 percent by target year 2050.

A desirable vision for Romania in medium and long terms in its efforts to combat the negative climate effects is to become a low carbon dioxide economy resilient to climate change which has integrated its policies and actions in a smart, 'green' and inclusive economic growth.

ACKNOWLEDGEMENTS

The researches have been conducted in the framework of the Romanian Academy Project: Romania's Development Strategy for the Next 20 Years: 2016-2035. Project 5 - Food Security and Safety, Stage 3: "Propose targets for the 2035 horizon in order to increase the role of Romanian agriculture as a food security provider and improve food quality".

REFERENCES

[1]EC, 2015, EU agriculture and climate change, http://ec.europa.eu/agriculture/climate-change, Accessed November 10, 2017.

[2] European Commission (EC), 2014, The EU’s CAP: for our food, for our countryside, for our environment. DG-Communication, Brussels.

[3] EEA, 2015, The European Environment,

https://www.eea.europa.eu/soer-2015/synthesis/report, Accessed November 10, 2017.
[4]IPCC, 2014, Intergovernmental Panel on Climate Change - The Fifth Report FAO – UN. state and outlook - 2015.
[5]INS, 2013, Emisii de gaze cu efect de sera pe domenii de activitate. www.insse.ro, Accessed January 7, 2018
[6]MMSC, 2015, Strategia națională privind schimbările climatice și creșterea economică bazată pe emisii reduse de carbon, Versiunea 3.
[7]Rusali, M-A, 2015, State and outlook of agriculture's pollution with greenhouse gases in Romania. The 3rd International Conference ESPERA '15, INCE.
[8]World Bank, 2013, Regiunea Europa şi Asia Centrală, 2007-2013. Beneficiar: Ministerul Mediului şi Schimbărilor Climatice.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE PERSPECTIVE OF AGRICULTURAL DEVELOPMENT IN IRAQ

Abdulmuttaleb Abbas SALIH, Hussein Ali Hussein AL-QAESI

University of Dhi-Qar, District Almustfawiyah, Nasiriyah, 64001, Iraq, Phone: +009647809249646, Emails: hussein_782003@yahoo.com, abd_mtlb@yahoo.com

Corresponding author: abd_mtlb@yahoo.com

Abstract

Agriculture is still an important sector since it provides an opportunity for Iraq to improve the country's economy. The perspective of agricultural development is therefore a very important aspect since it can shape the future of the agricultural sector. The present research is situated in the field of agriculture, focusing on evaluating the current perspectives on agricultural development in Iraq, by comparing the past and present ones, and finally looking for indicators of what path it might actually take, based on government policies, actual status, current directions in research and other indicators. This study will be divided into an introductory section, research methods, results and discussion in which data will be interpreted, and it will end with conclusions and recommendations.

Key words: *agricultural development, Iraq, perspectives*

INTRODUCTION

The status of agriculture in Iraq has been different in the past, despite the fact that Iraq has been a net food exporter, thanks to its abundance of water and land, with a relatively small population.

After World War II and independence, oil revenues were invested for a massive modernization of the agro-industrial complex in Iraq, with capital intensive initiatives and the introduction of modern inputs and the expansion of irrigation.[14]

Nowadays, Iraq's agricultural sector represents a small, but vital component of Iraq's economy, due to Iraq's involvement in military conflicts, particularly the 1980-88 Iran-Iraq War and the 1991 Gulf War, and by varying degrees of government efforts to promote and/or control agricultural production.

Many factors, such as population growth, massive urbanization, warfare and domestic turmoil have determined an ever increasing recourse to food imports and many producers were almost obliged to abandon input intensive production systems and they had to retrieve traditional methods and to rely on local inputs.

Extension of agriculture is a very important matter at the time in Iraq.

Also, according to many Iraqi experts there is a growing awareness about the pollution problems caused by the misuse of chemicals, while the cost of many imported inputs makes them unaffordable for most small farmers [3], so the development of programs and workshops for farmers, regarding use of technology, pesticides and benefits of organic agriculture would be a good method of ensuring the issues that pollutions might cause.

Regarding the direction that agriculture should take in Iraq, Iran, Saudi Arabia and other neighboring countries, there are strong forces pushing for intensive farming, based on all possible inputs [16],[17], but on the other hand there are also those who suggest various forms of low external inputs agriculture and organic agriculture, at least for some areas of the country and for some products and markets.[9].

Current perspectives of agriculture in Iraq

The Iraqi Ministry of Agriculture has formulated a Strategic Plan to address the limitations of agriculture in Iraq and endorsed a strategy for FAO assistance to the Iraqi efforts along with various key ministries. In order to expedite the rehabilitation of the agriculture sector, the Government of Iraq is increasing its investment in agriculture and is seeking technical assistance and support from

FAO and all other international organizations. As a result, many projects for agricultural extension have developed. Some programs are The Iraq Salinity Project, the ACIAR program, and the IAER program.

On the private sector, USAID has invested in programs designed to stabilize communities, foster economic and agricultural growth and build the capacity of national, local, and provincial governments to respond to the needs of the Iraqi people. Currently, USAID assists private Iraqi agricultural businesses in improving their productivity by introducing to them the latest technologies in agribusiness, including soil and water management. The goal is to increase productivity, lower production and marketing costs, increase the profitability of agricultural enterprises, and generate rural employment with technical assistance and business development training. USAID is helping the private sector increase agricultural revenues.[16]

MATERIALS AND METHODS

The questions that this study is aiming to answer are:

1. What is the current status of agriculture in Iraq and in the neighboring countries?
2. How did agriculture evolve in Iraq?
3.What are the current perspectives on agriculture in Iraq and how do the state policies affect and shape the current perspectives on agriculture?

This study involves the use of theory and statistical data. The theory may or may not be made explicit in the design of the research, although it will usually be made explicit in presentation of the findings and conclusions.

In the paper the fallowing indicators have been used: arithmetic mean, coefficient of variation, average annual growth rate, ecologic indicators and statistical indicators.

The formulas used for to calculate these indicators, are:

$For\ the\ arithmetic\ mean = \bar{x} = \frac{\sum xi}{n}$, where $\bar{x}$ = the arithmetical mean, xi= the average production values for a number of years (i); n= number of years taken into account.

RESULTS AND DISCUSSIONS

The current status of agriculture in Iraq and in the neighboring countries

The direction in which the Iraqi agriculture is going represents an important matter, since it can revive and contribute to national wellbeing, by taking also into account the growing competition for water and the challenges due to climate change, or use pesticides and chemicals in order to increase the production. This section will present the results regarding the current status of agriculture in Iraq and in its neighboring countries, as well as the current status and perspectives of agriculture in Iraq. Iraq was once one of the breadbaskets of the Middle East, and in fact today the yield gaps, understood as the differences between actual or observed yields and simulated potential yields in a given area, remain very significant [11].

Table 1.The evolution of agricultural land in Iraq during 1990-2014

Category	MU	1990	2000	2005	2010	2014
Country area	1,000 ha	43,832	43,832	43,832	43,524	43,505
	%	*100.0*	*100.0*	*100.0*	*99.3*	*99.3*
Agricultural area	1,000 ha	9,230	8,300	9,390	8,220	9,269
	%	*100.0*	*89.9*	*101.7*	*89.1*	*100.4*
Arable land	1,000 ha	5,000	4,100	5,200	4,000	5,034
	%	*100.0*	*82.0*	*104.0*	*80.0*	*100.7*
Permanent crops	1,000 ha	230	200	190	220	235
	%	*100.0*	*87.0*	*82.6*	*95.7*	*102.2*
Forest	1,000 ha	804	818	825	825	825
	%	*100.0*	*101.7*	*102.6*	*102.6*	*102.6*
Other land	1,000 ha	33,703	34,619	33,522	34,387	33,338
	%	*100.0*	*102.7*	*99.5*	*102.0*	*98.9*
Inland water	1,000 ha	95	95	95	92	73
	%	*100.0*	*100.0*	*100.0*	*96.8*	*76.8*

Source: FAOSTAT, http://faostat3.fao.org/download/E/EL/E [7].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

Of the total area of Iraq (43.5 million ha), 22 percent, i.e. 9.2 million ha is cultivable land, suitable for agriculture. Agriculture is mostly practiced on small farming units. More than 80 percent of the farms have a total size of less than 10 ha and even these 10 ha are on average scattered over several different locations. The agricultural area has had many variations during the period 1990-2014, from 9,230 thousand ha to 8,220 thousand ha in 2010 and increased up to 9,269 thousand ha in 2014. The arable land had the same trend with a small value in 2010 and an increase until year 2014 at 5,034 thousand ha. The permanent crops occupy 235 thousand ha, with small variations over the years.

Table 2. Structure and use of land in Iraq during 1990-2014

Mode of use	1990		2000		2010		2014	
	mil ha	%	mil ha	%	mil ha	%	mil ha	%
Country area	43,832	100.0	43,832	100.0	43,524	100.0	43,505	100.0
Agricultural area	9,230	21.1	8,300	18.9	8,220	18.9	9,269	21.3
Arable land	5,000	11.4	4,100	9.4	4,000	9.2	5,034	11.6
Permanent crops	230	0.5	200	0.5	220	0.5	235	0.5
Forest	804	1.8	818	1.9	825	1.9	825	1.9
Inland water	95	0.2	95	0.2	92	0.2	73	0.2
Other land	33,703	76.9	34,619	79.0	34,387	79.0	33,338	76.6

Source:FAOSTAT, http://faostat3.fao.org/download/E/EL/E [7]

Regarding the structure of land from the table 2, the agricultural land had the highest share in 2014, i.e. 21.4%, almost the same with year 1990. In year 2010 it was a gap, most of the categories studied had a decrease, followed by an increase until year 2014. It is remarcable how the categories vary between the years, being unusual to have such differences, but having the political issues, the fluctuations are easy to explain.

The arable land had a share between 9.2% and 11.6% and the permanent crops are for the whole period at a 5% from the total land.

Table 3. Total area equipped for irrigation

Country	MU	1961	1980	2000	2010	2014
Iran	1,000 ha	4,700	4,948	7,870	9,273	9,600
	%	*100.0*	*105.3*	*167.4*	*197.3*	*204.3*
Iraq	1,000 ha	1,250	1,750	3,525	3,525	3,525
	%	*100.0*	*140.0*	*282.0*	*282.0*	*282.0*
Jordan	1,000 ha	31	37	76.9	96.4	105
	%	*100.0*	*119.4*	*248.1*	*311.0*	*338.7*
Syria	1,000 ha	558	539	1,211	1,341	1,310
	%	*100.0*	*96.6*	*217.0*	*240.3*	*234.8*
Turkey	1,000 ha	1,310	2,700	4,745	5,215	5,215
	%	*100.0*	*206.1*	*362.2*	*398.1*	*398.1*

Source: FAOSTAT, http://faostat3.fao.org/download/E/EL/E [7].

Regarding the area equipped for irrigation Iran has the biggest surface, and has increased its surface since 1961 with 4,900 thousand ha reaching at 9,600 thousand ha, meanwhile Iraq has an increase with 2,275 thousand ha. As a percentage Turkey has a very high increase, from 1,310 thousand ha to 4,745 thousand ha in year 2000 and reaches 5,215 thousand ha in 2014, overpassing Iraq.

The highest development of cereal production yield (kg per hectare) is registered during 1990-2014 in Turkey, with a mean of 2,420, followed by Iran with 1992.05 and Syria, with 15,00.82. Iraq and Jordan show relatively close means, respectively 1,190.09 and 1,370.36.

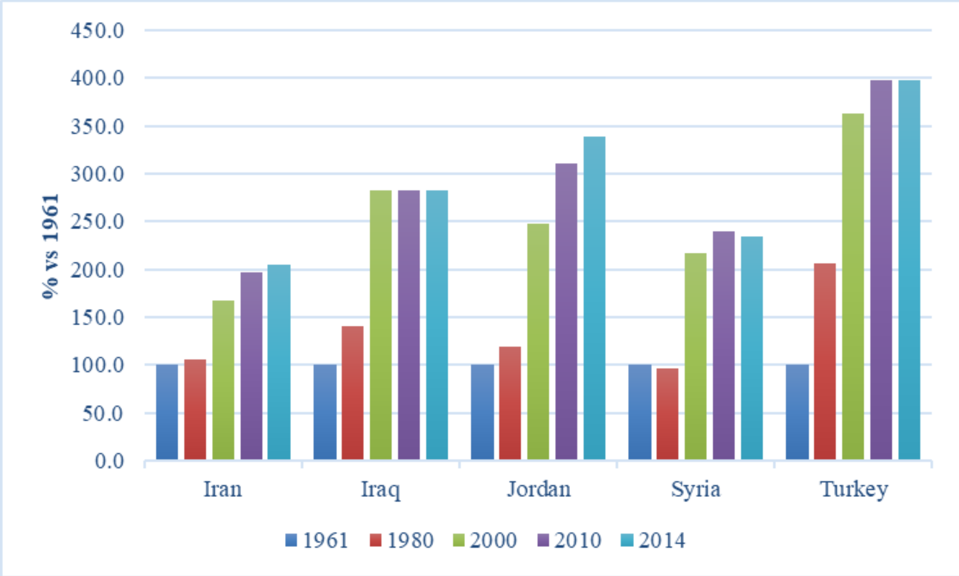


Fig. 1. The increase of the total area equipped for irrigation (1961=100%)
Source: World Development Indicators, http://data.worldbank.org/data-catalog/world-development-indicators[18]

Table 4. Evolution cereal production yield (kg per hectare) in Iraq and neighboring countries during 1990-2014

No	Country	Indicator	Period 1990-2014				Mean	StDev	Coefficient of variation	The annual growth rate
			1990	2000	2010	2014	mll ha	mll ha	%	%
1	Iran	kg/ha	1,445	1,833	2,358	1,963	1,992	315.6	15.84	1.28
		vs 1990(%)	100	126.8	163.1	135.8	x	x	x	x
2	Iraq	kg/ha	1,061	363	1,697	2,187	1,190	537.4	45.15	3.06
		vs 1990(%)	100	34.2	160	206.1	x	x	x	x
3	Jordan	kg/ha	1,220	1,726	1,963	1,455	1,370	452	33.0	0.74
		vs 1990(%)	100	141.5	160.9	119.3	x	x	x	x
4	Syria	kg/ha	750	1149	1232	1063	1501	391	26.05	1.47
		vs 1990(%)	100	153.1	164.3	141.8	x	x	x	x
5	Turkey	kg/ha	2,214	2,311	2,727	2,831	2,420	344	14.21	1.03
		vs 1990(%)	100	104.4	123.2	127.9	x	x	x	x

Source: World Development Indicators, http://data.worldbank.org/data-catalog/world-development-indicators[18]

In terms of cultivated areas, there are large variations between the years due to climatic and/or economic reasons. Certain studies certified that in the period 2000-2013 both population growth rates and those of agricultural production were lower but also that in Iraq the rhythms of agricultural production growth was smaller than the population growth rate.[8].

Current perspectives of agriculture in Iraq

The first important perspective in the development of agriculture is the extension which is a non-formal educational function that applies to any institution that disseminates information and advice with the intention of promoting knowledge, attitudes, skills and skills. Educational organizations are important elements in the institutional context for extension. The work of universities and training institutes in particular has a significant impact on extension organizations. The content of their curricula as well as the numbers and qualifications of their graduates are limiting or enabling factors in any country [1].

At the same time, extension is a political and organizational instrument utilized to facilitate development. Its purposes may differ, from technology transfer to problem-solving educational approaches and advancing community involvement in the process of development.

Most ministries of agriculture have an extension unit that deals mainly with crops and other agricultural systems. During the 1970s and 80s, efforts were made to unify ministerial agricultural extension operations but with limited success.

Extension is multidisciplinary. It combines educational methodologies, communication and community techniques. When effectively provided extension is known to enhance social and economic development. Many studies have demonstrated the high economic returns of investments in agricultural dissemination, thus investment in agricultural research and extension is a good input of agricultural growth [2].The role of government is critical for the reconstruction of agricultural extension even if the extension services are provided by private contractors [12].

Extension of agriculture is an important matter of discussion in Iraq and its neighboring countries, since it has a major economic and sociologic impact. According to experts there is a growing awareness about the pollution problems caused by the misuse of chemicals, while the cost of many imported inputs makes them unaffordable for most small farmers [3].

In terms of agricultural education, which is an important factor of the extension of agriculture. At the moment, educational agriculture can be pursued at universities (the most common are Mosul and Baghdad Universities), continued in research centers and by continuous training for farmers through the programs and workshops offered for the purpose of extending agriculture.

The SBAR is the largest national agricultural research (NARS) institution: it represents 26% of the potential research years of the NARS. Its main mandate is agricultural research which mobilizes about 75% of the time of its professional staff. Other activities cover community services (soil analysis, seed production, etc.), extension and training[15].

Below, in table 5, the main agricultural educational topics identified as a critical need in 2013 are listed. In the Arabian world, at the level of year 2012, the internet users were 34 at 100 persons, a continuous increasing no. in the last decade [13], i.e. the channels for information are wide opening.

Table 5. Preferred Formats through which Iraqi farmers prefer to receive agricultural information

Format	Farmer preference (%)	Extension agent preference (%)
Personal face-to-face	64.2	74.9
Written brochures and bulletins	20.7	11.7
Internet	9.5	3.8
Video media	3.8	9.6
Written books	1.8	0.0

Source: FAOSTAT, http://faostat3.fao.org/download/E/EL/E [7].

The second perspective, and much related with the first is the development of organic agriculture. Organic agriculture is an important factor of extension of agriculture so its reality and future prospects require theoretical and applied research, a good administration that would reflect in society's involvement, trough targeted investments, agricultural education, and appropriate legislation.

Table 6. Agriculture areas certified as organic

Country	Iran	Iraq	Jordan	Syria	Turkey
Area	1,000 ha	1,000 ha	1,000 ha	1,000 ha	1,000 ha
2006					162
2007			1.03		135
2008	11.4		1.03	25.66	142
2009	8		1.03	35.4	250
2010	6				192
2011	14.4		2.6		326
2012	41.35				399

Source: FAOSTAT, http://faostat3.fao.org/download/E/EL/E [7].

"Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity.

It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system."[5].

The purpose of organic farming is to eliminate the use of fertilizers, pesticides, animal drugs and food additives, I order to improve soil, water and environmental quality.

The excess use of nitrogen fertilizers in agriculture can lead to nitrate accumulation into plants, and in this regard, workshops and programs are required in order to deliver information to farmers and inform them about the benefits of organic agriculture. Today, organic agriculture is studied in colleges of agriculture in the Kurdistan region and Iraq especially to graduate students.

The agricultural policies adopted by the Ministry of Agriculture have made the agricultural inputs seeds and fertilizers in particular, available to farmers, particularly for the strategic crops, such as wheat. In Iraq's case, there are many reasons to believe that the country's agricultural potential is great [4].

As a result, farmers rely heavily on the inputs provided by the government for wheat. Financial capacities of the most vulnerable farmers in particular, are limited, according to FAO, whose staff interviewed farmers who made it very clear that seeds and fertilizers were their priority needs for the coming cropping season with 92 and 96 percent of them requesting support for seeds and fertilizer as illustrated in the graph below.

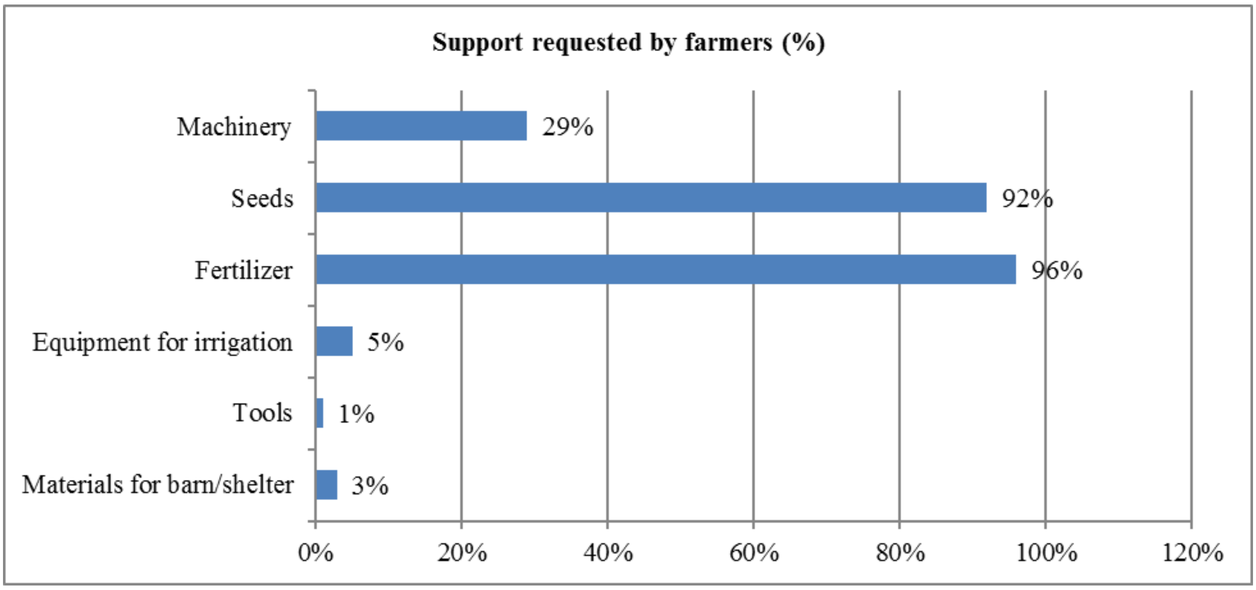


Fig 2. Support requested by farmers
Source: Rapid Assessment of Agricultural Livelihoods, FAO 2016.[7]

Agricultural growth would also lift growth in the food processing and service sectors. To support farmers and traders in this process, improving infrastructure and market information systems will be important for market access and to provide actors along the supply chain with useful information about prices and marketing opportunities.

It would also be good to implement measures to reduce the transaction costs related to international trade, including excessive documentation requirements, authorizations from multiple agencies, unclear or subjective criteria for the application of duties, and delays and uncertainties related to customs clearance.[10].

CONCLUSIONS

Iraq is trying to find solution to develop the agriculture and to overcome the issues it has been confronting in the last years. Of the total area of Iraq (43.7 million ha), 22 percent, i.e. 9.5 million ha is cultivable land, suitable for agriculture, which represents a small part compared to the other countries.

From this study we find that Iraq, and also the countries that were taken into study have developed a solution to one of the most important problems - the irrigation area. As it could be seen, all the countries have increased the surfaces equipped for irrigation, doubling or tripling it.

Extension and counseling help farmers to make the best decision for the agriculture development. Extension organizations need to develop communication with fertilizer providers since excessive use of agrochemicals can harm human health and the environment, and programs such as integrated pest management are recommended.

The agricultural policies in Iraq indicate that many ministries, committees, and institutions are involved in drawing up the agricultural policies of the country. These include the Agriculture Committee in the parliament, Council of Ministers, Ministry of Agriculture, Ministry of Water Resources, Ministry of Environment, and some non-governmental organizations (NGOs), which are very good perspectives for the development of the agriculture.

A key factor is the agricultural education, which is an important factor of the extension of agriculture, and is an important help for the development of knowledge of farmers, it can be pursued at universities (the most common are Mosul and Baghdad Universities), continued in research centers and by continuous training for farmers through the programs and workshops offered for the purpose of extending agriculture.

REFERENCES

[1]Alex, G., Zijp, W., Byerlee, D., 2002, Rural Extension and Advisery Services: New Directions. The World Bank, AKIS (draft doc.).Washington, DC. 2001

[2]Anderson, J.R., Feder, G., 2004, Agricultural extension: Good intentions and hard realities, World Bank Research Observer 19(1): 41-60.

[3]Bashur, I., 2008, Pesticides, fertilizers and food safety, in Tolba, Arab environment future challenges, Arab Forum for Environment and Development, Beirut, pp. 137-144.

[4]Davis, K., 2016, International Food Policy Research Institute/Global Forum for Rural Advisory Services" in Journal of International Agricultural Extension Education, Available at https://www.aiaee.org/index.php/journal, Accessed on December, 5, 2017.

[5]FAO/WHO, 1999, Codex Alimentarius Commission, Available online at: http://www.fao.org/organicag/oa-faq/oa-faq1/en/, Accessed on December, 5, 2017.

[6]FAO, 2016, Agriculture and Livelihoods Needs Assessment, available at http://www.fao.org/fileadmin/user_upload/FAO-countries/Iraq/ToR/FAO_Assessment1.pdf, Accessed on December, 5, 2017.

[7]FAOSTAT, 2014, available at: http://faostat3.fao.org/download/E/EL/E, Accessed on December, 5, 2017.

[8]Jeghayef Al Mohammad, Necula, R., Necula, D., 2016, The Analysis of the main indicators evolution of social and economic development in The Arab Republic of Syria, period 1960-2014, 7th Edition of the International Symposium „Agrarian Economy and Rural Development - Realities and Perspectives for Romania" pg 47-55, ICEADR

[9]Mahmoudi, H., Hosseininia, G., Azadi, H., Fatemi, M., 2008, Enhancing date palm processing, marketing and pest control through organic culture, Journal of Organic Systems, 3 (2): pp.29-39.

[10]Minot, N., Chemingui, M., Thomas, M., 2010, Trade Liberalization and Poverty in the Middle East and North Africa. Research Monograph. Washington, DC: International Food Policy Research Institute.

[11]Nin-Pratt, A., Johnson, M., Magalhaes, E., You, L., Diao, X., Chamberlain, J., 2011, Yield Gaps and Potential Agricultural Growth in West and Central Africa. Research Monograph 170. Washington, DC: International Food Policy Research Institute.

[12]Rivera, W.M., Zijp, W., 2002, Contracting for Agricultural Extension: International Case Studies and Emerging Practices. Wallingford, UK: CAB International.

[13]Rahman, A., Jeghaef Al Mohammad, Necula, R., Capătă, D.R., 2015, The economic and social development analysis in Syria for the period 1980-2013, Scientific Papers Series „Management, Economic Engineering and Rural Development" Vol 15(4):271-278

[14]Schnepf, R., 2003, Iraq's agriculture: background and status, Available at http://nationalaglawcenter.org/wp-content/uploads/assets/crs/RS21516.pdf, Accessed on December, 5, 2017.

[15]The Australian Centre for International Agricultural Research (ACIAR), available at: http://aciar.gov.au, Accessed on December, 5, 2017.

[16]USAID, U.S. Agency for International Development, 2006, Available at: http://pdf.usaid.gov/pdf_docs/Pdacr356.pdf, Accessed on December, 5, 2017.

[17]USAID, 2006, Agricultural reconstruction and development program for Iraq, Volume 1, Washington DC, p.327.

[18]World Development Indicators, 2014, available at http://data.worldbank.org/data-catalog/world-development-indicators

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ANALYSIS OF THE EXTENSION OF A BUSINESS IN THE FIELD OF PUBLIC FOOD

Daniela SIMTION

Lucian Blaga University, Faculty for Agricultural Sciences, Food Industry and Environmental Protection, 7-9, Dr. Ion Raţiu, Sibiu, Romania, Mobile: +40721435221, Email: simtiondaniela@yahoo.com

Corresponding author: simtiondaniela@yahoo.com

Abstract

Assessing the performance and financial position of a company calculated on the basis of the information provided by the companies in the financial statements reveals a certain trend of the company. The defining objective of financial management is to increase the firm's market value. The decisive factor that contributes to the increase of the value of the company are the investments. Investments give the company's identity. Thus, the first and decisive step towards increasing the market value of the firm is to make good investment decisions. This paper focuses on analysing and evaluating the expansion project of AMIOGO restaurant. Indicator values: Net current value, Internal Return Rate or Investment Recovery Duration indicate the viability and attractiveness of the proposed project. At the same time the possibility that the analyzed company can develop is highlighted or not: at what terms, during what time period, in what value limits, with what risks.

Key words: *costs, exploitation, forecast, profit, turnover*

INTRODUCTION

The development of mankind has made that all notions that make up the course of an ordinary day to be shaped directly proportional to the exchanges of mentality and invented technology. Thus, changes have taken place in all areas of infrastructure, communication and transport, up to homes, buildings, public establishments, accommodation, recreation or food.[7]

Food tourism trends to focus on prepared food and drink, while agro tourism focuses more on the raw ingredients and the farming experience.[2]

In this context, we propose expanding the activity of a restaurant with the specific of the Spanish cuisine, having as an objective the creation of a culinary tourism being transposed through preparations and arrangement.

Under the slogan*: "Eating differently is always what we are looking for when pushing a restaurant's door"* the public food unit will become an appealing and innovative one, by adopting the healthy, fresh, and natural Mediterranean cuisine.

There are differences between the concept of traditional product and the concept of local product.[6]

Romania has a relatively new history of the organic market, but increase the number of operators registered in the system is a spectacular one.[10]

MATERIALS AND METHODS

The current Net Value (VAN) is a complete efficiency investment indicator of the difference. The current Net Value of a project is determined by deducting from the present value of the net incomes from exploiting the project the value of the initial investment, respectively the present value of net payments to be made for the commissioning of the project as shown by the formula:

$$VAN = \sum_{t=1}^{n} \frac{FN_t}{(1 + r_t)^t} - Vi$$

Vi = initial investment as a negative flow, respectively net cash outflow;

FNt = the net cash flow estimated to be generated in year t;

Positive VAN projects are believed to lead to an increase in the value of the company. In this way, the VAN-based decision-making rules specify that all independent positive VAN projects must be accepted. If the VAN is greater than zero, the project is acceptable, as the income is sufficient to obtain a benefit and to return the initially invested capital, before the end of the investment lifetime. If VAN is equal to zero, the balance is achieved at the end of the lifetime and the investment is too little attractive.[5]

Return on investment or ROI is the method of assessing business initiatives in order to determine their viability. If the ROI is too small compared to the interest the investor would have made if deposited in the bank, the project needs to be re-analyzed or abandoned.

ROI = (Revenue from the investment - Amount invested) x 100 / Amount invested [1]

Internal Rate on Return, indicator used in analyses on the efficiency of investment projects using the update technique, expresses that interest rate level that equals up-to-date earnings with up-to-date expenses and makes the amount of updated net income equal to zero. This indicator is used to analyse the efficiency of investment projects. Internal rate on return is the minimum profitability threshold of a project, below which it is not efficient. The formula for calculating the internal rate on return is:

$$RIR = rmin + (rmin + rmax) \times [VNA(+) / (VNA(+) + |VNA(-)|)]$$

where: RIR = internal rate on return; rmin = the minimum updated rate corresponding to the updated net income that is positive; rmax = the minimum updated rate corresponding to the updated net income that is negative;

VNA (+) = the positive value of the updated net income corresponding to the minimum updated rate;

VNA (-) = the negative value of the updated net income corresponding to the maximum updated rate;

VNA (-) | = the negative value of the updated net income corresponding to the maximum updated rate taken in module. It is recommended that the difference between rmin and rmax should not be greater than 5. The project selection criterion is represented by its value which must be higher or at least equal to the average interest rate on the market. The higher the internal rate on return, the more cost-effective the investment.[5]

Investment Recovery Duration (Dr) expresses the return on investment (expressed in years). Calculation formula: Dr = Vi / Pn average, where: Pn average = average net profit on the forecast horizon. Dr - must be maximum 10 years. The informative value of this indicator, in addition to the net updated value, is reduced. The merit of this indicator is to indirectly evaluate whether the projected net profit projections in the project are concentrated towards the end of the reference period (and are therefore affected by a higher uncertainty).[3]

RESULTS AND DISCUSSIONS

Sales volume

A 38% increase in sales revenue was estimated for year N+1 compared to year N, due to the opening of the new restaurant. In the year N + 2, a 100% increase in revenue compared to the year N was estimated as a result of service capacity doubling (the new restaurant is exploited throughout the entire year N + 2, compared with only 6 months in year N + 1). For the next two years (N + 3 and N + 4), an increase in the volume activity was anticipated, based on: the exploitation of the commercial frequented place, the allocation of additional amounts for advertising and publicity, the increase of the service capacity and the employment level (from 70% to 78%). The effect is the increase in revenue by 6% in N + 3 compared to N + 2 and by 5% in N + 4 compared to N + 3.

Sales of goods represent 27% of total turnover (2% - from catering activities and 25% - from the activity of restaurants). Due to the specificity of the activity, sales with returns under 30 days represent 100% of turnover.

Cost elements

The cost of the sold goods is kept at approx. 45% from goods sales and represents approx. 15% of the exploitation expenses. Expenditure on anticipated raw materials for the forecasted period represent approx. 57% from the total exploitation expenses. The level of indirect costs of the company is at approx. 11% of total exploitation expenses, and depreciation costs represent approx. 2.3% of the latter.

For implementing the project the entity will aquire a loan of 327,000 Euros, with a 3-year repayment plan at equal rates and interest calculated on the balance. It was considered a 6-month grace period.

Interest expenses matched according to the loan repayment schedule at a 12% interest rate:

Table 1. Expenses with the repayment of the loan for the first year (Lei)

Year N+1					
Explanation	**Trim. I**	**Trim. II**	**Trim. III**	**Trim. IV**	**Total**
Reimbursement	0	0	148,785	148,785	297,570
Interests	31,245	44,630	43,145	38,685	157,705
Annuities	**31,245**	**44,630**	**191,930**	**187,470**	**455,275**

Source: Own findings.

Table 2. Expenses with the repayment of the loan for the two year (Lei)

Explanation	**Year N+2**	**Year N+3**
Reimbursement	595,140	595,140
Interests	110,111	38,684
Annuities	**705,251**	**633,824**

Source: Own findings.

Table 3. Expenses with the repayment of the loan in EURO for the first year (Euro)

Year N+1					
Explicatie	**Trim. I**	**Trim. II**	**Trim. III**	**Trim. IV**	**Total**
Reimbursement	0	0	32.700	32.700	65400
Interests	6.867	9.809	9.482	8.502	34.660
Annuities	**6.867**	**9.809**	**42.182**	**41.202**	**100.060**

Source: Own findings.

Table 3. Expenses with the repayment of the loan in EURO for the two years

Explicatie	**Year N+2**	**Year N+3**
Reimbursement	130,800	130,800
Interests	24,200	8,502
Annuities	**155,000**	**139,302**

Source: Own findings.

Fixed assets and their depreciation:

The company holds, at the date of drawing up the plan, fixed assets, at a net value of 3,301,000 mil Lei (the real estate of the restaurant, three vehicles for the delivery of orders, kitchen equipment and furniture). By carrying out the planned investments, the value of the fixed assets will increase by 1,624,350 Lei in the year N + 1. The depreciation system adapted is the linear one, with the annual global amortization rate being approximately 4.6% of the book value.

Stocks

The value of stocks is small, given the specificity of the activity, thus causing a very high rotation speed. Their structure is represented by commodities (53%), raw materials (20%), finished products (10%), packaging (10%) and consumables (7%).

As a result of increased control over the quality of the ingredients used, a significant decrease in stock volume was anticipated.

Receivables

Receivables will have relatively small values and will mainly represent unincorporated rights from the companies to which catering services are provided. The specificity of the activity allows the recovery of receivables from clients in the vast majority of cases at terms less than 30 days from the invoicing date.

Cash availability level

As can be seen from the "cash flow calculation," it indicates a balanced situation at the level of treasury without account breakthroughs and without the danger of monetary imbalances during the forecast period. The annual treasury surplus is distributed to dividends.

Commercial credit policy

Achizitiile se vor face pe baza de contract, cu termene rezonabile de achitare a facturilor, avand in vedere relatiile deja consacrate cu furnizorii.

Acquisitions will be made on a contractual basis, with reasonable time limits for paying the invoices, taking into account the relationships already established with the suppliers.

Debts to the state budget

These are represented by the company's contributions and deductions from the salaries of employees for the CAS, health fund, unemployment, wage tax and other contributions.

All these company's contributions amount to approx. 22.60% of the wages fund, and the contribution of the employees to CAS, funds and taxes amounts to approx. 26.80% of the wage fund.

Profit tax

This item was calculated using a 16% tax rate for the entire forecasted period.

Dividends

As a result of the allocation policy of the expected cash surpluses, dividends distributed annually during the forecast period were calculated at 75% (in year N + 1), 60% (in year N + 2) and 100% (in the last 3 years) of the forecasted net profit.

Social capital

The amount of the social capital will remain constant during the 4 projected years (620,000 thousand Lei).

The break-even point and the sensitivity analysis:

Turnover at threshold calculation: [10]

CAN+1pr. = (CFN+1)/(MCFN+1%) = 2,611,900/28.8% = 9,055,480

where:

Capr = turnover at threshold,

CF = fixed costs,

MCV%= the ratio of the turnover margin on variable costs.

Given the volume of activity anticipated for the N + 1 exercise, the value thus obtained translates into a monthly turnover of 754,623 thousand Lei.

Determining the safety margin:

N+1 = CAN+1p – CAN+1pr =
24,004,396 – 9,055,480 = 14,948,916 lei,

where:

CAp = expected turnover,
CApr = turnover at threshold.

This indicator expresses the risk degree of the exploitation. The higher its value is, the lower the risk is, or in other words, the exploitation activity is further from the minimum profitability level (zero profit). [8]

In the case of the N + 1 exercise, the indicator highlights a favorable situation, with the expected turnover exceeding the profitability threshold with approx. 165%

For the entire forecast period, the evolution of the safety margin is presented in Table 4.

Table 4. The evolution of expected turnover, turnover at threshold and safety margin (Thousand Lei)

Explanations	N+1	N+2	N+3	N+4	N+5
Expected turnover	24,004,396	38,810,000	36,898,600	38,743,530	38,743,530
Turnover at threshold	9,055,480	9,441,335	10,120,867	10,562,546	10,723,150
Safety margin	**14,948,916**	**25,368,665**	**26,777,733**	**26,180,984**	**28,020,380**

Source: Own findings.

For the sensitivity analysis we have identified the following scenarios:

A 25% increase in the meat price, generates a 15% increase in the company's variable costs.

Under these conditions, turnover at threshold reaches the level of 14,374,947 thousand Lei, with the following effects:

- diminishing the turnover margin on the variable expenses by 2,562,110 thousand Lei;
- diminishing the safety margin by 5,319,467 thousand Lei, its value in this situation being 9,629,449 thousand Lei;
- a decrease in the Profit from Exploitation Margin (MPE) from 17.96% to 9.96% and Return on Investment (ROI) from 48.12% to 11.92%.

In this variant the forecast turnover will exceed the profitability threshold by only 67%.

According to the current trends, it is anticipated that additional taxes on real estates will be introduced, this would lead to a 15% increase in fixed expenses.

Automatically an increase in turnover at threshold will take place up to the value of 10,413,802 thousand Lei. Such a hypothesis will also increase the risk of exploitation, but with a lower negative effect than the one caused by the increase in variable expenditures:

- the reduction of the safety margin by 1,358,322 thousand Lei, its effective value being of 13,590,594 thousand Lei.
- a decrease in the Profit from Exploitation Margin (MPE) from 17.96% to 16.74% and Return on Investment (ROI) from 48.12% to 42.58%.

In this hypothesis, the predicted turnover exceeds the critical point by 131%.

In order to obtain a profit of 10% higher than the anticipated value for the year N + 1, it is

necessary to stimulate an increased turnover, situation defined by:
- the increase of the safety interval by 1,494,891 thousand Lei, its value reaching 16,443,807 thousand Lei;
- an increase in the Profit from Exploitation Margin (MPE) from 17.96% to 18.11% and in the Return on Investment (ROI) from 48.12% to 54.21%.

For this scenario the calculations lead us to a turnover value of 25,499,287 thousand Lei, with approx. 6% higher than predicted.

Investment project evaluation indicators

Determining the Internal Financial Profitability Ratio (RIR)

This indicator was determined by considering a 10-year investment period and represents that value of the discount rate for which the net updated value is zero. [4]

As a result of the calculations, the discount rate for which the updated value of the net income is zero, is in the range 41% - 42%. According to the calculations, the most appropriate value of RIR is 42%.

Determining the net present value of the project

For the calculation of this indicator for an economic lifetime of the project of 10-years, a discount rate of 19% (consisting of 12% - the average interest rate on foreign currency loans and 7% - the risk factor for the realised projections) was used.

The calculations lead to a VAN of 9,168,106 thousand Lei by updating the net cash flows of the investment project at the above rate.

We mention that the financial projections are based on an approach of the business evolution in constant prices (those existing at the date when this business plan was drawn up).

Investment recovery period

The recovery term expresses the time required to recover the invested capital through the updated annual average net cash inflows generated by the project. [2]

The results lead to a recovery period of approx. 6.2 years which is considered to be good, compared to the lifetime of the project, which is at least 10 years.

CONCLUSIONS

After several calculations we have the following results:
• a monthly threshold turnover of 754,623 lei;
•the forecasted turnover exceeds the profitability threshold with approx. 165%
• the value of RIR is 42%;
• a VAN of 9,168,106 lei through the cashflow update;
• recovery period of approx. 6.2 years.

Managers use several methods and indicators when evaluating a project. The analyzes performed can help refine the results obtained, giving the management an explicit insight into the value / loss generating sources of a project. Determining and correctly interpreting the investment project evaluation indicators represents a major competitive advantage.

REFERENCES

[1]Cristea, H., 1997, Contabilitatea şi Calculaţiile în Conducerea Întreprinderii Ed. Mirton Timişoara, pp. 390
[2]Gennaioli, N., Ma, Y., Shleifer, A., 2015, Expectations and investment, National Bureau Of Economic Research Working Paper Series issued in June 2015, Cambridge, pp.158
[3]Grigorescu Adriana, 2008, Practica Managementului Proiectelor, Ed. Uranus, Bucuresti, pp. 91
[4]Kplan Schweser, 2009, Inc Financial Reporting and Analysis, and Corporate Finance, Level 2, CFA, pp.75
[5]McCollum James K., Bănacu, C.S., 2007, Management de Proiect, Ed., Universitară, București, 2007, pp.383, 379
[6]Miles, W., 2009, Irreversibility, Uncertainty and Housing Investment, Journal of Real Estate Finan Econ, 38, 173–182.
[7]Niculescu, M., 1997, Diagnostic strategic global, Ed. Economica, 1997, pp.229
[8]Prunea Petru, 2003, Riscul în activitatea economică. Ipostaze. Factori. Modalităţi de reducere, Editura Economică, Bucureşti, pp.86.
[9]Robu, V., Isfanescu, A., Hristea, A.M., Vasilescu, C., 2002, Analiza economico – financiara, Ed. ASE, pp.57.
[10]Tanase, M., Caratus-Stanciu, M., 2016, Organic Farming In Sibiu County, Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 16, Issue 4, 2016, 375-378.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

SPECIFIC METHODS APPLIED WITHIN THE STRATEGY FOR SUSTAINABLE DEVELOPMENT OF AGRICULTURAL EXPLOITATIONS

Daniela SIMTION

Lucian Blaga University, Faculty for Agricultural Sciences, Food Industry and Environmental Protection, 7-9, Dr. Ion Raţiu, Sibiu, Romania, Mobile: +40721435221, Email: simtiondaniela@yahoo.com

Corresponding author: simtiondaniela@yahoo.com

Abstract

In order to obtain quality products, it is necessary to approach the components of plant culture systems in a unitary way. The methodology proposed in this paper takes into account the influence of all factors and the interaction between them, the solutions obtained comprising both elements that characterize the system of culture as a whole and elements that characterize its component parts. The strategy concept to be proposed is based on the realization of the concentration and specialization of agricultural production on the dimensions of a rational exploitation of the land under the conditions of real privatization. In fact, strategy is a therapy that, if operated in a sick social - economic environment like our current agriculture, can have catastrophic effects, without prior diagnosis or misdiagnosis, or on the contrary it proves to be beneficial when it is being fundamentally administered. Human decisions that engage the future cannot be inspired by a single methodology or mathematical calculus; in this sense Keynes said: We assume perfect predictions in analysis. But we know that the forecast is actually imperfect according to Keynes.

Key words: *agriculture, concentration, efficient, result, process*

INTRODUCTION

The fundamental problem of Romania's agriculture is that of agricultural production growth in the structure, quantity and efficiency determined by the land, investment and human potential that this branch of the national economy has. [7]

Organizing efficient production structures is a must for all types and forms of agricultural units, but especially for those producing for the market; especially under the requirements of the European Union that aquire the establishment of a rational structure of the Romanian agricultural production in order to orientate the agricultural profile of the training exploitations.

The production structure is organized in the process of adapting to the market requirements and the restrictions imposed by the natural environment, also induced by the peculiarities of the specialization, diversification and joining of the branches.

Given the particularities of agriculture, whether technical or economic, we find that the factors that require a diversified, even complex structure of production, obviously at a level of its development and the conditions of a particular agrarian policy, are numerous, with a strong influence and of an objective nature, such as: the attenuation of the seasonal nature of agricultural production (the inconsistency between working time and production time, especially in the field of plant culture where a series of natural processes are taking place); the efficient use of fixed and circulating capital components; the full use of the exploitation’s workforce or of the employed one; organizing crop rotation, knowing their influence on the level of production; capitalizing on the productive potential of land capital; the capitalization of secondary crop production by animal husbandry; combat or at least mitigate effects of risk and uncertainty; protecting the natural environment and maintaining the ecological balance, avoiding the pollution of soil, groundwater, and products.

Concentration of agricultural production as a direction of the scientific organization of the productive activity in agriculture represents, in the current conditions of the technical progress, an objective necessity, characteristic for the development of agriculture.

Concentration of agricultural production is a result of the concentration of production factors on the same land area. This process takes place in all branches of agriculture and in all agricultural exploitations.

In plant production the concentration of production is achieved both by increasing the areas cultivated with certain plants, but also by reducing the exploitations cultivating such plants.

MATERIALS AND METHODS

It has been demonstrated that not every level of production concentration can ensure a proper increase in yields and economic efficiency. The issue is to determine the optimal degree of production concentration, both at the level of the production branch, but also at the level of agricultural holdings. One of the ways of determining the level of concentration is that of O. Onicescu [9], which is based on the formula:

$$G_c = \sum_{i=1}^{n} f_i^{\,2}$$

where:

G_c = concentration degree;
f_i = share of the branch;
$f_i^{\,2}$ = concentration coefficient of each branch.

In order to determine the degree of concentration in the specialty literature we come across numerous indicators used for this purpose, each of which has a different sensitivity depending on the phenomenon studied [3] and therefore a great attention is needed when choosing the convenient indicator. [6]

A synthetic indicator of both the level of production concentration and the evolution of the agricultural production concentration process is the concentration coefficient calculated by the formula of C. Gini [2]:

$$C = \sqrt{\frac{n \cdot c2 - 1}{n - 1}}$$

where

$$c^2 = \sum a^2$$

and

$$\frac{Xi}{X} = a$$

in which
c = the concentration coefficient;
n = the number of groups;
Xi = the number of participants in group i;
X = the total number of participants.

RESULTS AND DISCUSSIONS

Using the above relationship we can calculate the concentration coefficient in the plant production on the level of the whole country.

Table 1. Grouping the individual agricultural holdings by size class

Year	Total	Size classes of agricultural holdings (ha)					
		<0.5	0.5-1	1-3	3-5	5-10	> 10
N-5	3,419,736	115,077	1,154,712	1,289,420	529264	330,364	899
N	3,960,332	445,405	1,027,494	1,355,695	693,354	426,010	12,374

Source: Own findings based on the data provided by the National Institute of Statistics.

Starting from the primary data and using the intermediate data shown in Table 2, we finally obtained:

C_{N-5} = 38.5%
C_N = 29.5%

These values illustrate the level of production concentration in the two years.

Analyzing the evolution over time of the concentration trend based on the same data shows that the degree of concentration in the agricultural exploitations surveyed decreased in exercise N compared to N-1 by 21.9%.

There is a trend contrary to Western European agriculture, where the production

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

concentration process has a high amplitude.
Concentration and specialization of agricultural production, in the conditions of intensification and diversification of the market economy, raises the question of the optimal size of the agricultural exploitation - one of the most important problems of modern agriculture.

Tabel 2. Intermediate values

Size classes of holdings	N-5		N	
	$\frac{Xi}{X}=a$	a^2	$\frac{Xi}{X}=a$	a^2
<0.5	0.033	0.00108	0.112	0.01264
0.5-1	0.337	0.11356	0.259	0.06731
1-3	0.37	0.14212	0.342	0.11718
3-5	0.156	0.02433	0.175	0.03065
5-10	0.096	0.00921	0.107	0.01157
> 10	0.001	0.00000	0.003124	0.00000
Total	**1.000**	**0.2903**	**1.000**	**0.23935**

Source: Own findings based on the data provided by the National Institute of Statistics.

The optimal size of an agricultural exploitation expresses the level at which production concentration can reach under maximum efficiency conditions. If the concentration process expresses the objective process of combining production on exploitations, the optimal size of the exploitation indicates between what limits (minimum and maximum) must the level of production concentration be set, the extent to which it should be grown on branches and sub-branches, in oreder to obtain large economic impacts, through the full use of existing technical and geoclimatic conditions, through the superior organization of production and labor [8].
Due to the changes in the structure of agricultural property and due to the complexity and the extremely different and concrete situation in which it has to be solved, the issue of rational sizing and the optimal size of agricultural exploitations becomes one of the most current problems of concentration and specialization of agricultural production .
In close connection with the size of the agricultural exploitation, its profile and specialization is also the optimal crop structure subsystem. Like the system as a whole, the structure of cultures, which plays a very important role in the way in which it manifests and in the results it generates, it is influenced by natural, economic, technical, technological factors, etc. An optimal crop structure must satisfy in a simultaneity relationship several requirements: to offer products that qualitatively and quantitatively meet demand, to value and protect the natural conditions and other factors of production, to allow the organization of the crop and to ensure an acceptable profit (in the current context of sustainable development, the notion of the optimal profit is transformed, with the preference of the suboptimal profit that allows the achievement of both ecological and social efficiency), allowing the entrepreneur a real economic growth [1].

CONCLUSIONS

Under the current conditions, in which it becomes more and more important to obtain quality agricultural products, it is necessary to approach the components of plant culture systems in a unitary way.
Starting from this point, the basic feature of the proposed methodology for optimization is the complex approach of the plant culture system, whose functionality is determined by a number of factors.
This methodology allows to take into account the influence of all factors and the interaction between them, the solutions obtained comprising both elements that characterize the system of culture as a whole and elements that characterize its component parts. The steps to be taken in this case are presented in Fig.1.
For the delimitation of the territory of the agricultural holding in homogeneous parcels with different productive potential, the economic appreciation of the land is used. In our country, the method of economic assessment of land developed by the Research Institute for Pedology and Agrochemistry is being used. In this sense, the economic appreciation is made on the land plots of the analyzed units. [10]
All parcels offering crops the same class of favorability are grouped together in a single plot, called unit plot [5]. In the present paper, I do not consider it necessary to present the

methodology of land consolidation, a complex action that has been carried out by specialists in this matter, however, it should be emphasized that the good knowledge of the favorability class of each plot provides the necessary information regarding the capacity of land production, necessary for the rational layout of crops.

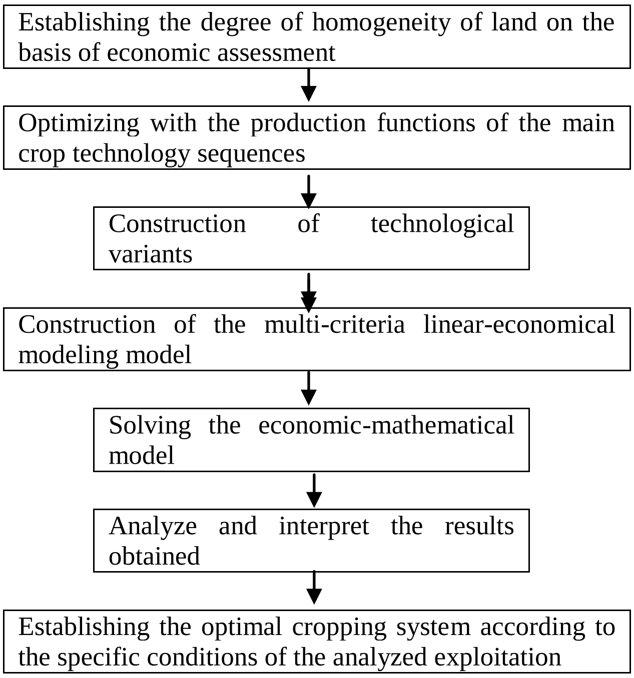


Fig.1. The Scheme for Economic Optimization of the Plant Culture System
Source: Hălmăjan, V., 1984, Metode şi tehnici moderne de amplasare a culturilor în unităţile agricole, Ed. Ceres, Bucureşti, pp.203 [5].

It is to be said, however, that only the homogeneity or inhomogeneity of the land is taken into account when establishing the optimization methodology of the plant cultivation system, the importance of the number of existing units is not being taken into account.

The main sequences of crop technology that lend themselves to optimization with the help of production functions are fertilization and herbicide, the methodology of optimization is similar. Regardless of the technological sequence to which we refer and the number of resources taken into study, to optimize the allocation of resources through production functions, the following steps must be taken:

-determining the sequences to be optimized;
-collecting data;
-statistical processing of collected data;
-choosing the type of function and testing it;
-solving production functions;
-establishing doses corresponding to the technical maximum and economic optimum

The construction of technological variants starts from the previously optimized sequences with the production functions help, considering that too many differentiation criteria are not being used in order not to increase the dimensions of the models too much: it is appropriate to vary only those sequences that require increased economic effort and which substantially influence the level of production and economic efficiency. These are followed:

-establishing the differentiation criteria;
-building technological variants;
-calculation of technical and economic indicators of built-up variants.

REFERENCES

[1]Gavrilescu, D., Giurcă D. (coord.), 2000, Economie agroalimentară, Ed. Expert/Ed.Bioterra, Bucureşti, pp.63.

[2]Gini, C., 1912, Variabilità e mutabilità Variability and Mutability, C. Cuppini, Bologna: 156. Reprinted in Memorie di metodologica statistica (Ed. Pizetti E, Salvemini, T). Rome: Libreria Eredi Virgilio Veschi, 1955.

[3]Hamphrey, T., 1996, Algebraic Production Functions and Their Uses Before Cobb – Douglas, pp. 108.

[4] Keynes, J.M., 1931, Tratat asupra banilor, Londra, pp.132

[5]Hălmăjan, V., 1984, Metode şi tehnici moderne de amplasare a culturilor în unităţile agricole, Ed. Ceres, Bucureşti, pp.203

[6]Iosif, Gh. N., 2000, Analiza economico – financiară a firmei în domeniul agroalimentar, Ed. Tribuna Economică, pp. 145.

[7]Leviel, B., 2000, Evaluation of risks and monitoring of nitrogen fluxes at the crop level on the Romanian and Bulgarian plain. Application to maize, wheat, rapeseed and sugar beet, PhD Thesis, pp. 93.

[8]Nastase, M., 1999, Dimensiunea optima a exploatatiilor agricole, Ed.Chrater B, Bucuresti, pp.59-96

[9]Onicescu, O., Mihoc, G., 1966, Energia informaţională, Studii şi Cercetări Matematice, pp.126

[10]Voicu, R., 2000, Economia si managementul exploatatiilor agricole, Ed. Tribuna Economica, pp. 309.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ROMANIAN TRADE WITH POTATOES IN THE EUROPEAN UNION CONTEXT

Bianca Eugenia SOARE

Bucharest University of Economic Studies, Faculty of Agrifood and Environmental Economics, 010961, 5-7 Mihail Moxa Street, 1st district, Bucharest, Romania, phone: 021 311 97 90 /112, Email: soare_bianca14@yahoo.com

Corresponding author: soare_bianca14@yahoo.com

Abstract

The scope of this study was to highlight Romania's position within the existing community context, in the period 2011-2016. Thus it is noted that our country obtained only 5.53*% of total community production that is 3,123,363.33 t compared to 56,439,851.67 t in the EU, it achieved 0.07% of the value of exports ($ 1,721.17 compared to $ 2,645,692.33 in the EU, its import value accounts for 1.13% of the EU potato import value, that is* $ 26461.50 compared to $ 2347447.83. *The national trade balance for potatoes is deficient, similar with the European Union situation. Romania can improve its production and international trade results through appropriate measures to support the respective production sector (i.e. potato production).*

Key words**:** *potatoes, production, import, export, trade balance, Romania*

INTRODUCTION

The importance of potato production for Romania derives from the following aspects: it is basic food in daily nourishment, human consumption being estimated at approximately 90 kg/inhabitant; potatoes can be kept for a long time in the winter; occupies one of the first places in terms of caloric energy consumption; it has high energy potential; potatoes are also used in animal feed [5].
Potato production it is important for many sectors such as food, industrial, agro-technological, fodder. It is a source of export and profit. The export includes early and extra time potatoes kept in qualitative conditions that give them competitiveness. Also it can be exported as food products resulting from the industrial processing of potatoes. By knowing the external market parameters effectively, potatoes can attract significant currencies [10].
Potato ranks fourth in production volume on food crops in the world (after rice, wheat and maize). The three main producers are China, Russia and India. Romania is also a major producer of potatoes in Eastern Europe, it produces about 4 million tonnes per year [13].
Adoption of best practice systems for production and management of systems for monitoring the technical and economic results, with innovative approaches, will ensure the proper functioning of the agri-food chain, and implicitly market competitiveness [3].
International trade allows manufacturers and distributors to search products, services, and components produced in foreign countries. Companies acquire them because of cost advantages or advanced technical methods used abroad such as methods that reduce the cost of production, lower prices, induce more consumption thus leading to increased profit [11].
Nationwide potatoes production is a key component for the market because the demand for this product is large, Romanian people being big consumers [12].
Foreign trade exerts an important influence on economic growth [6]. Trade balance is a component part of the current transactions balance [2].
The purpose of the study was to analyse the situation of potato trade in Romania compared to the European Union in recent years.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

MATERIALS AND METHODS

The information required for writing the paper was gathered by accessing databases with increased visibility [15; 16]. The indicators used are: total production (t), export (t and thousands USD), import (t and thousands USD) and trade balance (export value-import value). The studied period is 2011 - 2016, and for the construction of the dynamic series the average of the period was also calculated.
The methods used in the study were the documentation, the comparison, the percentage method. The time comparison was performed using the mobile base indices calculated with the formula:
$I_{bm} = (y_n/y_{n-1})100$,
where: y_n - the level of the indicator for the variable to be compared; y_{n-1} - the level of the indicator for the reference variable [9].
The comparison in space of the used indicators followed the reporting of the Romanian level at the European Union level.

RESULTS AND DISCUSSIONS

Romania is among the first 20 potato producers in the world. It is, also, one of the few European countries where the potato production has increased - from 2.8 million tons in 1961 to approximately 4 million tons in 2005, reaching in 2010 at 3.2 million tons [1].
In order to carry out a comprehensive analysis of the Romanian trade with potatoes, it is considered necessary to present the situation of total production at national level in the studied period. Also, for a more conclusive analysis, the Romanian economic reality is presented in the context in which Romania is a component part of the European Union. Romania had an agricultural potential of 6,45 million hectares arable land at the level of the year 2013 [8].
In Table 1 it is presented the evolution of potato production at national and European Union level.

Table 1. Potato production in Romania and European Union, 2011 - 2016 (kg)

Year	Specification	Romania	European Union
2011	T.*	4,076,570	62,651,700
	% total Europe**	6.51	-
2012	T.*	2,465,150	53,919,930
	2012/2011** (%)	60.47	86.06
	% total Europe**	4.57	-
2013	T.*	3,289,720	53,881,400
	2013/2012** (%)	133.45	99.93
	% total Europe**	6.11	-
2014	T.*	3,519,330	59,035,570
	2014/2013** (%)	106.98	-
	% total Europe**	5.96	109.57
2015	T.*	2,699,680	53,238,320
	2015/2014** (%)	76.71	90.18
	% total Europe**	5.07	-
2016	T.*	2,689,730	55,912,190
	2016/2015** (%)	99.63	105.02
	% total Europe**	4.81	-
Average **	T.**	3,123,363.33	56,439,851.67
	Average/2016** (%)	116.2	100.94
	% total Europe**	5.53	-

Sources: *Eurostat; ** own calculation

At national level, total potato production varied between 2.46 million tons in 2012 and 4.07 million tons in 2011, and the average of the period studied reached 3.12 million tons. The dynamics of the indicator highlights subunit values of component indices (between

60.47% in 2012 and 76.71% in 2015) as well as supraunitary values in 2013 of 133.45% and 106.98% in 2014.

The average of the period was also supraunitary 116.2% (Figure 1).

The European Union achieved an average of 56.4 million tons, a higher level of only 0.94% compared to the reference period (2016 when there were produced 55.9 million tons).

The variation limits for the indicator were 53.2 million tons and 62,6 million tons for the years 2015 and 2011 respectively. The dynamics of the indicator shows decreases compared with the reporting base in 2012 (-13.94%, at a level of 53.9 million tons of potatoes produced) and -9.82% in 2015. It can be seen increases with 9.57% in 2014 and 5.02% in 2016.

In the context of belonging to the European Union, Romania achieved only 5.53% of the community potato production (the average of the period). This average contribution is based on annual sequential levels of the Romanian contribution to total European Union production of: 6.51% in 2011, 4.57%, 6.11% in 2012 and 2013, 5.96%, 5.07% and 4.81%, 2014, 2015 and 2016.

The European Union focuses on free trade at the level of the community economic policy. Free markets generate economic growth and more and better jobs for Europe and its country partners. The Union encourages developing countries to use trade to improve their own economies and living standards [7].

Table 2 presents the situation related to Romanian and European Union potato exports.

Concerning the value of the Romanian potato exports, it had variation limits of $ 235 thousand in 2015 and $ 3,658 thousand in 2013, and the average of the period was $ 1,721.17 thousand.

The dynamics of the indicator comprises mostly sub-unit levels of component indices (32.68% for 2012 and 39.53 % for 2014, the lowest being 16.25 in 2015), and a higher level for 2013 with 341.23% followed also by 2016 with 270.64% (Table 2) and 270.62% for the average of the period respectively.

Table 2. Export of potatoes, 2011–2013, (USD thousand)

Year	Specification	Romania	European Union	% Romania towards Europe
Value aspects				
2011	Th. $*	3,280	3,062,463	0.11
2012	Th. $*	1,072	2,345,604	0.05
	2012/2011** (%)	32.68	76.59	-
2013	Th. $*	3,658	3,343,996	0.11
	2013/2012** (%)	341.23	142.56	-
2014	Th. $*	1446	2,497,371	0.06
	2014/2013** (%)	39.53	74.68	-
2015	Th. $*	235	2,089,454	0.01
	2015/2014** (%)	16.25	83.67	-
2016	Th. $*	636	2,535,266	0.03
	2016/2015** (%)	270.64	121.34	-
Average**	Th. $	1,721.17	2,645,692.33	0.07
	Average/2016 (%)	270.62	104.36	-

Source: *intracen.org; **own calculation

European Union recorded an average value of exports of $ 2.64 million (+4.36% in dynamics).

This fact was determined by the annual export values ranging from $ 2.08 million in 2015 to $ 3.34 million in 2013.

As a result of this situation, the components indices of the dynamics were between 74.68% in 2014 and 142.56% in 2013 and respectively 104.36% for the average of the period (Figure 1).

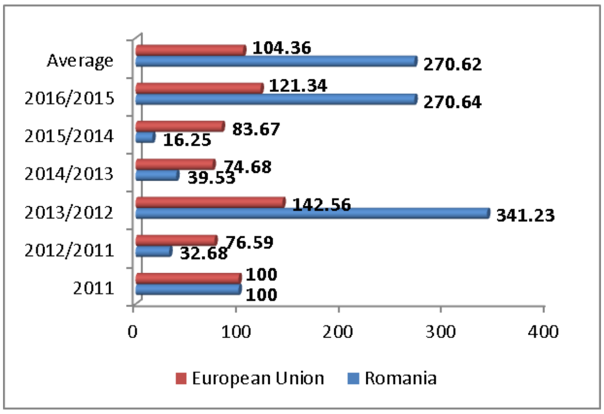


Fig. 1. Export of potatoes (Th. $) - dynamic (%)
Source: own calculation based on data available at www.intracen.org

Table 3 refers to the import trade operations carried out by Romania and European Union.

In terms of value, Romania achieved shares between 0.82% in 2013 and 1.55% of imports in 2016 compared to European Union. The

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

share for the average of the period was 1.13% of the total European Union potato imports.

Romanian potato imports registered the highest value of $ 36,539 thousand in 2016 (+217.75%), followed in decreasing order by year 2011 with $33,110, then 2014 with $ 25,901 thousand (having a little increase of 100.19%), and 2013 with a value of $ 25,853 thousand (+125.59%).

Table 3. Import of potatoes (2011–2013)

Year	Specification	Romania	European Union	% Romania towards European Union
Value aspects				
2011	Th. $*	33,110	2,557,090	1,29
2012	Th. $*	20,586	2,100,004	0,98
	2012/2011** (%)	62.17	82.12	-
2013	Th. $*	25,853	3,162,309	0,82
	2013/2012** (%)	125.59	150.59	-
2014	Th. $*	25,901	2,096,750	1,24
	2014/2013** (%)	100.19	66.30	-
2015	Th. $*	16,780	1,807,953	0,93
	2015/2014** (%)	64.79	86.23	-
2016	Th. $*	36,539	2,360,581	1,55
	2016/2015** (%)	217.75	130.57	-
Avg **	Th. $	26,461.50	2,347,447.83	1,13
	Average/2016 (%)	72.42	99.44	-

Source: *Intracen.org; **own calculation

The average of the period registered $ 26,461.50 thousand (- 27.58% compared to the previous term of the dynamic series - Figure 2). It is noticed that in 2016 the value of potato imports has doubled compared to 2015. This may be due to declining crop areas, from 242,636 ha in 2011, to 2016 at 182,239 ha [15]. Some authors consider that Romania is an importing country of potatoes[4].

At European Union level there is an average import value of $ 2.34 million, with limits of $ 1.80 million in 2015 and $ 3.16 million in 2013. The dynamics of the indicator contains two supra-unitary values (150.59% in 2013 and 130.57% in 2016) and three subunit values (82.12%, 66.30% and 86.23% in 2012, 2014, 2015), the average of the period being 99.44% (Figure 2).

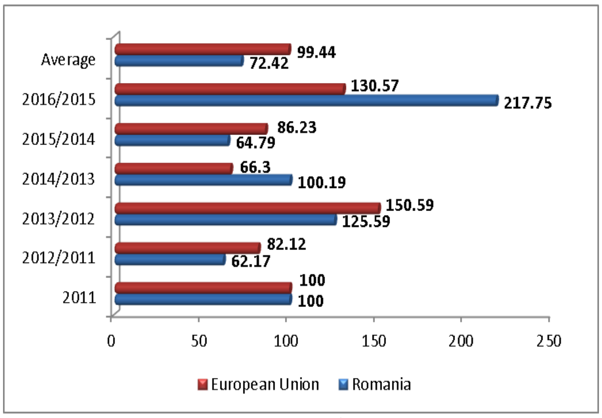


Fig. 2. Import of potatoes (Th. $) - dynamic (%)
Source: own calculation with data from Intracen.org

Table 4. Balance of foreign trade at potatoes - thousands $ in the studied period *own calculation

Year	Specification	Export	Import	±	% Romania towards European Union
2011	Romania	3,280	33,110	-298,30	-5.90
	E. U	3,062,463	2,557,090	505,373	
2012	Romania	1,072	20,586	-19,514	-7.95
	E. U.	2,345,604	2,100,004	245,600	
2013	Romania	3,658	25,853	-22,195	-12.22
	E. U.	3,343,996	3,162,309	181,687	
2014	Romania	1446	25,901	-24,455	-6.10
	E. U.	2,497,371	2,096,750	400,621	
2015	Romania	235	16,780	-16,545	-5.88
	E. U.	2,089,454	1,807,953	281,501	
2016	Romania	636	36,539	-35,903	-20.55
	E. U.	2,535,266	2,360,581	174,685	
Average	Romania	1,721.17	26,461.50	-24,740,33	-8.30
	E. U.	2,645,692.33	2,347,447.83	298,244,50	-

Source: Own calculation.

After 2000, Romania is characterized by a deficitary trade balance for potatoes. In the period 2001-2007, the trade balance for potatoes was deficient, mainly due to imports of potatoes from Poland and Greece [14].

The trade balance situation for potatoes in the period taken in study is presented in Table 4 and Fig.3.

Thus, in 2011, Romania registered trade deficits ($ -29,439 thousand). Romania held 5.90% of the deficit of the European Union trade.

For 2012, Romania achieved a deficit of -7.95% in the European Union trade ($ -19,514 thousand compared to the surplus of $ 245,600 thousand in European Union).

In year 2013, the trade balance deficit is maintained at the national level -22,195 thousand dollars while the European Union level registered a surplus of $ 181,687 thousand respectively.

The Romanian share of deficit was -12.22% at the level of the European Union. In the years 2014 and 2015 there was also a trade deficit in the share of -6.1% and -5.88%, respectively.

The highest deficit Romania has held was in 2016 when it amounted -35,903 thousand dollars, which represents a share of -20.55% at community level.

If we refer to the recorded situation for the average of the period there are found deficits of $ -24,740 and $ 298,244 thousand for Romania and for European Union respectively. Romania has -8.30% deficit in the overall level of the community trade balance. This deficitary balance can be explained by the reduction of the potato areas and the unfavorable evolution of the sales price [15].

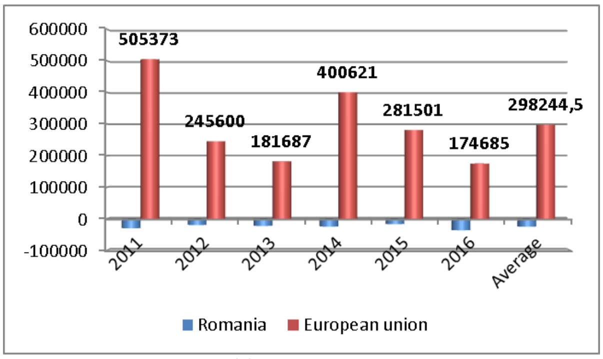


Fig. 3. The trade balance of foreign trade (USD thousands)

CONCLUSIONS

In terms of total production, it can be seen the non-uniform evolution for the national situation and European Union with downward trend. Romania's contribution to total community production is 5.53% below the average contribution rate under the existing potential. As a result, appropriate measures are needed to support this sector of activity.

The evolution of Romanian and European Union exports is fluctuating in terms of value. Romania exported only 0.07% of national production compared to European Union. As a result, it can be concluded that the Romanian potato producers have to pursue the improvement of the qualitative parameters necessary for the exports.

Regarding the evolution of Romanian potato imports is also fluctuant with upward aspects regarding the value (negative aspect). At the community level, the trend of imports is also fluctuant in terms of value. The Romanian potato imports were at 1.13% compared to the total community production.

The trade balance is strictly deficient at national level and has a surplus at European Union level. For a high economy (higher incomes from potato exports) Romania needs to become competitive at European level.

REFERENCES

[1] Alecu, I. N., Szabo, G., Nagy, C., Angelescu, C., Baciu, G. A., 2015, Comparative issues on the evolution of potato-growing areas and of crops obtained in Romania and in other European countries. Agrarian Economy and Rural Development - Realities and Perspectives for Romania, the 6th edition, pp. 200-207

[2]Bari, I., 1997, Economia mondială, Editura Didactică și Pedagogică R. A., București, 22: 619-642

[3] Boboc, D., Popescu, G., Stoian, M., Lădaru, G.R., Petrache, D.C., 2017, Best Practices for Integrating the Romanian Small Farmers into the AgriFood Chain. Amfiteatru Economic, 19(44): 315-326.

[4] Bularca, E. C., Nicolae, D., Draghici, M., 2013, The Statistical Indicators of potato produced In Romania. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 13, 4: 69-72

[5]Constatin, M., Chiran, A., Funar, S., Drăghici, M., Frone, F., Pânzaru, L., Peț, E., Gându, E., Alecu, I., Chihaia, A., 2009, Marketingul producției agroalimentare, Ed. Agrotehnica, București, 15: 341-402

[6]Crețoiu, G., Cornescu, V., Bucur, I., 1993, Economie politică, Ed. a II-a, Casa de editură și presă

Șansa S.R.L., București, 23: 401-428

[7] Lamaj, J., 2015, The Impact Of International Trade And Competition Market On Developing Countries, Proceedings of Managing Intellectual Capital and Innovation for Sustainable and Inclusive Society, 27-29 May 2015, Bari, Italy, 1533-1540. http://www.toknowpress.net/ISBN/978-961-6914-13-0/papers/ML15-306.pdf, Accessed January 21, 2018.

[8]Marcu, N., Cristea, M., Meghisan, M., 2015, Economic Performance Analysis Of The Romanian Agriculture. In 2nd International Multidisciplinary Scientific Conference on Social Sciences and Arts SGEM2015, Book 2, Vol. 3, No. SGEM2015 Conference Proceedings, http://www.citeulike.org/group/19359/article/1388069, Accessed January 20, 2018.

[9]Pânzaru, R.L., Medelete, D.M., 2005, Economie agrară - aplicații, Editura Universitaria, Craiova, 2: 11-18

[10]Pânzaru, R.L., Medelete, D.M., Ștefan, G, 2009, Economia producției vegetale, Editura Universitaria, Craiova, 3: 141-188

[11]Seyoum, B., 2009, Export-Import Theory, Practices and Procedures.2d Edition, Routledge, New York, London

[12]Soare, E., 2015, Study on Potato Market in Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 15 (3): 283-288

[13]Vlad, G. H., Done, C. M., 2014, Potato Crop Evolution in Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 14, (1):395-398

[14]Zahiu, L., Toma E., Dachin, A., Alexandri C., Aileni, D., Alboiu, C., Angelescu, C., Molănescu, G., Grodea, M., Huru, D., Iuliana, I., Luca, L., Moldovan, M., Socol, A., Socol, C., 2010, Agricultura în economia României între așteptări și realități, Ed. Ceres, București, 3: 58-96

[15] www.insse.ro, Accessed January 10, 2018

[16] www.intracen.org, Accessed January 10, 2018.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

TRENDS IN THE PRODUCTION AND MARKETING OF APPLES IN ROMANIA

Elena SOARE, Irina-Adriana CHIURCIU

University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +40213182564, Fax:+40213182888, Mobile:+40744 6474 10, Emails: soare.elenausamv@gmail.com; irina.chiurciu@yahoo.com

Corresponding author: soare.elenausamv@gmail.com

Abstract

The paper presents the main tendencies in the production and marketing of apples in Romania during 2012-2016. In order to carry out the present study, a number of indicators were analyzed: the number of apple trees from the national category and from the development regions of Romania; total apple production; average production per apple tree; average price for table apples; average annual apple consumption per capita; imports and exports of apples. Currently, Romania ranks second in terms of apple cultivated area and seventh in terms of apple production at EU level. The data used in the present paper was taken from the National Institute of Statistics and also from specialized international sites. The main tendencies in the production and marketing of apples were highlighted, especially from a quantitative point of view. In this regard, the changes that have occurred from one year to the next have been followed. Since there is a high potential for developing the apple production and marketing sector in Romania, a series of measures are required at both macroeconomic and microeconomic level.

Key words**:** apples, total apple production, imports, exports, Romania

INTRODUCTION

Nowadays, a greater importance is given to the production and marketing of fruits, both globally and nationally. The importance of fruits is due, on the one hand, to increased nutrient content, and on the other hand, the fruit culture generally does not harm the environment [14].

Apple is a very important food for the health of the population. The apple is composed of the following elements: water; tannin; organic acids; minerals; pectin and a series of vitamins. Nowadays, along with oranges and bananas, apples are among the most appreciated and consumed fruits globally. The apple is a low-calorie food with a significant amount of soluble fiber. In this sense, constant consumption of apples helps to maintain the health of the population. The apple (Malus Domestica Borkh) belongs to the Rosaceae family, the Pomoideae subfamily, having over 7,500 apple species globally [1, 13, 15].

Apples are grown in over 80 countries around the world. It is important to remember that in Europe the apple is grown on a large scale in more than 30 countries. In other words, over 37.5% of the countries where apples are grown are found in Europe. The major producers of apples in the European Union are: Poland; France; Italy; Germany; Spain; Hungary; Romania, etc. In our country there are a number of factors contributing to the production of apples, of which the most representative are: favorable climate for apple crop; high quality soil; tradition in apple culture; qualified experts in apple culture; high-quality varieties [2, 6, 14, 17].

In Romania, the production is much lower compared to the ones produced in the main apple-producing countries. For example, in 2016, Poland obtained an apple production of 3,604 thousand tons, compared to 467 thousand tons in Romania. Although significant quantities of apples and other fruit categories are produced at EU level, we are witnessing a low fruit consumption in over 50% of countries. In general, fruit consumption is determined by several factors: the market price for apples; the degree of information on the qualities and benefits of apple consumption; population incomes; age; sex; education in apple consumption, etc [15].

In Romania, the apple production and

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

marketing sector is an important sector of activity because it provides the quantities of apples needed for the consumption of the population on the one hand and on the other hand represents a segment of the export of agri-food products.

MATERIALS AND METHODS

The data used in this paper was taken from the National Institute of Statistics and from specialized international sites. Various specialized materials have been consulted. The main tendencies in the production and marketing of apples in Romania have been highlighted with the help of important indicators, such as: the number of apple trees in Romania and in the development regions; total apple production achieved; average production per tree apple; average price for table apples; annual apple consumption per capita; imports and exports of apples. The main indicators analyzed in this paper were studied in their dynamics for 2012-2016. The results found in the paper were presented in tables, interpreted and illustrated graphically. The index method was mainly used.

RESULTS AND DISCUSSIONS

The number of existing apple trees in Romanian plantations is an important indicator, which contributes directly to the production of apples made in Romania. At national level, over 50 varieties of apples are grown, of which the most appreciated are: Frumosul de Voinesti; Delia; Ardelean; Ionathan; Golden delicious; Florina; Generos; Fuji; Romulus 1, 2, 3, Rădășeni, Roșu de Cluj, Fălticeni etc [2, 6, 15].
Table 1 presents the evolution of national and regional development indicators. It can easily be noticed that in the period 2012-2016, the number of apple trees varied from year to year. The highest number of apples was recorded in 2012 (27,969,280 trees). At the opposite end, the smallest number of apples was 24,787,332 trees (2016). In 2016, the number of trees dropped by 11.38 compared to 2012. According to statistical data published for 2016, in Romania there were about 55,000 thousand hectares cultivated with apples. The area cultivated with apples in 2016 put Romania on the second place in the top of the European Union countries with the largest areas cultivated with apples. The first place in this top, as expected, was occupied by Poland with 164,000 hectares of apple trees. It is necessary to specify that the surface with apples covered in statistics includes: plantations that no longer produce; plantations that produce very little and plantations with large productions [18].

Photo 1. Apple blossom
Source: [2]

At the level of the development regions it can be seen that the largest number of apples was recorded in the North-West region. In this region, in 2016, there were 28.15% of the total number of nationally grown apples. From the statistical data presented, it can be seen that in this region, in 2016, the number of apple trees decreased by 6.39% compared to 2012. This decrease in the number of apples was lower compared to the one recorded at national level. In the Central Region, it is noted that the most significant decrease in the number of apples was recorded in 2016 (-23.47%), compared to 2012.
In the Bucharest-Ilfov region, the lowest number of apples was recorded in the analyzed period. It ranged from 58,687 to 70,090 apple trees. In all development regions there were decreases in the number of apples in 2016 compared to 2012 [3].

Table 1. The evolution of the apple trees in Romania and in the development regions, in the period 2012-2016 (number)

Specification	2012	2013	2014	2015	2016	2016/ 2012 (%)
Romania	27,969,280	27,062,046	26,397,942	25,403,345	24,787,332	88.62
NORTHWEST Region	7,455,321	7,109,014	7,146,224	7,197,199	6,979,035	93.61
CENTRAL Region	5,112,209	4,848,562	4,565,962	4,132,595	3,912,838	76.53
NORTHEAST Region	4,911,099	4,636,069	4,757,878	4,397,157	4,217,067	85.86
SOUTHEAST Region	2,111,233	1,966,535	1,824,240	1,756,898	1,952,322	92.47
SOUTH-MUNTENIA Region	3,793,018	3,828,183	3,697,568	3,738,446	3,696,842	97.46
BUCHAREST – ILFOV Region	70,090	62,804	60,680	58,813	58,687	83.73
SOUTH-WEST OLTENIA Region	2,373,239	2,382,037	2,469,061	2,178,201	2,163,069	91.14
WEST Region	2,143,071	2,228,842	1,876,329	1,944,036	1,807,472	84.34

Source: Own calculation based on National Institute of Statistics, Tempo On-line Database, 2018, [12]

In Romania, from the statistical data presented, it can easily be noticed that the apple trees are cultivated in all the development regions. At national level, a number of areas with a high degree of favorability for apple culture have been highlighted. Among these areas were the following: Maramures; Valcea; Arges; Dambovita; Bistrita, etc [2].

Photo 2. Apples in apple trees plantation
Source: [17]

Apple production made in Romania is an important component on the fruit market. Table 2 shows the evolution of the total apple production achieved at national level and in the development regions in the period 2012-2016. The most significant apple production in Romania was recorded in 2013 (513,580 tonnes). In 2015, the apple production declined compared to 2013-2014. This decrease was due to the lack of rain and very high temperatures. However, at national level, there were a number of fruit farms that recorded high yields. For example, 70% of the apple production in Itesti in 2015 reached representatives retailers from all over the country, and the remaining 30% was used for the canning industry in Reghin, Vaslui and Itesti [16].

The lowest domestic apple production was 462,935 tonnes (2012). In 2016, there was a slight increase in apple production by 0.93% compared to 2012. According to the data provided by Eurostat, Romania ranked seventh in 2016 in terms of apple production at the level of The European Union. In top three places, apple producers in the European Union ranked, in 2016, the following countries: Poland (3,604 thousand tons); Italy (2,456 thousand tons) and France (1,820 thousand tons). Important positions in the apple-maker list are occupied by: Germany; Spain and Hungary [18].

In the Northwest region, the largest apple production in Romania is obtained. In this region, in 2016, 26.69% of the national production was obtained. The largest apple production in the Northwest Region was 150,705 tonnes (2014). In this region in 2016, there was an increase in apple production by 13.30% compared to 2012. There were also increases for apple production in 2016 as compared to 2012, in the following regions: South-West Oltenia (1.99%); Center (3.34%) and South East (4.46%). The South-Muntenia region ranks second in apple production. In 2016, 24.80% of the nationwide production was achieved in this region. From the statistical data presented for this region, it is easy to see that apple production in the year 2016 decreased by 1.56% compared to 2012. The fall in apple production in 2016 compared to 2012 was registered in the following regions: North-East (-11.49); Bucharest-Ilfov (-56.39%); West (-9.09%). The smallest apple production is found in the Bucharest-Ilfov region. These low apple productions in this region are mainly due to the low number of apple trees.

Table 2. The evolution of the total apple production in Romania and in the development regions in the period 2012-2016 (tons)

Specification	2012	2013	2014	2015	2016	2016/ 2012 (%)
Romania	462,935	513,580	513,195	476,059	467,259	100.93
NORTHWEST Region	110,082	139,495	150,705	135,124	124,727	113.30
CENTRAL Region	51,457	58,813	69,146	57,472	53,176	103.34
NORTHEAST Region	84,596	79,694	90,240	81,435	74,878	88.51
SOUTHEAST Region	30,826	33,651	35,668	32,805	32,202	104.46
SOUTH-MUNTENIA Region	117,750	121,440	103,603	103,997	115,918	98.44
BUCHAREST – ILFOV Region	947	607	595	477	413	43.61
SOUTH-WEST OLTENIA Region	42,955	50,950	37,742	37,620	43,814	101.99
WEST Region	24,322	28,930	25,496	27,129	22,131	90.99

Source: Own calculation based on National Institute of Statistics, Tempo On-line Database, 2018, [12]


Photo 3. Apple production
Source: [6, 16]

The evolution of the average production per apple tree at national level and in the development regions is presented in table 3. From the statistical data presented, it can be noticed that, in 2012, the smallest average production was recorded per apple tree, only 17 kg / tree. Between 2013 and 2016, the average apple tree production was constant, at 19 kg per tree. In 2016, average apple tree production increased by 11.76% compared to 2012. The highest average yields per apple tree were in the South-Muntenia region. In this region, average production oscillated between 28-32 kg / tree. The average apple tree production is due mainly to the more productive varieties of apples and their resistance to natural conditions. Average productions per apple trees were achieved in the following regions: Northwest (21 kg / tree in 2014), South West-Oltenia (21 kg / tree in 2013) and South East (20 kg / tree in 2014). The smallest average production on the apple tree is obtained in the Bucharest-Ilfov region. In this region, average apple tree production has dropped by 50% in 2016 compared to 2012. In this region in 2016 there was an average apple production of only 7.00 kg, compared to 19.00 kg / tree obtained nationwide. In the Bucharest-Ilfov region, only 36.84% of the average national apple tree production was recorded in the year 2016. Other lower average productions compared to the national one were achieved in the Central Region (10.00-15.00 kg / tree).

Table 3. Evolution of the average production per apple tree in Romania and in development regions during the period 2012-2016 (kg / tree)

Specification	2012	2013	2014	2015	2016	2016/ 2012 (%)
ROMANIA	17.00	19.00	19.00	19.00	19.00	111.76
NORTHWEST Region	15.00	20.00	21.00	19.00	18.00	120.00
CENTRAL Region	10.00	12.00	15.00	14.00	14.00	140.00
NORTHEAST Region	17.00	17.00	19.00	19.00	18.00	105.88
SOUTHEAST Region	15.00	17.00	20.00	19.00	16.00	106.66
SOUTH-MUNTENIA Region	31.00	32.00	28.00	28.00	31.00	100.00
BUCHAREST – ILFOV Region	14.00	10.00	10.00	8.00	7.00	50.00
SOUTHWEST OLTENIA Region	18.00	21.00	15.00	17.00	20.00	111.11
WEST Region	11.00	13.00	14.00	14.00	12.00	109.09

Source: Own calculation based on National Institute of Statistics, Tempo On-line Database, 2018, [12]

The average price for table apples in Romania has been influenced by several factors, such as: internal availability for human consumption; apple demand; imports, etc. The average price for table apples varied between 2012 and 2015 (Fig.1.).

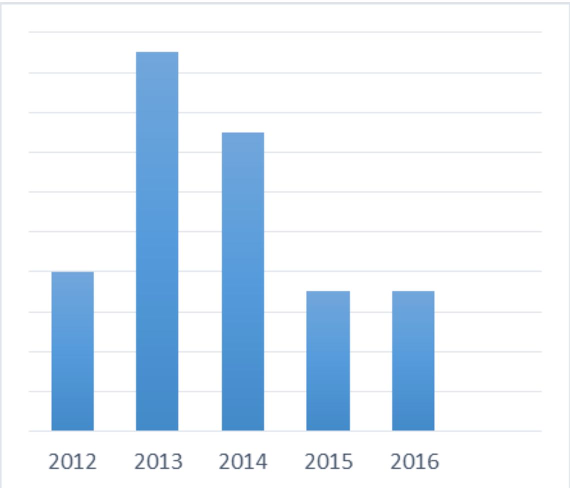


Fig.1. The evolution of the average price for table apples in Romania during the period 2012-2016 (lei/ kg);
Source :Own design based on NIS Tempo-online database 2018 [12]

In 2016, it is noticed that the price remained constant compared to the year 2015. The high average price for table apples was 2.79 lei / kg (2013). At the opposite end, the lowest price was 2.67 lei / kg (2015-2016). It can be seen that in 2016, the price recorded a slight decrease, by 0.38% compared to 2012.

Average annual apple consumption per capita in Romania during the analyzed period recorded an upward trend (Fig.2.). The highest average apple consumption was 28.4 kg / inhabitant (2016) and the lowest consumption was 20.76 kg / inhabitant. In 2016, apple consumption increased by 36.80% compared to 2012.

In Romania, there is a relatively low consumption of apples, compared to other countries in the European Union or in the world. For example, the Netherlands consumes an average of 40 kilograms of apples. In the United States, consumption is over 40 kilograms of apples per capita [6].

In the period 2012-2015, Romania's apple imports have risen steadily. The largest quantity of apple imports was 137,679 tonnes (2015), and the smallest was 67,000 tonnes (2012).

In 2015, Romania's apple imports increased by 105.49% compared to 2012.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

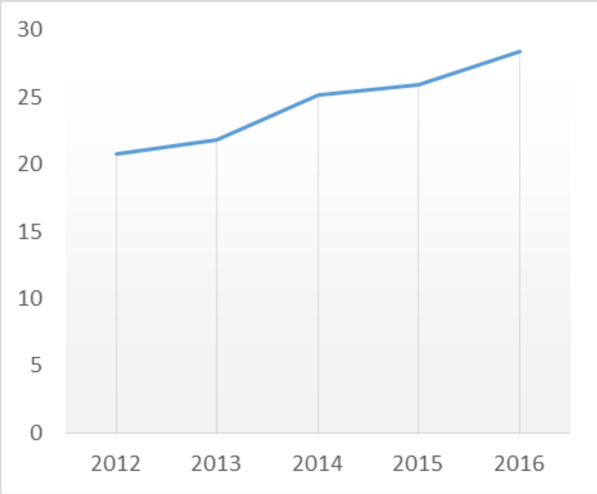


Fig.2. Average annual apple consumption per capita in Romania, 2012-2016 (kg / inhabitant)
Source: [4, 5, 10, 11, 12]

Romania's apple exports during the analyzed period were significantly lower than the imports.
In 2015, 53,573 tonnes were exported compared to 137,679 tonnes imported. The smallest exports were recorded in 2014 (38,222 tons), and the largest exports of apples were 53,373 tons (2015). In 2015, apple exports increased by 0.70% compared to 2012 (Fig.3.).

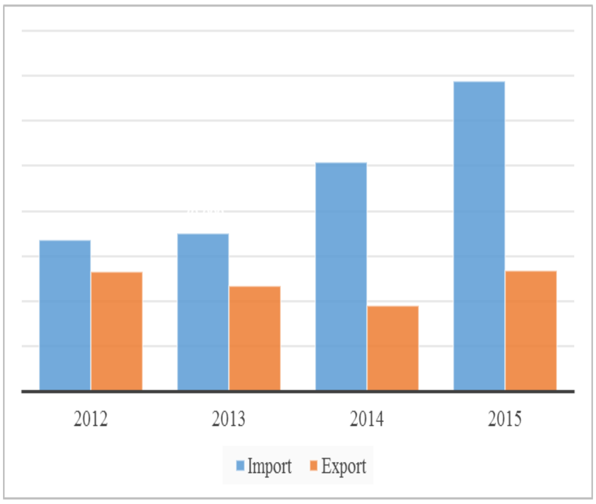


Fig. 3.Evolution of import and export of apples in Romania, in 2012-2015 (tons)
Source: [4, 5, 10]

According to official data, in 2016, substantial quantities of apples from Poland were imported in Romania, although our country ranks 7th in the top of apple producers in the European Union. Apple's value imports from Poland amounted 21.5 million euros in 2016. Apples are imported in large quantities from Poland because they are at lower prices than the domestic ones [7].
In 2016, Romania also made significant apple imports from: Italy (8.5 million euros); Germany (3.3m euros); Hungary (EUR 1.6 million) and Austria (EUR 1.5 million). During the analyzed period, there was a trade deficit in apple-commodity trade, as follows: 2012 (-18.1 million); 2013 (-18.4 million); 2014 (-20.8 million); 2015 (-31.3 million) and 2016 (-38.1 million) [18].
It can be noticed that, in the analyzed period, the trade deficit in apple trade was significantly increased.
In Romania, to support the fruit and vegetables sector, financial support is provided, both from European funds and from national funds.
For example, the maximum amount of oil purchased and used for which financial support is granted, for orchards, is 130 liters per hectare [9].
In order to increase the competitiveness of the apple production and marketing sector in Romania, the following measures are imposed:
-The rejuvenation of plantations;
-Stimulation of investments;
-Stimulating surfaces with high quality fertilizers;
-Increasing mechanization of works;
-Reconversion of land;
-Increase storage space, etc.[8]

CONCLUSIONS

The main trends in the production and marketing of apples in Romania during 2012-2016 were:
-In 2016, at national level, were recorded about 55,000 thousand hectares cultivated with apples;
-The number of apples in the existing plantations at national level have changed from one year to the next;
-The highest number of apples was 27,969,280 (2012), and the lowest number of apples was recorded in 2016 (24,787,332 apples);
-The Northwest region has been remarked

within the regions of Romania with the highest number of apples in 2016;
-The Bucharest-Ilfov region, in 2016, was evidenced by the lowest number of cultivated apples (58,687 apples);
-The highest apple production at national level was 513,580 tons (2013);
-Romania is ranked 7th in the ranking of apple producers in the European Union in 2016;
-in 2014, the largest apple production was obtained in the North-West region (150,705 tons);
-In 2016, in the Bucharest-Ilfov region, apple production decreased by 56.39% compared to 2012;
-19 kilograms per tree was average apple production, between 2013 and 2016, at national level;
-In 2013, in the South-Muntenia region, the highest average apple tree production (32 kg / tree) was achieved. At the opposite end, in 2016, in the Bucharest-Ilfov region, the smallest average production was recorded per apple tree (7.0 kg / tree);
-2.79 lei / kg was the highest average price for table apples registered at national level in 2013;
-In 2016, the highest average apple consumption per capita (28.4 kg / inhabitant) was recorded at national level. In Romania, a smaller quantity of apples is consumed compared to other countries;
-During the analyzed period imports of apples were higher than apple exports. This phenomenon is explained by the fact that imported apples are less expensive compared to internally produced apples.

REFERENCES

[1] Bălan, A., Soare, E., Cofas, E., Niculae, I., 2012, Study on the fruit sector in Romania, Lucrări Ştiinţifice, Seria I, Management Agricol, Vol..XIV (2): 133-140
[2] Caragea, C., State, C., 2014, Magic Flowers, Apple Flowers, DACICCOOL.RO, Flori magice, flori de mar http://www.daciccool.ro/stil-de-viata/casa-si-gradina/7043-flori-magice-flori-de-mar, Accessed on January 15, 2018
[3]Dona, I., 2015, Rural Economy, Economica Publishing House, Bucharest, pp: 318-322 (Economie rurala, Editura Economica, Bucuresti, pp: 318-32)
[4] Faostat, 2012, Crops and livestock products http://www.fao.org/faostat/en/#data/FBS, Accessed on January 20, 2018
[5] Faostat, 2013, Crops and livestock products http://www.fao.org/faostat/en/#data/FBS, Accessed on January 20, 2018
[6]Gălăţanu, M, 2012, Various News (Stiri diverse) http://www.efinance.ro/food_drink62.php-, Accessed on January 15, 2018
[7]Isvoranu, M., 2017, Why half of the imported apples come from Poland. Position of Carrefour retailer (De ce jumătate din merele de import vin din Polonia. Poziția retailerului Carrefour) http://www.roaliment.ro/actualitate/mere-import-polonia-carrefour/, Accessed on January 25, 2018
[8]Jurnalul.ro, 9 February 2018, Mugur Isarescu wonders why Romania is importing huge quantities of apples (Mugur Isărescu se întreabă de ce România importă cantități uriașe de mere) http://m.jurnalul.ro/bani-afaceri/economia/mugur-isarescu-se-intreaba-de-ce-romania-importa-cantitati-uriase-de-mere-765456.html, Accessed on February 12, 2018
[9]Ministry of Agriculture and Rural Development, 2018, Vegetables-Fruits (Ministerul Agriculturii si Dezvoltarii Rurale, Legume-fructe) http://www.madr.ro/horticultura/fructe-si-legume.html-Accessed on February 10, 2018
[10]National Institute of Statistics, Food Balance in 2015, 2016 (Bilanturi alimentare in anul 2015, 2016) http://www.insse.ro/cms/sites/default/files/field/publicatii/bilanturi_alimentare_in_anul_2015.pdf, Accessed on February 10, 2018
[11]National Institute of Statistics, Availability of population consumption in 2016, 2017 (Disponibilitatile de consum ale populatiei in anul 2016, 2017)
[12]National Institute of Statistics, Tempo On-line Database, 2018 http://statistici.insse.ro/shop/, Accessed on February 10, 2018
[13]Oltenacu, N., Lascăr, E., 2015, Capacity of maintaining t he apples quality, in fresh condition-case. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 15(1):331-336.
[14] Peț, E., Străin, L. M., Peț, I., 2014, Aspects of the Romanian fruit market, Lucrări Ştiinţifice, Seria I, Management Agricol, Vol. XVI (2), 97-100.
[15] Popescu, A., 2016, Some considerations on the dynamics of fruit and apple production and consumption in Romania in the period 2007-2014. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 16 (3): 267-276.
[16] Radu, F., 2015, The success of the Itesti apples, The Awakening – Bacau's Newspaper (Succesul merelor de Itesti, Desteptarea-Ziarul Bacaului) https://www.desteptarea.ro/succesul-merelor-de-itesti/, Accessed on February 10, 2018
[17]Razi Gabriel, 2011, Record year for the apple

production: Producers took advantage and exported seven times more, Finance newspaper (An record pentru producţia de mere: producătorii au profitat şi au exportat de şapte ori mai mult, Ziarul Financiar) http://www.zf.ro/companii/an-record-pentru-productia-de-mere-producatorii-au-profitat-si-au-exportat-de-sapte-ori-mai-mult-8444008, Ziarul Financiar, Accessed on February 5, 2018

[18] Rotaru, R., 2017, Romania ranks second in the EU on the apple-cultivated surface, but imports apple of 21.5 million euros from Poland, Ziarul Financiar (România ocupă locul doi în UE la suprafaţa cultivată cu meri, dar importă mere de 21,5 mil. euro din Polonia) http://www.zf.ro/companii/retail-agrobusiness/romania-ocupa-locul-doi-in-ue-la-suprafata-cultivata-cu-meri-dar-importa-mere-de-21-5-mil-euro-din-polonia-16664979, Accessed on February 10, 2018

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE FORESTRY ECOSYSTEMS MANAGEMENT IN THE FOREST DISTRICT SIBIU, AGAINST THE DEFOLIATOR SPECIES *LYMANTRIA MONACHA* L., 1758 (LEPIDOPTERA: LYMANTRIIDAE) DURING THE PERIOD 2013-2017

Cristina STANCĂ-MOISE[1], Robert BLAJ[2], Silviu SBÎRCEA[3]

[1,2]"Lucian Blaga" University of Sibiu, Faculty of Agricultural Sciences, Food Industry and Environmental Protection, Sibiu, Romania, Phone: 0040269234111, Fax: 0040269234111, E-mail: cristinamoise1@yahoo.com, robert_blaj@yahoo.com
[2,3]Direcția Silvică Sibiu, Calea Dumbrăvii 140, Sibiu 550399, Phone: 0269242449.

***Corresponding author*:** cristinamoise1@yahoo.com

Abstract

In the present paper the investigations had as a purpose to knowledge of the Lymantria monacha L., 1758 *populations dynamic during the period 2013-2017 in the Forest Direction Sibiu, in order to use the results for a monitoring plan and control for the year 2018. The investigations made within the frame work of the Forest Districts: Arpaș, Avrig, Miercurea Sibiului, Sibiu and VI Cibin in the last five years studied the presence of this defoliator in a large number within Forest District Miercurea Sibiului (260 specimen), followed by the Forest District Arpaș (147 specimen), Sibiu (83 specimen), Forest District Cibin VI (55 specimen) and Forest District Avrig (52 specimen).*

***Key words*:** *Lymantria monacha L., 1758, Forest Direction Sibiu, pheromonal traps*

INTRODUCTION

The Forest Direction Sibiu manages a surface of 60,971 ha forest fond, in the state property. From this surface, after the centralization of the data obtained during the years 2013-2017, it comes out that the pest damaged 3,183.5 ha, that represents 5.22% from the total surface.
Among the biological pests that made damages in the forest ecosystems of the Forest Direction Sibiu, we mention: the insects (*Hylobius abietis, Lymantria monacha, Pristiphora abietina, Ipidae*) vegetal parasites and mammals. From all of them we can affirm that *Lymantria monacha* L., 1758 is the most noxious defoliator of this forests, mostly of the coniferous forests ones [2-13].
The identification of the presence of this defoliator and the numeric increase in the forest ecosystem from the Forest Direction Sibiu, requires strict measures in order to limit its populations [14-18].
Based on the studies made during the years 2013-2017, it comes out that among the five monitored Forest Districts, the Forest District Miercurea Sibiului is the most affected by this defoliator attack [19]. The presence in the large number of the butterflies captures of *Lymantria monacha L., 1758* imposes a corresponding monitoring to control [1] this pest populations in the area of the Forest Direction Sibiu.

MATERIALS AND METHODS

The most efficient method to establish the presence and evolution of this pest populations is the pheromonal method.
The study of the population dynamic of the defoliator *Lymantria monacha* L., 1758 was made in accordance with the order nr. 42/13.03.1987 in the forests where the spruce fir and the fir trees were more than 30%, not matter the age of the arbores. Within the frame work of the Forest Direction Sibiu between the years 2013-2017 were installed a number of 150 points of control using the pheromonal traps Atralymon mounted [8-12, 20] on the plastic poster with caterpillar glue proceeded from the Chemistry Institute "Raluca Ripan" Cluj-Napoca.
The placement of the traps in the field during

the years of monitoring took place before the flight beginning of the adults [4-7,13]. This moment was different from a location to another, depending on the altitude and latitude of the Forest District monitorized (Arpaș, Avrig, Miercurea Sibiului, Sibiu and VI Cibin). In order to include all zones possible to become infested, the pheromonal traps were placed in the monitoring system (1:20.000) in the way that at about 200 ha should be "a control point".

RESULTS AND DISCUSSIONS

During the years 2013-2017, it was monitored the evolution of the population of the defoliator *Lymantria monacha L., 1758* in the five Forest Districts (Arpaș, Avrig, Miercurea Sibiului, Sibiu and VI Cibin) that belong to the Forest Direction Sibiu. Every year at the end of the flight period of the pest *Lymantria monacha L., 1758*, were centralized the results data in accordance with the Table 1-5. All these data constitute the necessary information about the evolution of the pest populations in the forest ecosystems within the frame work of Forest Direction Sibiu, and also the pest control measures.

Table 1. The dynamics of the maximum captures of *Lymantria monacha* L., 1758 in 2013

	Forest District	Max. No.	U.P.	U.A.
1	Arpas	42	V	76A
2	Avrig	10	III	85A
3	Miercurea	58	III	145
4	Sibiu	16	I	74B
5	Vl Cibinului	11	II	109B
TOTAL		137		

Source: Field Survey, 2013.

Table 2. The dynamics of the maximum captures of *Lymantria monacha* L., 1758 in 2014

	Forest District	Max. No.	U.P.	U.A.
1	Arpas	34	V	63B
2	Avrig	4	III	130A
3	Miercurea	35	III	145
4	Sibiu	13	II	151A
5	Vl Cibinului	16	II	120A
TOTAL		102		

Source: Field Survey, 2014.

Table 3. The dynamics of the maximum captures of *Lymantria monacha* L., 1758 in 2015

	Forest District	Max. No.	U.P.	U.A.
1	Arpas	23	IV	121B
2	Avrig	3	II	73E
3	Miercurea	50	III	162B
4	Sibiu	20	I	36A
5	Vl Cibinului	0	0	0
TOTAL		96		

Source: Field Survey, 2015.

Table 4. The dynamics of the maximum captures of *Lymantria monacha* L., 1758 in 2016

	Forest District	Max. No.	U.P.	U.A.
1	Arpas	36	IV	54B
2	Avrig	12	II	73E
3	Miercurea	33	III	162B
4	Sibiu	19	I	36A
5	Vl Cibinului	0	0	0
TOTAL		100		

Source: Field Survey, 2016.

Table 5. The dynamics of the maximum captures of *Lymantria monacha* L., 1758 in 2017

	Forest District	Max. No.	U.P.	U.A.
1	Arpas	12	IV	33A
2	Avrig	23	II	81A
3	Miercurea	84	III	168B
4	Sibiu	15	I	36A
5	Vl Cibinului	29	II	131B
TOTAL		163		

Source: Field Survey, 2017.

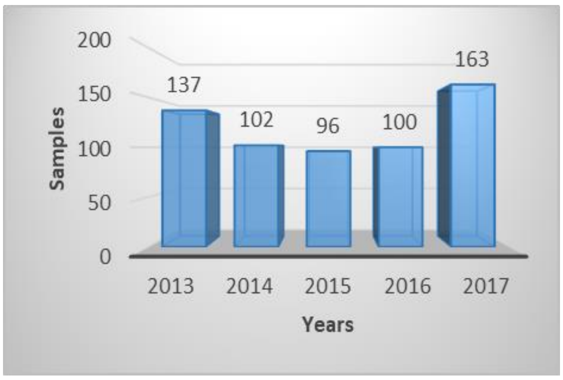


Fig. 1. The dinamics of the maximum captures of *Lymantria monacha* during the period 2013-2017

After the data centralizing from the five Forest Districts belonging to Forest Direction Sibiu, it comes out that the year with maximum attack were 2013 with 137 captures and 2017 with 163 captures. This was because of the favourable meteorological conditions for development of this defoliator.

Table 6.The monitoring of infestation with *Lymantria monacha* L., 1758 in the coniferous forest and also the control measures proposed for the year 2018

Forest District	The surface with the presence identified (ha)		The surface after the nr of butterflies on one poster in the year 2017			The no. of pheromonal traps in the year 2018
	2016	2017	Over 100	Over 200	Over 400	
Arpas	5,130	5,130	0	0	0	25
Avrig	4,310	4,310	0	0	0	21
Miercurea	9,500	9,500	0	0	0	85
Sibiu	2,490	2,490	0	0	0	12
Vl Cibinului	1,600	1,600	0	0	0	7
Total	23,030	23,030	0	0	0	150

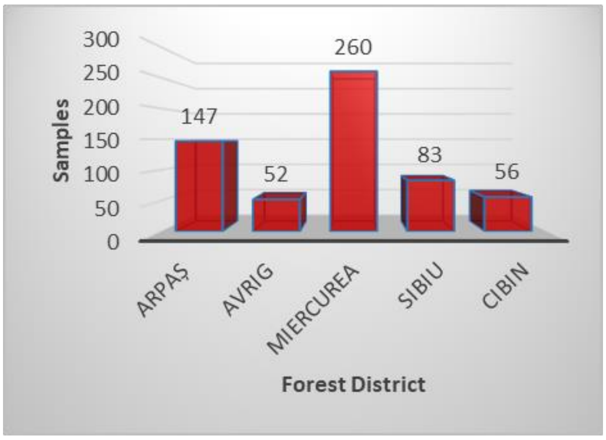


Fig.2. The dynamics of the maximum captures of *Lymantria monacha* L., 1758 within the frame work of forest Direction Sibiu
Sursa: Own design based on field survey.

The butterflies flight of *Lymantria monacha*, L., 1758 took place in the months July-September of the years 2013-2017, but the beginning and the end of the flight were offset depending on the place of the trap in the five Forest Districts: Arpaș, Avrig, Miercurea Sibiului, Sibiu and VI Cibin and the climatic evolutions specific to every year.
The highest number of 84 butterflies of *Lymantria monacha*, L., 1758 at a “control point” during all period of observations in the year 2017 were recorded at the Forest District Miercurea Sibiului [19].
After the analysis of the data about all five Forest Districts we established that the most affected is the Forest District Miercurea Sibiului with 260 specimen captured during the five years of study, followed by Forest District Arpaș, with 147 captured specimen, Forest District Sibiu with 83 specimen. The least affected were the Forest District VI Cibin and Avrig with more than 50 captured specimen.

CONCLUSIONS

The works to protect the forest within the framework of the Forest Direction Sibiu are effected for the maintaining an adequate phyto-sanitary situation in nurseries, solariums, young cultures and forest of deciduous and coniferous trees.
After the catalogue of the captured made by mean of 150 pheromonal traps in order to capture the species *Lymantria monacha*, L., 1758 during the years 2013-2017 on the surface of 23,030 ha of forest we could have the following conclusions: taking into consideration the correlation between the maximum density of insects during the larvae and adult stages it could be forecasted the pheromonal traps number necessary to protect the forestry ecosystem for the year 2018.
Another conclusion is that the density of populations is influenced by the variations of the maximum temperature in the month of May in every year of the study, by the rainfalls recorded during the flight period and by the yearly dryness during the period between 2013-2017.
Within the frame work of the Forest Direction Sibiu the pest *Lymantria monacha* L., 1758 continues to be in a latent stage because during the five years of study were not captured more than 200 butterflies on a point in the forests under 60 years old or more than 500 butterflies on a point in the forests older than 60 years, that require the additional measures to control this pest populations.

REFERENCES

[1] Altenkirch, W., Huber, J., Krieg, A., 1986, Field trials on the biological control of the nun moth (*Lymantria monacha*). Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz, 93(5):479-493.
[2] Bejer, B., 1988, The nun moth in European spruce forests. In Berryman AA, ed. Dynamics of forest insect

populations: Patterns, causes, implications. New York, USA: Plenum Press, 211-231.
[3]Dziadowiec, H., Plichta, W., 1985, The effect of nun moth (*Lymantria monacha* L.) outbreak on characteristics of litter fall in the pine forest. Ekologia Polska, 33(4):715-728.
[4]Fuester, RW., Drea, J.J., Gruber, F., 1975, The distribution of *Lymantria dispar* and *L. monacha* (Lepidoptera: Lymantriidae) in Austria and West Germany. Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz, 82(11/12):695-698.
[5]Gruber, F., Fuester, R.W., Drea, J.J., Jr, 1978, Distribution of *Lymantria dispar* (L.) and *L. monacha* (L.) in France (Lepidoptera, Lymantriidae). Annales de la Societe Entomologique de France, 14(4):599-602.
[6]Humphreys and Allen, 2002, Part II profiles of selected forest pests Insect pests, 103-105.
[7]Keena, M.A., 2003, Survival and development of *Lymantria monacha* (Lepidoptera: Lymantriidae) on North American and introduced Eurasian tree species. Journal of Economic Entomology, 96(1):43-52.
[8]Mihalciuc, V., Diter S., Olenici, N., Creangă, I., Bândiu, C., Ghizdavu, L., Ceianu, I. Simionescu, A., 1988, The establishment of *Lymantria monacha* population dynamics and technologies of warning against the mass propagation - the early detection of mass propagation to prevent the attacks by the application of control measures in due time. Final scientific report. Manuscript I.C.A.S. Bucharest, 55 pp.
[9]Mihalciuc, V., Simionescu, A., 1989, Considerations about the evolution of *Lymantria monacha* populations all over the country during the period 1974-1986. Forests Magazine, (1): 31-33.
[10] Mihalciuc, V., Mircioiu, L., I. Oprean, 1997, The influence of climatic factors on the numerical variation of *Lymantria monacha* populations in Romania. In: Knizek, M., Zahradní, P. Divis, K. (eds.) Proceedings of the Workshop on Forest Insects and Disease Survey, Pisek, Czech Republic, April 7-10, 1997, Forestry and Game Management Research Institute Jiloviste - Strnady, Prague, 119-131.
[11] Mihalciuc, V., Olenici, V., Mircioiu, L., Bujilă, M., Oprean, I., Tautan, L., Gânscă, L. Chis, V. Popovici, N., Pop, L. Gocan, A., Ciupe, H., Olenici, N., 1998, Research on pests dangerous for species of coniferae. Final scientific report. Manuscript I.C.A.S. Bucharest, 118 p. + 24 annexes.
[12] Mihalciuc, V., Mircioiu, L., Mihalciuc, A., 2000, Improved detection and control of *Lymantria monacha* L., Forestry Bucovina VIII 1. Research Articles 8 (1): 1-14.
[13]Schmutzenhofer, H., 1986, Monitoring and disruption of mating of the nun moth, *Lymantria monacha*, with the pheromone disparlure. Anzeiger fur Schadlingskunde, Pflanzenschutz, Umweltschutz, 59(7):125-130.
[14] Stancă-Moise, C., 2014, Controlul populațiilor de dăunători, Editura Universitatii Lucian Blaga din Sibiu.
[15] Stancă-Moise, C., 2014, Diversity and the main ecological requirements of the epigeic species of forest ecosystems in the Sibiu county, in the years 2013-2014. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 14(3): 323-326.
[16]Stancă-Moise, C., 2016, Defoliating insects impacts on forest ecosystems, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. 16(4): 339-343.
[17] Stancă-Moise, C., Blaj R., 2017, *Ips thypographus* (Coleoptera, Scolytidae) at "Ocolul Silvic Miercurea Sibiului" (Sibiu County, Romania), Analele Universitatii din Oradea, Fascicula Biologie, 24(1):14-18.
[18] Stancă-Moise, C., Berereton, T., Blaj, R., 2017, The control of the defoliator *Lymantra monacha* l. populations (Lepidoptera: Lymantriidae) by making use of pheromone traps in the forest range Miercurea Sibiului (Romania) in the period 2011-2015, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. 17(4): 327-331.
[19]Wellenstein, G., 1978, *Lymantria monacha* L., Nonnenspinner, Nonne. In: Schwenke W, ed. Die Forstschädlinge Europas. Hamburg, Germany: Verlag Paul Parey.
[20]http://www.bucovina-forestiera.ro/article/imbunatatirea-sistemului-de-depistare-si-control-a-defoliatorului-lymantria-monacha/, Accessed on January 10, 2018.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

BENEFIT ASSESSMENT OF PASSIVE HOUSE IN BULGARIA IN SUSTAINABILITY CONTEXT

Yavor STOYANOV

University of National and World Economy, Students city, 1700, Sofia, Bulgaria, Phone: +359887306556, E-mail: j.stojanov@mail.bg

Corresponding author: j.stojanov@mail.bg

Abstract

Demand for cost-effective and environmental friendly building solutions as well as the continued implementation of eco-innovation in construction sector leads to an increase of research interest in passive house. The aim of the paper is to assess the benefits of passive house in Bulgaria which influence on environment, economy and society. On this basis are made general conclusions and recommendations related to benefits of passive house for achieving sustainable housing, their assessment for economy, society and environment and evaluation of factors for increasing the benefits of passive house.

Key words: *benefit, passive house, sustainability*

INTRODUCTION

The building of houses related to the concept of sustainable development and the achievement of a sustainable and energy-efficient construction sector requires a study of the benefits of passive house in economic, environmental and social contexts.

The benefits of building passive house in ecological aspect could be related to achieving energy efficiency, water conservation, reduction of greenhouse gas emissions, material efficiency, pollution prevention. They could be analysed in economic aspect mostly related to cost efficiency over time, adaptability with minimal cost, long life cycle of systems. Benefits of passive house could be assessed according their possibility to achieve social sustainability. The benefits could be both 1) for the people living in these buildings - healthy indoor environment, comfort in use, safety (personal, household), provision of recreational amenity, and 2) benefits to society as a whole - job creation, safety (environmental), creating ecological thinking and attitudes to move to energy-efficient buildings.

According some authors [2][4], ecological benefits of passive house are related to energy efficiency and internal comfort. They define passive house as an "energy-efficient home in which a comfortable interior climate can be maintained without active heating and cooling systems". The potential for energy savings in the passive house is up to 90% compared to traditional building depending on design [3]. A view of other authors [7] confirms this statement and they consider that passive house improves energy efficiency through energy savings. The passive house is the logical development of the low-energy house: improving comfort and reducing energy demand through "passive" building and technical measures that ensure avoidance of unnecessary heat loss and optimal use of free heat flows [9].

The view of some authors [5] reflects the economic and environmental benefits of passive buildings. They consider that more and more efforts are being made to develop passive and environmental friendly houses as a result of energy and environmental strategies to reduce energy consumption and polluting emissions. Together with a certain reduction in energy consumption, they will reduce the negative impact on the environment by using more environmental friendly materials.

Passive house offers the opportunity to achieve very low energy consumption with quality and less expensive solutions. Low maintenance costs of passive house create

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

benefits for the environment and the economy, while additional maintenance for conventional buildings requires more materials and capital than additional costs needed for the improved components of passive house [9].

In regard to the social benefits of a passive house, it is one of the highest standards in terms of achieving inner comfort. In this connection its founders define the main characteristics of passive house such as: 1) the use of post-heating or post-cooling of the fresh air mass to achieve thermal comfort 2) sufficient indoor air quality conditions 3) –no additional recirculation of air [6].

A research related to passive house regions [7] states that these buildings also have another very important function of providing training and knowhow. Their implementation increases the capacity of designers, builders, local government and educational institutions. They found out that passive house has social benefits in terms of improved public services and quality of living. Furthermore other authors [10]consider that ecological projects provide more competitive services in the sectors and better efficiency and quality in service provision. This could become a driving force for enhancing competitiveness through implementation of approaches for sustainable growth [10]. At the same time research [8] shows that benefits of passive house derive from longer-term relationships with clients and the low energy outcome brings higher quality design and greater robustness.

In research some authors [1] use six environmental themes of sustainability that can be used to analyse sustainable housing in general and passive house in particular. They are related to 1) energy, because passive house reduce the demand of energy and use renewable resources 2) materials: more efficient use of materials, reducing waste 3) water: reducing water usage, preventing land drying up, and protecting water quality 4) indoor environment connected with air quality, thermal comfort, and reducing noise levels 5) surrounding environment: impact on bio-diversity, reduce noise, wind etc 6) miscellaneous: flexibility and safety. These themes could be considered as benefits of sustainable housing in social, economic and ecological aspect.

MATERIALS AND METHODS

The aim of the paper is to assess the benefits of passive house in Bulgaria which influence on environment, economy and society. On this basis are made general conclusions and recommendations for implementations of passive house standard in Bulgaria.

The following tasks have been set out to achieve the aim of the paper:

(i)Literature review of benefits of passive house and achievement of sustainability;

(ii)Assessment of total benefits (social, ecological, economic) of passive house and evaluation of factors for increasing the benefits of passive house;

(iii)On the basis of analyzed information will be offered recommendations and general conclusions.

The benefits to the economy, society and the environment of passive house have been assessed in detail. They are classified as benefits for achieving social, environmental and economic sustainability (Fig. 1).

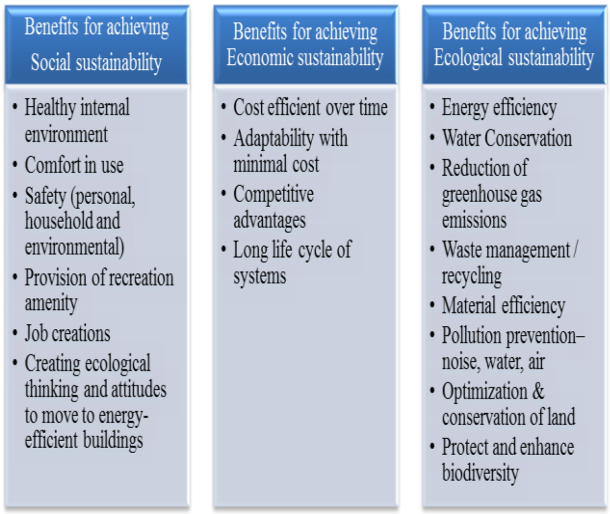


Fig. 1. Benefits for achieving sustainability in construction sector
Source: Own findings.

Findings and conclusions in the paper are based on structured interviews with 48 experts from construction sector involved in the implementation of energy-efficient construction and passive house standard. The survey was conducted in June 2017.The distribution of respondents according to the participation in the construction process is as follows: 52% are managers of the construction company, chief engineers and technical managers (construction contractors), 31% are building engineers and architects (building designers) and the other 17% are traders of systems for energy-efficient construction (Fig. 2). The majority of respondents – 83 % are men and 17% are women. This could be explained by the sector in which the survey was conducted. The age range of respondents is between 30 and 60 years. 25% of them are between 30 and 40 years, 60 % are between 41 and 50 years, and the other 15 % are between 51 and 60 years.

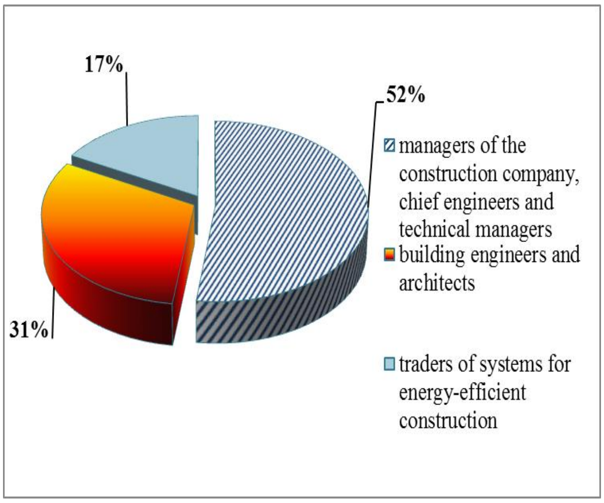


Fig. 2. Distribution of the respondents according to the participation in the construction process, %
Source: own findings

RESULTS AND DISCUSSIONS

Experts assessed the total benefits (social, ecological and economic) of passive house (Fig. 3). Most of the respondents (75 %) state that total benefits of passive house have very large range. 13 % consider that the benefits have large range. The response “intermediate range of benefits” and “small range of benefits” have been given by respectively 6% from the experts.
The assessment of benefits of a passive house in temporal aspect (Fig.4) shows that 69 % of experts consider that there are benefits in long –turn aspect and 31 % of them share the opinion that they are both in long turn and short-turn aspect. None of the experts consider that the benefits of building passive house are only in short-turn aspect.

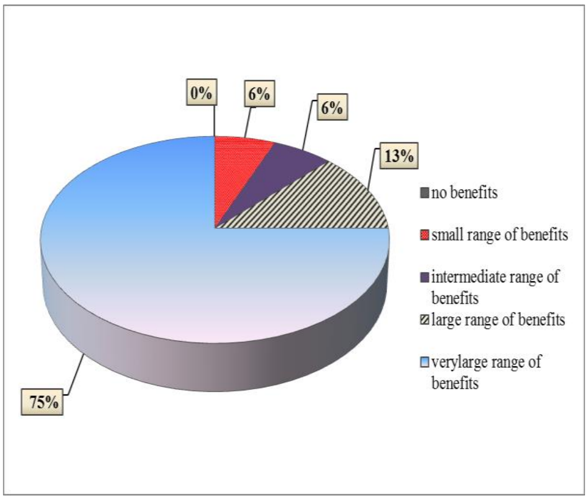


Fig. 3. Assessment of total benefits (social, ecological, economic) of building passive house, %
Source: Own findings.

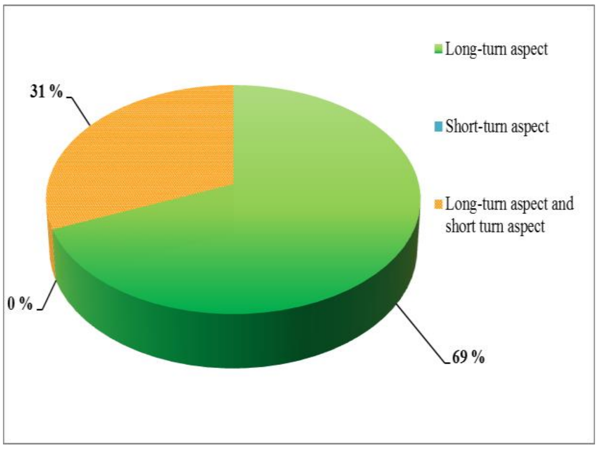


Fig. 4. Benefits of building a passive house in temporal aspect, %
Source: own findings

According respondents opinion for the share of economic, social and ecologic benefits of a passive house the highest share receive environmental (39%) and economic (38%) benefits (Fig. 5).
The similar share of economic and ecological benefits are related to the respondents' opinion that there are benefits for both the environment by reduction of greenhouse gas emissions, use of renewable resources, development of eco-innovation, but there are economic benefits by reducing energy consumption of systems and heat loss.

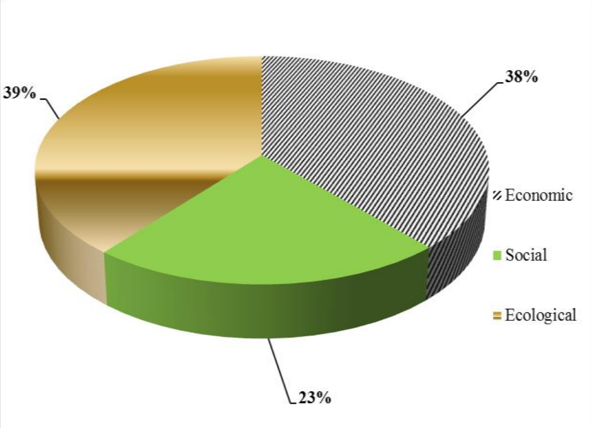


Fig. 5. Share of economic, social and ecologic benefits of passive house, %
Source: own findings

The lowest share receives social benefits - 23%. This could be explained with not so well developed research area of benefits in social aspect.
Table 1 presents assessment of benefits for achieving ecological, social and economic sustainability. Experts consider that “Creating ecological thinking and attitudes to move to energy-efficient buildings” has very large range of benefits for achieving social sustainability, followed by “Healthy internal environment” (63%), “Safety” and “Provision of recreation amenity” (56%).

Table 1. Benefit assessment for economy, society and environment of passive house, %

Benefits for achieving :	**No benefits**	**Small range of benefits**	**Intermediate range of benefits**	**Large range of benefits**	**Very large range of benefits**
Social Sustainability					
Healthy internal environment	0	0	19	19	63
Comfort in use	19	13	0	25	44
Safety (personal, household and environmental)	6	19	0	19	56
Provision of recreation amenity	13	6	6	19	56
Job creations	0	13	38	13	38
Creating ecological attitudes to move to energy-efficient buildings	0	0	13	13	75
Economic sustainability					
Cost efficient over time	0	0	0	19	81
Adaptability with min. cost	0	13	6	19	63
Competitive advantages	6	19	19	25	31
Long life cycle of systems	0	6	19	25	50
Ecological sustainability					
Energy efficiency	0	0	0	6	94
Water Conservation	13	0	6	19	63
Reduction of greenhouse gas emissions	0	0	6	6	88
Waste management / recycling	6	0	31	19	44
Material efficiency	0	13	6	31	50
Pollution prevention – noise, water, air	0	0	13	13	75
Conservation of land	0	0	19	25	56
Protect and enhance biodiversity	13	13	25	25	25

Source: Own findings.

Factors that may contribute to increasing the benefits of passive house are evaluated on Fig. 6.
The highest support have factors “Best practice of companies with similar activity successful in passive house projects” (69%), “Increasing social activity of society in environmental terms” (63%), followed by “Innovation and innovative policy, know-how” (63%).(Fig. 6).
Half of the respondents feel that very important are factors such as the “Labor market” and the “Availability of qualified personnel”, “Training and increasing the awareness of the standard "passive house"”, “Increasing qualification and improving the image of firms”.

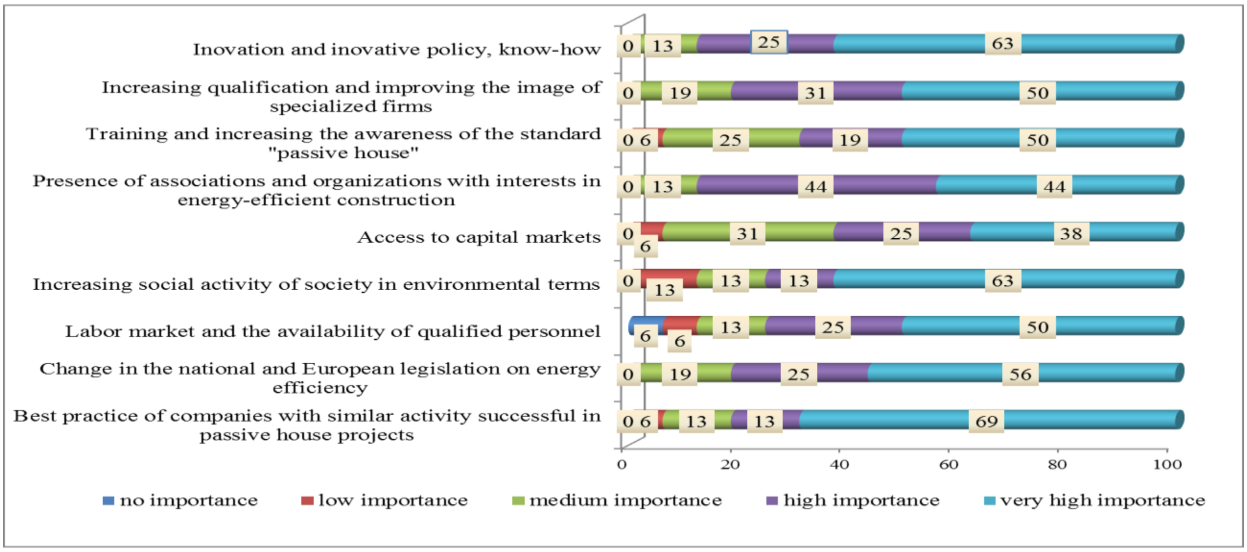


Fig.6. Evaluation of factors for increasing the benefits of passive house, %
Source: Own findings.

CONCLUSIONS

Based on the literature review of benefits of passive house and their benefit assessment could be made conclusions and recommendations as follows:

-The literature review of the benefits of passive house shows they are related to reducing energy consumption of systems, the use of non-renewable resources, providing and generating comfort in the building, reducing negative impact on the environment and preserving natural ecosystems .

-Respondents' view shows that there is large range of social, economic and ecological benefits of passive house. The highest share receives the benefits for environment and economy. Social benefits receive lowest share because the social aspect of passive house is the least studied.

-According to the expert view the holistic approach is applied in passive house projects in Bulgaria and therefore the focus is placed on the benefits in the long-term perspective.

-Assessed factors receive high evaluations in terms of its importance for the building of passive house. More than 80% consider that evaluated factors have a high or very high importance. “Creating ecological thinking and attitudes to move to energy-efficient buildings” and “Healthy internal environment” are the most significant factors for achieving social sustainability. “Cost efficiency over time” and “Long life cycle of systems” have very large range of benefits for achieving economic sustainability and most of the evaluated factors as “Energy efficiency”, “Water Conservation”, “Reduction of greenhouse gas emissions” etc. have very large range of benefits for achieving ecological sustainability.

-The highest evaluation received by factor “Best practice of companies with similar activity successful in passive house projects” shows that is necessary to disseminate the good practices of the other countries related to the sustainable innovations and passive house standard as this type of sustainable constructions in Bulgaria is still not well developed. This will help for better implementation of the Standard and will lead to improvement of quality of the project realization.

-Factors with very high assessments for increasing the benefits of passive house are “Training and increasing the awareness of the standard "passive house"” and “Increasing qualification and improving the image of specialized firms”. This requires being encouraged and undertaken specific programs supporting investors and contractors of the passive house standard in order to increase the professional capacity and their qualification related to its implementation. It is necessary to organize information campaigns and training of investors, contractors, owners, architects, specialists, experts, policy makers for increasing the awareness of the standard "passive house". This will increase the awareness for the benefits of low-energy buildings, but will also contribute to the implementation of innovative solutions in construction sector and lead to implementation of new policies supporting the transition to sustainable green energy.

-The very high importance of the factor “Interests and participation of municipalities in energy-efficient construction/projects” shows that respondents consider local authorities have an significant active role in implementation the passive house standard and development national policies and measures to support the energy efficient sector. In this regard, municipalities could create programs for financial support related to investors and owners. The advisory function of municipalities is also very important and they could provide consultations on issues related to energy efficiency.

REFERENCES

[1]Abu Bakar, A. H., Razak, A.A., Abdullah, S., Awang, A., 2010, Project management success factors for sustainable housing: a framework. Asian Journal of Management Research. 16 pp., https://core.ac.uk/download/pdf/11965245.pdf, Accessed on October 20, 2017.
[2]Adamson, Bo., 1987, Passive Climatization of Residential Houses in People’s Republic of China. Lund University. Report BKL.
[3]Bosenick, F., 2017, What are the benefits of Passive House buildings? International passive house association, https://blog.passivehouse-international.org/benefits-passive-house-buildings/, Accessed on October 20, 2017.
[4]Feist, W., 1988, Forschungsprojekt Passive Hauser. Institut Wohnen und Umwelt, Darmstadt: 1988.
[5]Moldovan, R., Dragoş, G., 2015, Increasing passive houses performances by using ecological structures. Bulletin of the Transilvania University of Braşov, Engineering Sciences. Vol. 8 (55), Series I: 383-398.
[6]Passive House Institute, Definition of passive house. http://www.passiv.de.Accessed on September, 10 2017.
[7]PassReg Project, 2015, Passive House Regions with Renewable Energies Final report. Project coordinator: Marianne Fujara. https://www.google.bg/#q=PassReg+Project,+2015.+Final+report&spf=68, Accessed, September 18, 2017.
[8]Pitts, A. 2017, Passive House and Low Energy Buildings: Barriers and Opportunities for Future Development within UK Practice. Sustainability, 9, 272, 26 pp, www.mdpi.com/journal/sustainability, Accessed on September 18, 2017.
[9]Schuster, G., Lipp, B., 2001, Das ökologische Passivhaus Grundlagenstdie, Haus des zukunft, https://nachhaltigwirtschaften.at/de/hdz/projekte/das-oekologische-passivhaus.php, Accessed onSeptember 18, 2017.
[10]Stoyanova, Z., 2015, Implementation of project management in the water sector in the EU. Proceedings of Scientific conference “Agribusiness and rural areas - present and future development”. University of Varna.

OPTIONS OF CONTROL OF PESTS AFFECTING ROOTS AND BULBS

György SZABÓ

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest, Romania, Mobile phone: +40744 538 025, Email:szabogyorgy68@yahoo.com

Corresponding author: szabogyorgy68@yahoo.com

Abstract

Knowing that we have respected the 3-4 years crop rotation, in the previous years we did not realise the damages caused by pests of the potato. In some cases, even knowing that the land was pest-free, we found that certain species are present, such as globodera wireworms, ditylenchus, meloidogyne and pratylenchu. Root mites /rhizoglyphus echnopus/ can cause serious damage. Their damage is twofold, the first one being direct and the second one indirect. Indirect damage consists of the fact that the pests open the doors to secondary infections which reach the lesions by clinging to the insects. Afterwards the fungi and bacteria can cause to these lesions bigger damage than the primary pests. Looking for the reasons of such infestation and presence of pests in the soil, asking for other experts' opinions on soil analysis, it was earnestly started to think about controlling these pests. Being aware of the existence of biological pest control, it was contacted the company BIÓVÉD 2005 kft which provided the hyperparasitic fungus Arthrobotris oligospora. The research performed in parallel on crops such as tomatoes, cucumbers, cabbage, cauliflower, peppers, carrots, parsley, in the vegetable fields in the South-East of Hungary and in the Covasna County depression. The purpose of the paper was to monitor the activity of the A. Oligospora fungus in the soil at various temperatures, at various stages of the life cycle of the potato crop and to apply the optimal dosage of fungus on a preset surface. The conclusion was that the treatment split between autumn and spring gives the best results because the rains falling in August – September and March respectively help the hyperparasitic fungus to penetrate the soil at the proper depths for it to take effect.

Key words: *tuber nematode, germination, humidity*

INTRODUCTION

Controlling most pests that attack the potato is very difficult. The most dangerous are the species of wireworms such as globodera, ditylenchus, meloidogyne and pratylenchus.[4] Root mites /rhizoglyphus echnopus/ can cause serious damage.[5].

So far the basis of control was adequate crop rotation which is not always effective because among the pests there are multiple hosts organisms.

Chemicals don't offer sufficient protection and are a rather expensive solution.

Pest control is hindered by the fact that some species remain viable for several years even without the host plant and some of them can migrate over a large area.

Researchers have been working to fight them using hyperparasitic fungi. [8] Most research are focused on species of arthrobotris.

MATERIALS AND METHODS

Research was conducted with the sample product of company Biovéd 2005 Kft-Hungary, labelled AO. [7]

The experiment surfaces were highly infected with the species globodera rostochiensis, ditylenchus destructor, meloidogyne and pratylenchus. [4] Root mites were also present on all experiment surfaces.

Photo 1. Infested potatoes
Source: Own source.

A three year crop rotation was maintained on the host surface, soil and plant analysis proving the existence of the aforementioned pests. The mentioned surface is located in Romania, Covasna County in Transylvania. [9] The following image is not unique in Transylvania. The damage doesn't stop with the harvest, but continues in storage. In a lot of cases, the presence of secondary pests leads to moist putrefaction.

The following damages can be seen at harvest time.

A large quantity of crop remained on the ground, leading to a guaranteed spread of infection.

The only solution to eliminate the pests would be leaving the land fallow for several years. Most farmers don't consider this an option, which is why major losses are recorded every year. Using nemathorin is extremely expensive and doesn't represent the perfect solution.

My experiments concerned these surfaces which were treated with AO. The outcome is rather ambiguous because we were not familiar with the application process.

AO had no effect on root mites, the damages being identical after each treatment.

But the aforementioned wireworms were completely eliminated after certain treatments with AO. It was subsequently identified the reason of the varying success. Also, it was found the reason of failure to be the application method. If AO and pesticides are properly applied, we can successfully control wireworms such as Meloidogine incognita, regular wireworms attacking the potato, the potato rot nematode Ditylenchus destructor and migratory species. [1]

RESULTS AND DISCUSSIONS

The outcome of timely and proper AO treatment could be observed on the field, and the laboratory analysis showed a lack of cyst and warms. The crop measured at harvest time included a surplus of 16 tons, in favour of the treated crop. On cultivated land where the crude crop is around 32-36 tons, a 16 tons surplus is a significant result.

We hope that losses resulting from the storage of potatoes on treated surfaces will also be significantly lower than for untreated ones. The measurements will be recorded after the potatoes are removed.

On similarly infected land with the surface presented, we have implemented a cultivation experiment on 12 ha, where the treated surface will have a preset area. In view of this year's results, the land owner is willing to leave only ½ ha as control surface.

Practically, the arthrobotris application technology is finalized, the possibility of usage on a large scale depending on the product authorization.

Chemicals authorized nowadays are very expensive and not efficient enough. They are a burden on the environment and their application requires major precautions.

Arthrobotris is a fungus that can be found in nature and has no impact on the environment.

Arthrobotris oligospora [10] is first of all a fungus specialised in capturing nematodes. The formulation made from it is suitable to control the infection with certain species of nematodes. The fungus itself is saprohytic in nature and lives in the soil and in the presence of a convenient living organism it captures it with a loop formed specifically for this purpose. In this case it functions as a predator as long as it can find prey. We might call it a lion of the soil.[6]

It tolerates frost rather well, germination starts at temperatures around 10°C, the optimum temperature for reproduction being 22-25°C. Its activity slows around 30°C, and it completely ceases at 35°C.

After application it tolerates very well the light of day, being spread on dry soil it stays alive a long time and it starts to activate only when the soil humidity reaches the proper level. Soil drying quickly after germination significantly decreases its effectiveness.

Species of nematodes against which it can be used successfully:

(i)Potato/bulb nematode /species Ditylenchus./

(ii)Root-knot nematode /species Meloidogyne./[3]

(iii)Wireworms/beet phylloxera /heterodera sch./

(iv)Potato nematode /heterodera ro./

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

(v) Radicle nematodes /pratylenchus/.[4]

Photo 2. Tuber infested with Potato nematode (Ditylencus)
Source: Own source.

Photo 3.Tuber attacked by the wireworm (Agriotes)
Source: Own source.

With respect to the listed species, it was obtained experience on an industrial scale. The usage technology was developed on crops of potatoes, carrots, green vegetables, celery, peppers, tomatoes, beets, onion, cucumbers, cabbage.

The formulation might be effective as well against other species of nematodes, but we didn't have an opportunity to assess this on an industrial scale or on small plots.

During the experiments, it was noticed that Arthrobotris o. can also be used successfully against various types of insects, such as: (i)greenhouse whitefly, (ii)against pepper thrips and (iii)against bulb mites.[4].

Suggestion of utilisation:

On highly infected surfaces, against known pests, split treatment had the best outcome every time.

-It is recommended to apply the first treatment starting with the end of August, the end of October at the latest. For an effective protection /on a highly infected surface, for example where the previous damage was of 30% for potatoes or 40-50% for carrots/ the recommended dose is 1-1,5 kg/ha.

-In the spring, when the soil is prepared, 8-10 days before seeding or sowing, we apply and mix in the soil Arthrobotris in quantity of 1 kg/ha.

-On highly contaminated soil, after seeding but before using herbicides, we apply again 1 kg/ha. We introduce this treatment in the soil by irrigation. For less infected soil, the third treatment can be omitted.

The formulation Arthrobotris is sensitive to certain herbicides, slows down germination, its reproduction decreases, making it less effective. To avoid any adverse effects of chemicals, the sprayer must be cleaned very well to eliminate any traces of solution and the formulation must be applied on its own, mixing it with the soil by making use of agricultural machinery. After seeding or sowing, the Arthrobotris spread will be irrigated in the soil with a precipitation of 8-10 mm. Herbicides and anti-fungi solutions should be preferably used afterwards.

The effectiveness of the formulation depends greatly on the soil humidity after the application. Neither the fungus nor the nematodes are active on dry soil. We can expect the best results if the treatment is applied on good weather, from the end of August until the middle of September, as in this period the soil usually receives enough precipitation for the fungus to activate. The soil temperature is also high enough to allow the fungus to reproduce quickly.

The fungus doesn't die on frosted soil, but it doesn't activate either. The germination starts in the spring at a temperature over 10°C. The application must take place before this, on soil with a lower temperature, for proper mixing. The fungus doesn't travel far in the soil, therefore it is very important to spread it as evenly as possible.[8]

With respect to the listed species, I have obtained experience on an industrial scale. The usage technology was developed on crops of potatoes, carrots, green vegetables, celery, peppers, tomatoes, beets, onion, cucumbers, cabbage.

The formulation might be effective as well against other species of nematodes, but I didn't have an opportunity to assess this on an industrial scale or on small plots.

During the experiments I noticed that Arthrobotris o. can also be used successfully against various types of insects, such as.:

1. greenhouse whitefly.
2. against pepper thrips.
3. against bulb mites.[4]

Suggestion of utilisation:

On highly infected surfaces, against known pests, split treatment had the best outcome every time.

1. It is recommended to apply the first treatment starting with the end of August, the end of October at the latest. For an effective protection /on a highly infected surface, for example where the previous damage was of 30% for potatoes or 40-50% for carrots/ the recommended dose is 1-1,5 kg/ha.
2. In the spring, when the soil is prepared, 8-10 days before seeding or sowing, we apply and mix in the soil Arthrobotris in quantity of 1 kg/ha.
3. On highly contaminated soil, after seeding but before using herbicides, we apply again 1 kg/ha. We introduce this treatment in the soil by irrigation. For less infected soil, the third treatment can be omitted.

The formulation Arthrobotris is sensitive to certain herbicides, slows down germination, its reproduction decreases, making it less effective. To avoid any adverse effects of chemicals, the sprayer must be cleaned very well to eliminate any traces of solution and the formulation must be applied on its own, mixing it with the soil by making use of agricultural machinery. After seeding or sowing, the Arthrobotris spread will be irrigated in the soil with a precipitation of 8-10 mm. Herbicides and anti-fungi solutions should be preferably used afterwards.

The effectiveness of the formulation depends greatly on the soil humidity after the application. Neither the fungus nor the nematodes are active on dry soil. We can expect the best results if the treatment is applied on good weather, from the end of August until the middle of September, as in this period the soil usually receives enough precipitation for the fungus to activate. The soil temperature is also high enough to allow the fungus to reproduce quickly.[2]

A substantial crop surplus can be obtained by feeding nutrients according to the plant requirements. It is recommended to dose N in several stages, to avoid having the excess N lead to a decrease in crop quality.[9]

CONCLUSIONS

Following the extended drought in the spring, the activity of Arthrobotris could stop definitively, land irrigation being required to prevent this.

It is not yet clear for what period the fungus remains active, what is certain is that it works very well when using a consistent technology.

The crop on the treated land is significantly bigger than on land that wasn't treated, since the plant doesn't „feed" the worms. It's worth noting that the plants' need of nutrients also changes. We recommend a leaf analysis during the proper stages of the phenophase, based on which the nutrients should be administered to the plant.

The crop's storage period increases considerably, especially for plants with edible roots. Very few pests reach the storage room, hence very little damage occurs in storage. It doesn't create the proper conditions for fungi and bacteria.

Observations were also made on crops of grapes, raspberry, apple, peach, but additional research is needed. It was found that it is highly applicable on field as well as on horticultural plants and on flower gardens.

The formulation Arthrobotris o. can be used with very good results on numerous industrial plants. The technology isn't very different, but change is often justified depending on the type of soil, infection level or soil sensitivity.

ACKNOWLEDGEMENTS

I want to thank Dr. Bohár Gyula, owner of the company Bióvéd 2005 kft- Hungary, for his support, for providing the microbiological product Artrobotrys oligospora used in the experiments. Thanks to Eng. Osváth Zoltán, breeder of potato cultivars in Prügy- Hungary, who provided guidance with the experiments throughout the years. Thanks to Prof. Dr.

Stelica Cristea as scientific counselor in preparing the paper for publication.

REFERENCES

[1]A biologiai novenyvedelem alapjai (The basics of biological nutrition), https://issuu.com/ezvans/ docs/fischl_g__za_-_a_biol__giai_n__v__n, Accessed January 10, 2018
[2]Antal Aniko Katalin, 2003, Study of biological control methods with nematode-trapping fungi against root-knot nematodes, Ph.D.Thesis, Pannon Egyetemi Konyvtar es Leveltar, konyvtar.uni-pannon.hu/doktori/2003/Antal_Aniko_dissertation.pdf, Accessed January 10, 2018.
[3]Bozsik, A., 2006, A terjedés és a kártétel szempontjából fontos állati kártevők az Európai Unióban (Occurrence of animal pests with importance from point of view of dispersion and damage in the European Union, a teaching guide), Debrecen, https://www.researchgate.net/.../A-terjedes-es-a-kartetel-szempontjabol-fontos-allati-ka..., Accessed January 10, 2018.
[4]Daunatorii cartofului si afectarea plantelor, (Potatoes pests and plant damage)www.horticultorul.ro/insecte-boli-daunatori.../daunatorii-cartofului/, Accessed January 10, 2018.
[5]Fan, Q-H., Zhnag, Z-Q., 2003, *Rhizoglyphus echinopus* and *Rhizoglyphus robini* (Acari: Acaridae) from Australia and New Zealand: identification, host plants and geographical distribution, Systematic & Applied Acarology Special Publications (2003) 16, 1-16, hbs.bishopmuseum.org/fiji/pdf/fan-zhang2003.pdf, Accessed January 10, 2018.
[6]Mandoki, Z., 2012, Environmentally friendly control methods against the southern root-knot nematode (Meloidogyne incognita CHITWOOD, 1949)) in forced vegetables (A kertészeti gyökérgubacs-fonálféreg (*Meloidogyne incognita* CHITWOOD, 1949) elleni környezetkímélő védekezés lehetőségei a zöldséghajtatásban), Budapest Corvinus University, phd.lib.uni-corvinus.hu/646/1/Mandoki_Zoltan.pdf, Accessed January 10, 2018.
[7]Microbiology, 2018, https://bioved.hu/mikrobiologia/, Accessed January 10, 2018.
[8]Protecția plantelor cu soluții fungice economice, (Plant protection with economic fungi solutions) http://www.protectieplante.ro/, Accessed January 10, 2018
[9]Szabo Marton, 2014, Növénykártevő fonalférgek visszaszorításának lehetősége nematóda-csapdázó és *Trichoderma* gombák segítségével: *in vitro* konfrontációs és génexpressziós vizsgálatok *Caenorhabditis elegans* modellrendszer felhasználásával, (The possibility of suppressing plant disease nematodes is a nematode trap and Trichoderma fungi: in vitro confrontation and gene expression studies using Caenorhabditis elegans model system), Ph.D. Thesis, Szent István Egyetem, Gödöllo, https://szie.hu/file/tti/archivum/Szabo_Marton_ertekezes.pdf, Accessed January 10, 2018.
[10]Varga Laszlo, 2014, „Sprinterek" a biológiai hatóanyagok között ("Sprinter" among biological agents), AgroInform, https://www.agroinform.hu/.../sprinterek-a-biologiai-hatoanyagok-kozott-20430, Accessed January 10, 2018

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

APPLICATION OF THE FUNGIC FORMULATION ARTHROBOTRIS OLIGOSPORA AGAINST THE NEMATODE DITYLENCHUS DESTRUCTOR

György SZABÓ

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest, Romania, Mobile phone: +40744 538 025, Email: szabogyorgy68@yahoo.com

Corresponding author: szabogyorgy68@yahoo.com

Abstract

In the year 2008 we started to use a microbiological product based on hyperparasite fungi, named Arthrobotris oligospora against nematodes, on several crops such as potatoes, carrots, parsley, knowing that this pests cause significant damages. We resorted to biological control, seeing as chemical control can be expensive. The purpose of the paper was the monitoring of and the decrease in the rate of the infestation caused by the nematode Ditylencus destructor from 43.2 % to 1.4%. Following application of the microbiological product in various quantities both in autumn and in spring, we reached an optimum dosage during the vegetative stage. The differentiated application of the microbiological product both in autumn, 1.5 kg and in spring, 1.5 kg led to the desired outcome. Based on the results obtained we concluded that in autumn, the product applied against nematodes has enough time to develop and infiltrate the soil to have the desired effect, i.e. capturing nematodes. This can actually be observed in the yield, when for a dose of 1.5 kg fungus / ha applied in the autumn, we obtain a healthy crop of 25.8 to/ha, and for 1.5 kg fungus /ha applied in the spring we obtain a healthy crop of 19.9 to/ ha. When using the fungus, the soil is not chemically loaded and it doesn't present after-effects from other crops. The microbiological product based on A. oligospora has better results when the soil humidity reaches a saturation of 80%. On land with insufficient humidity, the results decline.

Key words: *tuber nematode, harvest, humidity*

INTRODUCTION

Starting with 2003, infections with the nematode Ditylenchus destructor [6] spread dramatically in Romania as a result of massive imports of planting stock from the European Community. The infection spread in several ways, such as feeding animals with infected potatoes and using the manure for fertilisation, selling non-certified seed potatoes, grazing sheep on land where potatoes had been cultivated, after the harvest, and moving farm equipment from one plot to the other, etc.
Monoculture and intensive crop rotation led to huge damages caused by this pest year on year, on considerable surfaces. [1] A frequent situation is having the farmer leave half of the yield on the field at harvest time. On the experiment surface, based on the yield records, around 15-16 tons of potatoes were left on the field.

MATERIALS AND METHODS

A technological application experiment /2008-2009/ on an area infected with Ditylenchus destructor took place near Sfantu Gheorghe, Campul Frumos region, in Transylvania, Covasna County, Romania. The area was a 10 ha non-irrigated field.
The composition of the microbiological product AO is the following [2]:
It doesn't contain any dangerous substances.
Ingredients: Active substance: approx. 5% w/w
Conidia of Arthrobotrys oligospora fungi in min. concentration $2x10^8$ conidium/g
Carrier: Perlite: approx. 85-95% w/w
Water content: max. 5% w/w
The formulation is sensitive to fungicides, acids and alkali, and agents attacking organic substances. The quality of this formulation is decreased by storing it in humid conditions and at a temperature over 30 °C.

The quantity of water used to dissolve the AO product was 400 l/ ha.

The formulation can be applied using any kind of sprayer, provided that the mixer is in good functioning condition, the formulation being prone to settle. The equipment must be well cleaned of any chemical traces, because antifungal solutions and certain herbicides prevent the germination of the AO fungus or hinder its growth.

The objective of the experiment is to determine the optimum date and dosage for the application of the fungic formulation Arthrobotrys oligospora /AO/ against the potato nematode Ditylenchus destructor. [7]

In choosing the surface we considered the fact that in the year 2007, the potatoes grown on this surface were infected with Ditylenchus to a considerable extent. This pest is widely spread in Transylvania, and potatoes can hardly be grown without disinfecting the soil. [3]

Table 1. Treatments applied during the experiment:

No	Treatment	Surface
1.	00 control, / the soil was not disinfected/.	0.24 ha.
2.	Nemathorin disinfectant 10G 30 kg/ha, at the time of the sowing [6]	1.00 ha.
3.	Nemathorin 10 G 18 kg/ha + AO 1.5 kg/ha, at the time of the sowing	1.00 ha.
4.	AO 1.5 kg/autumn, + AO 1.5 kg/spring, applied during soil preparation	4.76 ha.
5.	AO 1.5 kg/spring, applied during soil preparation	1.00 ha.
6.	AO 1.5 kg/autumn, applied before land cultivation	1.00 ha.
7.	AO 3 kg/spring, mixed in during soil preparation	1.00 ha.

Note: Sowing date: 08-09-10 April 2009.
Source: Own experiment.

Before emergence it received 18 mm precipitation, in May it rained 22 mm, in June 12 mm, in July 16 mm.

Harvest: between September 26 and October 08.

RESULTS AND DISCUSSIONS

As shown in Table 2, the smallest crop was obtained on the control plot where no anti-nematode substance was applied, as well as the biggest crop infected at a 43.2% ratio. The lowest level of infection, i.e. 1.4 % was obtained on the plot where the AO quantity was applied in a differentiated system, both in autumn and in spring.

By comparison with the plot where the application of 1.5 kg/ha was only made in spring, we can conclude that AO is effective when the soil humidity is higher, having sufficient time to infiltrate the soil in depth and destroy the nematodes. In dry springs, such as 2009, when the precipitation was insufficient for emergence and growth, we find that the AO fungus was not effective in capturing nematodes because the water scarcity didn't create a proper environment for its survival and action.

Table 2. Treatments applied by crop type

No.	Treatments kg/ha	Gross crop kg/ha	Healthy crop kg/ha	Infected crop kg/ha	Infected crop %.
1.	00 control	27,120	15,404	11,716	43.2
2.	Nemathorin 10G 30 kg/ha	32,640	30,453	2,187	6.7
3.	Nemathorin 10G 30 kg/ha + AO 1.5 kg/ha	30,420	24,884	5,536	18.2
4.	**AO 1.5 kg/autumn, + AO 1.5 kg/spring**	**33,170**	**32,706**	**464**	**1.4**
5.	AO 1.5 kg/spring	29,100	19,963	9137	31.4
6.	AO 1.5 kg/autumn	30,860	25,830	5,030	16.3
7.	AO 3 kg/spring	29,890	21,909	7,981	26.7

Source: [7]

When soil humidity is insufficient, the nematodes are searching for a source of water to survive, and in the absence of water, they enter the tuber through the umbilical area, where the potato skin is very thin. [9] This is why is was found that big tubers have higher chances of being infected by nematodes, from the first appearance of new tubers.

The extent of the damages continues to increase in storage, being possible for most of the yield to rot if stored at warm temperature. It is recommended to cool stored potatoes by ventilation. [4]

The cost of Nemathorin 10 G per ha is 800 Euros, a considerable amount, especially when compared to the volume/quantity obtained on untreated surfaces.

Photo 1. Infested potatoes
Source: Own source

CONCLUSIONS

Based on the data obtained, we can conclude that with respect to AO, **differentiated treatment in autumn-spring** has the best results. The infection ratio is obviously lower for this treatment, and the yield is over 20% bigger. [10]

The yield increase is probably stimulated as well by the fact that besides nematodes, AO also greatly decreases the number of root mites.

Increasing the AO dosage doesn't necessarily have a positive effect, in the spring the soil temperature is probably still too low for fungus activity while later on, dry weather doesn't encourage reproduction.

On surfaces extensively infected with Ditylenchus destructor it is recommended to apply the differentiated treatment. Differentiated treatment provides sufficient time for fungus reproduction and this is the season when natural precipitation create favourable soil conditions.

The recommended AO dose is 1.5 kg/ha autumn and 1.5 kg/ha spring. It is important to apply and process it at the right time.

Adjustment of other experiments, to determine whether AO-type soil disinfectants and Nemathorin 10 G can be applied together. [5]

Laboratory analyses confirmed the compatibility of the two substances, but after application on the selected area, the results were not positive.

It is appropriate to analyse the subsequent life of surfaces treated with AO. We anticipate that Ditylenchus destructor will disappear in the following year from the surface treated effectively with AO. The field remains clean until the pest is introduced on the surface with infected seed potatoes.

It would be interesting to make this experiment on an area that was optimally irrigated, to receive an answer to the question to what extent is fungus activity influenced by uniform soil irrigation.

International literature focused for a long time on using fungi to control pests and diseases since some of these species have a fungicide and insecticide effect.

Chemicals used in plant protection have a secondary effect on production and are retained in the soil, causing health problems to people, by absorption. This is why some pesticides were withdrawn from the market, replaced with other less toxic pesticides or microbiological products.

The properties of these hyperparasite and antagonist fungi have good effects on increasing production and maintaining soil fertility.

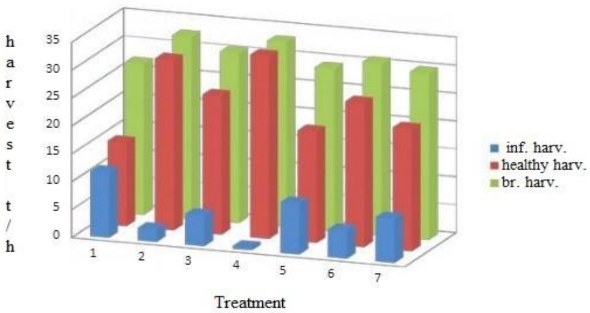


Fig. 1. Quantities according to treatments
Source: Own design based on own results.

This fungus species - Arthrobotrys oligospora – creates unfavourable conditions in the soil, after treatment, for insects to reproduce and cause harm. It has such effect on nematodes, wire worms, caterpillars and thrips larvae and on other insects living in the soil, without affecting the earthworm. This behaviour gives Arthrobotrys an important place in biological culture.[8].

In storing the fungus product, attention should be paid to keep the temperature in cool and dry spaces under (20-25 C). In this case storage should not exceed 3 months. During the application, the sprayer pressure is not relevant. A superficial incorporation or irrigation is recommended after application, as it helps achieve the desired effect. If the application uses the drip irrigation system, the fine filters must be removed to avoid clogging as a result of sedimentation. It can be applied mixed with soluble fertiliser and other bacteria-based products which condition the soil. It should not be applied together or mixed with products containing Trichoderma, which consumes it, being an antagonist. The recommended dosage is 1,5-3 kg/ha or in concentration of 1%, applied to the soil surface and superficially incorporated before sowing or seeding, and it can be applied both before and after emergence. Benefits of the Arthrobotrys fungus: - biologic product with a wide-ranging effect on pests living in the soil, it is a growth stimulant which can be applied to all vegetable crops, small dosage at minimum costs, encourages the growth of the undamaged root and diminishes the effect of nocuous fungi and bacteria on the root, solid plant growth with multiple yields, healthy root which can better process nutrients. Natural break down causes a significant amount of gibberellin, which has a positive effect on the plant's generative stages - florescence, fertility, vegetation.

ACKNOWLEDGEMENTS

I want to thank Dr. Bohár Gyula, owner of the company Bióvéd 2005 kft- Hungary, for his support, for providing the microbiological product Artrobotrys oligospora used in the experiments. Thanks to Eng. Osváth Zoltán, breeder of potato cultivars in Prügy- Hungary, who provided guidance with the experiments throughout the years. Thanks to Prof. Dr. Stelica Cristea as scientific counselor in preparing the paper for publication.

REFERENCES

[1]A burgonya legfontosabb kártevõi (The most important pests og potatoes), https://www.agronaplo.hu/szakfolyoirat/2005/5/.../a-burgonya-legfontosabb-kartevoi, Accessed January 9, 2018

[2]Biovéd – növények kedvence, https://bioved.hu/, Accessed January 9, 2018

[3]Cum dezinfectam solul din solar, (How do we disinfect the soil from the green-house) 2016, Agrointeligenta, agrointel.ro/68334/cum-dezinfectam-solul-din-solar/, Accessed January 9, 2018

[4] Igy lehet kihuzni oszi burgonyaval tavaszig (So you can get it out with potato until spring), https://24.hu/fn/gazdasag/2012/10/20/igy-lehet-kihuzni-oszi-burgonyaval-tavaszig/, Accessed January 9, 2018

[5]Nemathorin 10 G, insecticid pentru nematozi (Nemathorin 10 G, insecticide for nematodes) www.seminteplante.ro/.../3261-insecticid-nemathorin-10-g-100-gram... Accessed January 9, 2018.

[6]Nematodul tuberculilor de cartofi (Ditylenchus destructor), (Potato tubers nematode) www.horticultorul.ro/insecte.../nematodul-tuberculilor-de-cartof/, Accessed January 9, 2018.

[7] Protecția plantelor cu soluții fungice economice, Plant protection with economic fungi solutions), www.protectieplante.ro/, Accessed January 9, 2018

[8]Ragadozo gombak, 2007, Akcios potential, akciospotencial.blog.hu/2007/11/07/ragadozo_gombak, Accessed January 9, 2018.

[9]Sándor, F., András, N., 2011, A vadállomány szabályozása - A fenntartható vadgazdálkodás populációökológiai alapjai, (Controlling game stock - The population-ecological fundamentals of sustainable game management), www.tankonyvtar.hu/hu/tartalom/tamop425/2011_0001_521_A.../ch02.html, Accessed January 9, 2018.

[10]„Sprinterek" a biológiai hatóanyagok között, („Sprinterek" between biological agents) https://www.agrokerholding.hu/Pages/Hirek/?hid=1374? hid=1374, Accessed January 9, 2018.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EVOLUTION OF TOURISM IN THE WORLD AND NATIONAL CONTEXT

Cristiana TINDECHE, Alina Gabriela MĂRCUȚĂ, Adelaida Cristina HONȚUȘ

University of Agronomical Sciences and Veterinary Medicine - Bucharest, Faculty of Management, Economical Engineering in Agriculture and Rural Developments, No. 59, Mărăşti Boulevard, no.1 Sector, Bucharest, cod 011464, Romania, e-mail: tindeche_cristina@yahoo.com, alinamarcuta@yahoo.com, adelaidahontus@yahoo.com

Corresponding author: adelaidahontus@yahoo.com

Abstract

In Romania, as a socio-economic phenomenon, tourism is included in the unitary economy of the country. Thus, tourism is becoming a major coordinated civilization society. In the European Union and tourism is considered an important industry who knows the great potential for future development. The working methods used are based on a statistical analysis and the material consists of a database provided by Eurostat that reflects the situation in the 28 countries of the European Union. Tourism statistics are not only used to monitor EU tourism policies but also EU regional policy and sustainable development policy. The forecasts for the coming years, the assessment of factors permanent optimistic tourism sector remaining the fastest pace of development. In the theoretical context of regional science, with its many disciplines and practical, determined by the economic and social role of tourism at European and national level, in this paper we approached the regional tourism development in the EU Member States, giving more importance to Romanian tourism. The study shows that the approach of tourism development in the European Union enjoys a lot of interest from the researchers, from many points of view: theoretical and applicative, in the aspects of planning and tourism development, regional, quantitative through modelling and prognosis, qualitatively through structural analyses on history, dynamics, trends, tourist flows, destinations and forms of tourism, etc.

Key words: *tourism, accommodation capacity, gross domestic product (GDP), income from tourism*

INTRODUCTION

Tourism is a consequence, it must be supported by the development of other economic and socio-cultural activities, but this requires state/government intervention in a concerted way, in other words, a single tourism strategy can't be effective unless it is corroborated with support strategies developed for the other sectors (transport, agriculture, industry, commerce, culture, education, etc., plus tax strategies).

Tourism has the potential to contribute to employment and economic growth as well as to the development of rural, peripheral or less developed areas. In view of these characteristics, reliable and harmonized statistics are needed in this area as well as in the wider context of regional policy and sustainable development policy. [11]

Tourism statistics are used to monitor not only EU tourism policies, but also EU regional policy and sustainable development policy.

In a statistical context, tourism refers to the activity of visitors who travel to a destination outside their usual environment for less than a year. [7] Such trips may be made for any principal reason, including business, leisure or other personal reasons, other than employment by a resident employer, household or business in the place visited.

Currently, tourism statistics are limited to a minimum stay of one night; starting with the 2016 reference year, European official statistics also includes visits abroad for less than a day. [20]

The engine of tourism development is tourism workforce and employment [13].

Tourism is an economic activity which could contribute to the reduction of unemployment in the world, as it has done so far, but the quality of its employees is the driver of its development. [14].

The development of the tourism is considered as a priority economic option, having in mind the high potential for a large variety of tourism types. [16].

In Europe, Romania is one of the countries where the number of arrivals has been increasing constantly in the past years. [15].

A system of tourism statistics has been established by Council Directive 95/57 / EC of 23 November 1995 on the collection of statistical data in the field of tourism. Under this legal basis, EU Member States must regularly provide a set of comparable statistics on tourism. [5]

According to a World Tourism Organization publication (UNWTO) entitled "Tourism highlights", the EU is a major tourist destination, with five of its member states being among the top ten destinations in the world in 2016. [17]

In this context, the purpose of the paper was to analyze the evolution of tourism at the world and national level.

MATERIALS AND METHODS

The measurement of the tourist phenomenon is based on a system of indicators, which are calculated on the basis of the following information: Macroeconomic indicators (indicators for tourism accommodation capacity evaluation, tourist traffic assessment indicators, financial indicators) [1, 17]; Microeconomic indicators (tourism demand indicators, tourism supply indicators, demand-supply relationship indicators, result indicators) [1, 17]; Tourism efficiency indicators (economic efficiency indicators of the accommodation base, economic efficiency indicators of public catering activity, economic efficiency indicators of tourism activity, indicators of economic efficiency of recreational activity, indicators of social efficiency). [1, 17]

The material used consists of a database provided by Eurostat that reflects the situation in the 28 countries of the European Union regarding the number of tourist units, the number of tourists, the number of overnight stays, the situation of expenses and receipts related to tourist activity, etc. [8]

RESULTS AND DISCUSSIONS

Worldwide, tourism has become one of the fastest growing economic sectors, a conclusion based on issues such as: tourism has a direct, indirect contribution, and induced by 9% in gross domestic product (GDP); 1 in 11 jobs are in tourism; the volume of international tourism exports accounts for about 6% of world exports; the number of international tourists increased from 25 million tourists in 1950 to 1,035 million arrivals in 2016, with an increase of 1.8 trillion international tourists forecast for 2030. Europe is the world's largest number of international tourists, annual average rate over the period 2005-2016 of 2.5%.[6] In 2016, 51.6% of international tourist arrivals were registered in Europe, compared with 40% in 2008, and 77% (412.2 million) were international travel arrivals in EU Member States. Among the EU countries (28), in 2016, France ranks first in the world in terms of arrivals of international tourists (83.0 million), followed by Spain - the third largest in the world - with 57.5 million arrivals, Italy - No. 5 in the world - with 46.4 million arrivals, Germany - the world's No. 7 in the world with 30.4 million arrivals, UK - the eighth largest in the world - with 29.3 million arrivals, etc. [10]

Romania recorded 1.7 million international travel arrivals and 1.5 million USD receipts from international tourism in 2016. If the adjacent sectors are also taken into account, it is estimated that a total contribution to EU GDP of around 10% is expected and 12% of total employment. [6]

According to the literature, in some EU Member States more than half of the total number of tourist trips made in 2016 were to destinations abroad; these are Luxembourg, Belgium, Malta and Slovenia (as well as Switzerland). However, at most 10% of the trips made by residents in Romania, Spain and Portugal were abroad. [19]

It is estimated that around 61.1% of the EU-28 population aged at least 15 years participated in personal tourism activities in 2016, more precisely at least one tour of personal interest during the year. Again, there

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

are large differences between EU Member States, as the participation rate ranged from 25.1% in Romania to 88.5% in Finland. (Table 1). [8]

Table 1.Tourist tours of residents (aged at least 15 years), 2016

	Number of trips (thousands)			Breakdown of all trips by destination and duration (%)				Share of the population (aged 15+) taking part in tourism trips for personal purposes (%)
	All trips	Short trips (1-3 nights)	Long trips (4+ trips)	Short domestic trips (1-3 nights)	Long domestic trips (4+ trips)	Short outbound trips (1-3 nights)	Long outbound trips (4+ trips)	
EU-28	**1,182,025**	**678,873**	**503,152**	**50.5**	**24.4**	**6.9**	**16.1**	**51.1**
Belgium	13,031	4,896	8,135	11.3	6.0	26.3	56.4	56.5
Bulgaria	3,774	2,196	1,578	52.7	31.3	5.5	10.5	25.8
Czech Republic	32,693	20,675	12,018	58.8	23.9	4.4	12.9	83.9
Denmark	31,792	23,512	8,280	64.3	9.9	9.7	16.1	83.0
Germany	236,910	122,242	114,668	43.7	21.2	7.9	27.2	76.0
Estonia	3,998	3,058	940	58.4	5.9	18.1	17.6	71.1
Ireland	11,910	6,821	5,089	41.3	9.2	16.0	33.5	74.1
Greece	6,334	1,893	4,441	27.9	60.9	2.0	9.2	38.5
Spain	127,933	88,701	39,232	66.5	25.5	2.8	5.2	52.9
France	226,261	119,794	106,467	49.7	38.2	3.2	8.9	71.3
Croatia	8,173	4,974	3,200	42.8	23.4	18.1	15.7	49.2
Italy	54,993	28,507	26,485	45.4	33.7	6.4	14.5	37.7
Cyprus	2,495	1,217	1,278	39.6	12.4	9.2	38.8	61.9
Latvia	4,620	3,313	1,305	60.2	10.3	11.5	18.0	51.5
Lithuania	4,438	2,779	1,659	48.8	10.9	13.8	26.5	57.9
Luxembourg	1,845	849	997	1.4	-	44.6	53.7	82.5
Hungary	17,317	11,628	5,689	53.7	18.9	13.4	13.9	53.0
Malta	510	222	288	26.0	5.0	17.6	51.4	52.7
Netherlands	42,280	22,021	20,259	42.1	16.5	10.0	31.4	82.2
Austria	22,470	12,633	9,837	37.2	13.9	19.0	29.9	75.6
Poland	48,630	25,275	23,354	48.0	30.9	3.9	17.1	53.3
Portugal	14,556	10,382	4,274	67.3	22.7	3.5	6.5	38.5
Romania	17,387	10,433	5,953	59.6	34.5	0.4	5.5	25.1
Slovenia	4,531	2,960	1,570	34.3	7.3	31.0	27.3	62.8
Slovakia	7,063	3,331	3,732	33.6	23.0	13.6	29.8	53.6
Finland	37,605	28,011	9,594	62.2	14.5	12.3	11.0	88.5
Sweden	38,953	26,573	12,390	59.2	17.3	9.0	14.5	76.6
United Kingdom	159,414	89,976	59,438	49.9	17.3	6.6	26.2	65.7
Switzerland	19,630	9,260	10,370	24,6	12.2	22.6	40.6	83.5

Source: [9]. http://ec.europa.eu/eurostat/data/database

With regard to the offer, it is estimated that just over 570,000 tourist accommodation units were active in the EU-28 in 2016 and that together they provided almost 31 million accommodation places (Table 2). [8].

Almost one third (32.2%) of EU-28 accommodation places were concentrated in only two of the EU Member States, namely France (5.1 million accommodation places) and Italy (4.8 million places of accommodation), followed by the United Kingdom, Spain and Germany.

In recent years, the number of overnight stays in tourist accommodation structures has generally tended to rise.

However, there was a short-term decrease in the number of nights spent in tourist accommodation establishments in 2008 and 2009 as a result of the economic and financial crisis: the number of tourist nights in the EU-28 decreased by 0.6% in 2010 and with another 2.1% in 2011. In 2012, the number of tourist nights spent increased by 4.7%, and this positive evolution continued, with growth of 3.3% in 2013, 4.3% in 2014 and 2.1% in 2015. In 2016, the number of nights spent in tourist accommodation establishments in the EU-28 reached a maximum of 2.7 billion nights, up 1.8% compared to 2015. [8]

EU-28 residents spent about 2.6 billion nights on holiday abroad in 2016. German residents spent 730 million nights traveling outside Germany in 2016, and UK residents spent 564 million nights abroad (data for 2016); residents of the two Member States accounted for more than half (50.4%) of the total number of nights spent abroad by EU-28 residents. [8]

Taking into account the size of the population of a country, Luxembourg was the EU Member State whose residents spent the most nights abroad per capita (an average of 24.6 nights in 2016), followed by Cyprus (20.3).

On the other hand, tourists from Romania, Bulgaria and Greece spent on average less

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

than one night on foreign travels in the year 2016.

Table 2.Tourist accommodation structures, 2016

	Number of establishments (units)	Number of bed places (thousands)	Nights spent of residents or non-residents (millions)
EU-28			
Belgium	5,139	366.2	32.6
Bulgaria	3,163	314.3	21.7
Czech Republic	9,013	710.4	42.9
Denmark	1,118	420.0	29.6
Germany	50,925	3,318.6	366.5
Estonia	1,419	58.1	5.8
Ireland	6,574	205.9	29.2
Greece	34,522	1,238.6	95.1
Spain	47,689	3,483.0	404.0
France	28,895	5,109.9	402.3
Croatia	67,724	893.8	66.1
Italy	158,412	4,849.4	378.2
Cyprus	802	87.6	13.7
Latvia	644	39.1	4.2
Lithuania	2,062	72.9	6.5
Luxembourg	434	64.9	2.9
Hungary	4,176	435.6	26.1
Malta	166	41.9	8.8
Netherlands	9,214	1,373.6	99.8
Austria	20,329	993.6	110.4
Poland	9,885	694.0	66.6
Portugal	3,429	519.9	55.0
Romania	6,191	309.0	20.2
Slovenia	2,900	106.6	9.5
Slovakia	2,687	149.1	10.8
Finland	1,408	251.0	19.8
Sweden	4,269	805.3	52.3
United Kingdom	87,079	4,001.0	303.6
Iceland	916	-	4.3
Liechtenstein	86	2.0	0.1
Norway	2,707	575.3	30.6
Switzerland	5,541	398.6	41.3
Montenegro	524	149.3	9.2
FYR of Macedonia	441	43.4	1.5
Serbia	987	102.4	6.0
Turkey	-	-	130

Source: [9]. http://ec.europa.eu/eurostat/data/database

In 2016, Spain was the main tourist destination in the EU for non-residents (people from abroad), with 260 million nights spent in tourist accommodation establishments, representing 21.5% of the total for the EU-28. In the top non-residential destinations in Europe, the top four positions are occupied by the following countries: Spain, and Italy (with 187 million accommodation nights), France (with 131 million accommodation nights) and England (with 105 million nights of accommodation in 2016). The number of nights spent by non-resident tourists in these countries accounts for approximately 56.6% of the total number of nights spent. The lowest tourist demand was represented by Luxembourg and Latvia. [8].

Depending on the demographic size of each country, it is possible to analyze the number of nights spent by resident and non-resident tourists, taking into account an indicator of the intensity of tourism. This indicator is based on Mediterranean destinations in Malta, Cyprus and Croatia. Also, Austrian and Alpine destinations were among the preferred tourist destinations in the 28 countries included in the European Union in 2016. The study found that countries like Montenegro and Iceland were among the popular tourist preferences. [3]

The economic importance of international tourism can be measured by analyzing the proportion of revenue generated by international travel in relation to GDP; these data are derived from balance of payments statistics and include both business trips and leisure trips. In 2016, the EU Member States with the highest GDP shares of tourism revenue were Croatia (17.2%), Malta (14.4%) and Cyprus (12.3%), figures confirming the importance of tourism for these countries. In absolute terms, the largest revenues from international tourism in 2016 were recorded in Spain (EUR 49 billion) and France (EUR 43.2 billion), followed by the United Kingdom, Italy and Germany (all three registering 33-EUR 35 billion). [10]

Germany recorded the highest level of spending on international tourism, totaling EUR 70.3 billion in 2014. Germany was followed by the United Kingdom (EUR 47.8 billion) and France (EUR 36.7 billion).

Spain was the EU Member State with the highest net income in tourism in 2016 (EUR 35.4 billion), while Germany recorded the largest deficit (-37.6 billion). [6]

According to Eurostat, France remained at 2016 with the highest number of tourist overnight stays (403 million nights), although it fell by 1.3% compared to 2015. This is followed by Spain (401 million nights with 3.1% more than in the previous year), Italy (370 million, -1.8%) and Germany (366 million, + 2.9%).

The number of overnight stays has increased in most Member States. The highest increases were observed in Latvia (11.1%), Belgium (7.2%), Portugal (7.1%) and Greece (6.9%). In contrast, the largest decreases were registered in Slovakia (-5.5%), Finland (-1.9%) and Italy (-1.8%). [13]

Romania was among the countries that recorded the highest increases in non-residents' overnight stays of 8.3%, although they account for only 18% of total overnight stays. In total, the number of nights spent in accommodation units in Romania increased by 5.5%.

Also according to Eurostat, Spain was the European Union (EU) country with the highest income from incoming tourism, reaching 43.521 million euros, followed by France and Italy, according to data on the tourist behavior of EU residents. (Table 3). [20]

Table 3. State of income and payments in tourism in the year 2016 (millions Euro)

	Travel revenue	Travel payments
Germany	29,666	64,944
Austria	14,706	7,825
Belgium	10,128	15,173
Bulgaria	2,917	1,015
Cyprus	2,023	1,005
Croatia	6,861	722
Denmark	5,110	7,471
Slovakia	1,789	1,666
Slovenia	2,090	734
Spain	43,521	11,911
Estonia	954	619
Finland	3,020	3,805
France	41,680	30,405
Greece	10,444	1,844
Hungary	3,782	1,537
Italy	32,055	20,511
Ireland	3,022	4,609
Latvia	586	534
Lithuania	1,029	722
Luxembourg	3,592	2,798
Malta	989	265
Netherlands	10,696	15,707
Poland	8,533	6,842
Portugal	8,606	2,946
United Kingdom	28,526	40,380
Czech Republic	5,480	3,345
Romania	1,141	1,427
Sweden	8,091	12,060

Source: [9]. http://ec.europa.eu/eurostat/data/database

For its part, France received 41.680 million euros of tourism revenue, while Italy reached 32.055 million euros, and Germany and the UK occupied the following places in the ranking. (Table 3). [20]

External tourism-Foreign tourism (travel abroad) is headed for one more year by German tourists, spending 64.944 million euros in its spending abroad in 2016. The second emitter market was UK (40,380 M €), followed by France (30,405 M €).

Romania had revenues of € 1,141 million, but with a deficit of 286 million.

France is the EU country with the highest number of nights spent in accommodation establishments in 2016 (405 million, up 1.1% over the previous year) followed by Spain (387 million + 1%). [11]

The following overnight countries are Italy (363 million, -4.6%), Germany (355 million, + 1.3%) and the UK (320 million, + 6.5%), according to a published report by the Eurostat Statistical Office

In the top 5 of the tourist destinations for Romanians are Bulgaria, Hungary, Italy, Turkey and Austria. [18]

Internally, the tourism industry contributes less than 1% to GDP.

Romania is on the last place in the region as tourism receipts, the sums being around 3 times lower than in neighboring Hungary and Bulgaria, 7 times lower than in Poland or the Czech Republic and 15 times lower than in Turkey, Greece or Austria.

This despite its geographical position and configuration, and the fact that Romania has the highest tourist accommodation capacity between the countries of Central and Eastern Europe, with about 4,000 accommodation units. Instead, the number of tourists and the number of overnight stays remain very low. [2]

Therefore, the contribution of the Romanian tourism to the national economy is very low if we relate to other neighboring countries. The tourism sector's contribution to GDP increased from 1.5% in 2015 to 2% in 2016 and capped somewhere around 3, 5% over the past three years. [4]

The value appears to be insignificant considering tourism contributions of over

10% of GDP made by other countries such as Hungary or Poland.

At the level of the year 2016, the tourism balance remained deficient, with 287 million euro receipts from foreign tourists and 377 million euros expenses of Romanian tourists abroad. Which gave a negative balance of 90 million euros [12]

As for domestic tourism, it is little developed compared to the EU countries, both because of the low income of potential tourists and cultural and poor promotion. The result is the wasting of important natural resources and the loss of a considerable number of jobs, which are almost certain in a country with a developed tourist system.

In a world where tourism is today one of the strongest industries, accounting for 30% of global service exports, over 940 million international tourists and more than $ 920 billion in revenue from these flows, resisting the global economic crisis with annual increases moderate (4% in recent years), and Romania is still looking for its place. [12]

Knowing the beneficial effects of tourism on an economic, social, cultural, geopolitical level, more and more countries are steering their investment and promotional efforts towards this sector, generating a growing competition on the international market. We are witnessing spectacular growth in some countries, as tourist destinations (eg China, India, Brazil, Germany, Ukraine, etc.), or to (re) confirmation of others as strong destinations (Spain, France, Italy, USA, Turkey, Mexico, Switzerland etc.) [19]

CONCLUSIONS

The study shows that the approach of tourism development in the European Union enjoys a lot of interest from the researchers, from many points of view: theoretical and applicative, in the aspects of planning and tourism development, regional, quantitative through modelling and prognosis, qualitatively through analyses structural, as historical, dynamic, evolution and trends, on tourist flows, on destinations, on forms of tourism, etc.

However, it is imperative to establish strategies that will be the focus of tourism, such as:

- formulation of medium and long-term policies in tourism,
- planning the development of tourism and regulating tourism activities by developing appropriate legislation
- conciliation of tourism development by ensuring the economic environment, infrastructure, regulations and fiscal environment in order to encourage investments and coordinated development.
- to provide training and education facilities to provide qualified workforce for the tourism industry.
- coordination of bilateral and multilateral relations in tourism with international organizations, funding agencies and non-reimbursable loans.

REFERENCES

[1]Andrei, Dalina, 2004, An Analysis of Romania's Tourism Behavior since 1990, Romanian Journal of Economic Forecasting, 5(3), p. 74.

[2]Baidal, J.A.I., 2017, Tourism planning in Spain. Evolution and Perspectives, Annals of Tourism Research, 31(2):313-325

[3]Barros, P.C., Botti, L., Peypoch, N., Robinot, E., Solonandrasana, B., Assaf, A.G., 2015, Performance of Frence destinations: Tourism attraction perspectives, Tourism Management, 32(1):141-145.

[4]Biji, M.E., Lilea, E., Vătui, M., 2016, Some problems regarding statistical analysis of the distribution by statistical regions of tourism development, Regional development in the context of the integration in the European Union, Editura Economică, Bucureşti, pp. 199-202.

[5]Corfu, A., Breda, Z., Costa, C., 2014, EU Integration and Tourism Destination Management: the Case of Portugal, Amfiteatru Economic, 20, pp. 20-25.

[6]Coshall, T.J., Charlesworth, R., 2017, A management orientated approach to combination forecasting of tourism demand, Tourism Management, 32, pp. 759-765.

[7]Cristureanu, C., 2012, International Tourism Economy and Policy, "ABEONA" Publishing House for Tourism and Culture, Bucharest, pp. 31-40.

[8]Eurostat: Official EU statistical data, https://www.eui.eu/Research/Library/ResearchGuides/ Economics/Statistics/DataPortal/EDD.aspx, Accessed February 10, 2018

[9]Eurostat, Your key to European Statistics, http://ec.europa.eu/eurostat/data/database, Accessed February 10, 2018.

[10]Haugland, A.S., Ness, H., Grønseth, B-O., Aarstad,

J., 2015, Development of Tourism Destinations. An Integrated Multilevel Perspective, Annals of Tourism Research, 38 (1):268-280.
[11]Holzner, M., 2016, Tourism and economic development: The beach disease? Tourism Management, 32(4): 922-930.
[12]Mitruţ, C., Constantin, L.D., 2013, Quantitative and Qualitative Dimensions of Tourism Contribution to Regional Development in Romania. The Case of Cultural Tourism, Economic Computation and Economic Cybernetics Studies and *Research,* 43(1):55-59.
[13]Popescu, A., 2016, Research On The Dynamics And Teritorial Dispersion Of The Occupied Population in Romania's Tourism in The Period 2007-2015, Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 16(4):279-288.
[14]Popescu, A., 2016, The Correlation Between Tourism Accommodation Capacity And Tourist Inflow By Micro Region Of Development in Romania, Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 16(4):289-298.
[15]Popescu, A., 2016, The Position Of Tourist And Agrotourist Guesthouses in Romania's Accommodation Structures, Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 16(1) 417-424.
[16]Popescu, A. 2016, Research On The Concentration Of Tourist Arrivals in Romania, Scientific Papers.Series "Management, Economic Engineering in Agriculture and rural development, Vol. 16(1): 425-430.
[17]Roşca, R.E., 2014, The effects of tourism development at national and international level, Romanian-present economy and perspectives, Editura Universităţii Suceava, p. 43-50.
[18]Snak, O., Baron, P., Neacşu, N., 2011, The economy of tourism, Editura Expert, Bucureşti, p. 95-98.
[19]Stănciulescu, C.G., Ţiţan, E., Voineagu, V., Ghiţă, S., Todose, D., 2013, The analysis of the tourism development in European Countries, Economic Computation and Economic Cybernetics Studies and Research, 3-4, pp. 33.
[20]UNWTO Tourism Highlights, World Tourism Organization, 2016 Edition.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

FACTORS INFLUENCING INFORMATION NEEDS OF FLUTED PUMPKIN FARMERS IN YOLA NORTH LOCAL GOVERNMENT AREA OF ADAMAWA STATE, NIGERIA

***Ibrahim Shehu USMAN[1], Olabanji AJAYI[1], Sikiru Adekunle OLAYIWOLA[2]**

[1]Modibbo Adama University of Technology, School of Agriculture and Agricultural Technology, Department of Agricultural Economics and Extension, P.M.B 2076, Yola, Nigeria, Phone:+2347067952643, Emails: ibrogirie1@gmail.com, Phone:+2348037191742 Email: ajayiolabanji@yahoo.com
[2]Federal University Wukari, Faculty of Agriculture and Life Sciences, Department of Agricultural Economics and Extension, P.M.B 1020 Katsina-Ala Road Wukari, Taraba State, Nigeria, Phone: +2348068579558, Emails:ollyskool@gmail.com

****Corresponding author***: ibrogirie1@gmail.com

Abstract

The study analysed factors influencing information needs of fluted pumpkin farmers in Yola North Local Government, Adamawa State, Nigeria. The specific objectives were to: describe the socio-economic characteristic of the respondents; identify the sources of information by the respondents; evaluate the relationship between socio economic characteristics of the respondents and information utilization as well as identify the constraints faced by the respondents in the study area. Three wards were purposively selected based on their high involvement in fluted pumpkin farming, 96 commercial fluted pumpkins farmers were identified using snowballing sampling technique and were used for the study. Interview schedule was used to collect data. Data collected were analysed using descriptive and inferential statistics. Result shows that most (85.4%) of the respondents were male and 35.4% were between 30-39 years with mean age of 37 while 78.2% were educated as well as cultivated average of 1.6 hectares. The distribution of the respondents by source of information revealed that 80.3% sourced their information through friends and neighbours. The result of multiple regression showed that the coefficients of gender, household size and educational status were positive and significant. The study also revealed that inadequate fund (65.6%), poor provision of extension services (47.9%), poor access of irrigation facilities (40.6%) as the most serious constraints faced by the respondents. It was concluded that fluted pumpkin farmers had formal education which enable them utilized any available knowledge as information. The study recommended that farmers growing fluted pumpkin should be sensitized on how to borrow not only for production but for the value chain.

***Key words**: information needs, influence, fluted pumpkin*

INTRODUCTION

The farmers' information utilization is increasing constantly in this dynamic world. It is obvious that the development of agriculture is highly dependent on the innovation as knowledge changing rapidly [22]. According to [9], rural communities need a wide variety of information such as availability of agricultural support services, Government regulations, wages rates, crop production and managements, disease outbreaks, adaptation of technologies by other farmers, and so on. The content of the information services needs to reflect their diverse circumstances and livelihoods. Therefore, the basic element in any development activity is information which can be seen, available and accessible to all farmers in order to bring the desired development most especially in their farming activities [22]. In other words, farmers seek for desired information in order to boost their production and productivity. The fluted pumpkin is one of the most important vegetable which was believed to be the first indigenous vegetable crops priority rating of south-eastern Nigeria [3]. As it's well known that, information is the key to power in addressing food and nutrition, and access to information is very essential for farming productivity [12].Fluted pumpkin is an important diet for children, women, nursing mothers, men as well as livestock due to its high nutritive value. But in Nigeria, the yield has not been able to meet the demand for human food not to mention that of livestock feed [18]. Among the different foods, consumption and production, fluted pumpkin has contributed to good health by providing cheap sources of minerals, protein, essential oils and vitamins needed to supplement people's diet mainly carbohydrates and had increased human resistance to disease [1].

One of the ways of achieving and creating awareness of fluted pumpkin production is through effectiveness of information sources on improved farm practices.

However, considering the fact that it was initial produces as a backyard crop, producers now see its production as business and produce all year round. A number of studies [11]; [7]; [16] and [14] have been carried out on fluted pumpkin production in other part of Nigeria, but little or no information exist on factors influencing information needs of fluted pumpkin farmers in Yola North Local Government area of Adamawa State, Nigeria.

Therefore, this study was conducted to analyse the information needs and utilization by fluted pumpkin farmers in Yola North Local Government Area of Adamawa State.

The specific objectives of the study were to:

(i)describe the socio-economic characteristic of respondent in the study area;

(ii)identify the sources of information by the respondents;

(iii)evaluate the relationship between socio economic characteristics of the respondents and information utilization and

(iv)identify the constraints faced by the respondents in the study area.

MATERIALS AND METHODS

Study Area

The study was carried out in Yola North Local Government Area of Adamawa State, Nigeria. Three (3) wards were purposively selected for this research because a considerable quantity of fluted pumpkin is produced and marketed in this area. These wards were; Jambutu, Gwadabawa, and Rumde. Snowball sampling technique was used, a total of Ninety-six (96) fluted pumpkin farmers were identified and they were all used for the study.

Descriptive statistics such as frequency distribution, means and percentages were used to achieve objects i, ii and iv. Multiple regression models were used to analyse objective iii which determine the relationship between the socio-economic characteristics of the respondents and the information utilized by the respondents. The explicit formula is shown as:

$Y=f(X_1, X_2, X_3, X_4, X_5, X_6)$

The implicit model was specified as follows:

$Y= bo + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + Ui$

Where;

Y= number of information utilized by the respondents (percentage information used by the respondent)

X_1= gender (dummy male 1, female 0)

X_2= age (years)

X_3= educational status (years of schooling)

X_4= household size (number)

X_5= farm size (in hectare)

X_6= farming experience (in years)

μ= error terms

Four functional forms (linear function, exponential function, semi logarithm and double log function) were tried; the model with best fit was taken as the lead equation.

RESULTS AND DISCUSSIONS

Socio-economic Characteristics of the Respondents

The result from Table 1 indicates that both males and females were involved in Fluted pumpkin production. The result reveals that majority (85.4%) of the respondents were male while female constituted only (14.6%). This result shows that fluted pumpkin production in the study area is majorly carried out by male gender which could be as a result of the responsibility the male being household head to cater for his family therefore, ventures into fluted pumpkin production in other to generate quick income. This agree with the finding of [13] who reported that fluted pumpkin are remunerative crops and that farmers, particularly young men, turn towards it production as is known to generate quick income for sustenance. The age distribution of the respondents revealed that majority (35.4%) of the respondents were between 30-39 years of age, 34.4% were within the age range of 40-49 years of age and 20-29 years represent 22.0% while 8.3% of the respondents are more than 50 years of age. This implies that more than 70.9% of the farmers were between 30-49 years of age while the mean age of the farmers was 37 years. This result indicates that majority (70.9%) of the respondents are young. Young farmers have the strength and capacities when fully involved in fluted pumpkin production thus their productivity will be high. The result is in line with the finding of [15], who reported that younger farmers are more likely to take risk by seeking and adopting better fluted pumpkin leaf production methods than older farmers who are more often than not conservative. The distribution of the respondents according to educational level shows that majority (78.2%) of the farmers had attend more than primary school level. However, 21.9% of the fluted pumpkin farmers had no formal education. It is well known that the level of education of farmers have significant impact on their productivity and ability to adopt new innovations and learn from what the extension agents teach them. They may also have the ability to combine different inputs to improve their productivity [4].The distribution of the respondents by farming experience indicated that majority (58.3%) of the respondents had farming experience between 1-5 years while 35.5% and 5.2% of the farmers had farming experience of 6-10 years and above 10 years respectively. This indicates that fluted pumpkin cultivation is an emerging enterprise in the study area while 5.7 years is identified as mean farming experience among the respondents. This means that, gradual increase of years of faming will therefore be sufficient potential for increase production and sustainability of fluted pumpkin cultivation in a study area [23].

Table 1.Descriptive Statistics of the Respondents

Socio-economic Characteristic	**Frequency**	**Percentage (%)**
Gender		
Male	82	85.4
Female	14	14.6
Age (years)		
20-29	21	22.0
30-39	34	35.4
40-49	33	34.3
$\geq$ 50	8.0	8.3
Mean age- 37 years		
Educational level		
No formal education	21	22.0
Primary education	14	14.6
Secondary education	43	44.8
Tertiary education	7	7.3
Adult education	11	11.5
Farming experience		
1-5	56	58.3
6-10	35	35.5
$\geq$ 11	05	5.2
Farm size		
$\leq$1	43	44.8
1.0 - 1.5	37	38.5
> 1.6	16	16.7
Mean farm size 1.6 hectares		

Source: Field survey, 2016

The distribution of the respondents according to farm size shows that 44.8 % of the respondents has farm size of 0.5 - 1.0 hectares while 38.5 % had between 1.0 – 1.5 hectares and 16.7 % had farm size of 1.6 hectares and above. The mean farm size of the respondents is about 1.6 hectares. Most of the farmers which accounted for 83.3 % cultivated 1.5 hectares. The finding reveals that fluted pumpkin farmers in the study area are mainly small scale farmers; thus fluted pumpkin production is at subsistence level. [18] classified small scale farmers as those having 0.1 - 1.59 hectares farm size. This result is in line with the finding of [2] that majority of Nigerian farmers are small scale farmers who cultivate less than 5 hectares. The distribution of the respondents based on access to extension agent shows that 92.7% had no access to extension services. About 7.3% reveals to have a rare (once to twice a year) contact with extension agents. [5] states that, poor extension contact will often result in poor access to relevant information on how to improve agricultural production and this could be a discouraging factor for the farmers.

Source of Information of the Respondents

The distribution of the respondents by source of information revealed that majority (80.3%) sourced their information through friends and neighbours (Table 2).

Table 2. Distribution of the Respondents Based on Their Sources of Information

Extension contact	**Frequency**	**Percentage**
Radio	13	9.8
Television	5	3.8
Newspaper	2	1.5
Extension agent	3	2.3
Non-government organisation	3	2.3
Friend/Neighbour	106	80.3
Total	**132**	**100**

Source: Field survey, 2016
*Multiple response

Only 2.3% revealed that they got their information on recommended methods of production through extension agents. By implication, there is an inadequate extension service to fluted pumpkin farmers in the study area which may deny the respondents modern agricultural techniques. This result is in line with the findings of [17] who stated that farmers sought information by asking friends, neighbours, talking to relatives and discussions with those whom they thought had the needed and right information.

Relationship between socio-Economic characteristics and Information Needs and Utilization of Respondents

The result of the regression analysis on the relationship between socio-economic characteristics and information utilization revealed a coefficient of multiple determination (R^2) of 0.64 (Table 3). This shows that 64% of the variation is accounted by explanatory variables use in the model. Most variables involved in the model jointly influenced the information used significantly as shown by the F- value (4.837) which is significant at 1% level of probability (Table 3).

From the result on Table 3, gender, household size and education were positively related to information used by the respondents. Gender (0.264), household sizes (0.0307) are found to be significant at 5% level of significance while educational level (0.0002) was found to be significant at 1% level of probability. This means that as the family size increase, so also utilization of the recommended practices of fluted pumpkin production. This could be true because large family give large labour which may lead to increase of farm size thereby looking for more information to maximize output. According to [21]; [19] large family size implies more family labour and more information will be available for the household farm activities. It is evident that women in other part of the country are restricted due to either socio cultural and religious believe, not participating in most social event as men which according to [6]; [10], stated that both men and women contribute significantly to agricultural production yet, their access to these agricultural resources differ which could be as a result of cultural restriction. Furthermore, as [20] argues, farmers with basic education are better equipped for making more informed decision for lives and for their communities as well as becoming active participants in economic, social, and cultural dimension of development. These result shows that majority of respondent were males, comes from large homes and attained certain level of education beyond primary school and therefore appreciate the important of needs of information and uses.

Table 3. Relationship Between Socio-economic Characteristics and Information Needs and Utilization of Respondents

Variables	Coefficient	Std Error	t-Statistic	Prob.
C	12.57591	2.135830	5.888067	0.000
Gender (X_1)	3.159007	1.399329	2.257515	0.0264**
Age (X_2)	1.139334	0.749673	1.519774	0.1321^{ns}
Household size (X_3)	0.673175	0.306506	2.196287	0.0307**
Educational status (X_4)	2.593450	0.678423	3.822764	0.0002***
Farming experience (X_5)	0.676934	1.342784	0.504128	0.6154^{ns}
Farm size (X_6)	0.479273	0.530632	0.903212	0.3689^{ns}
R-squared	0.636818			
Adjusted R-squared	0.595896			
F- Statistic	4.837568			

Source: Data analysis 2016. ***significant at 1%; **significant at 5%, Ns-not significant

Constraint Faced by the Respondent in Fluted Pumpkin Production

Result of the constraints faced by respondents in the study area was presented in Table 4. Inadequate fund (65.6%), poor provision of extension contact (47.9%), poor access to irrigation facilities (40.6%) and high cost of seeds (36.5%) has been identified as the most serious problem facing the farmer in the study area. Small holder farmers often lack access to appropriate inputs and the necessary technical production skills due to inadequate input and soft credit market as well as weak extension systems [24].

Table 4. Constraint of Fluted Pumpkin Production

Constraints	Frequency	Percentage
Poor access of irrigation facilities	39	40.6
Poor technical know- how on production	20	20.8
Poor access to improved seed	29	30.2
High cost of transportation	26	27.1
High cost of labour and farm input	22	22.9
Poor pricing system	13	13.5
Poor provision of extension service	46	47.9
Inadequate/ lack of funds	63	65.6
Pest and disease problem	6	6.3
Poor knowledge on health benefit	10	10.4
Weed problem	1	1.0

Source: Field survey, 2016

This finding agrees with that of [8] who confirm that farmers experience a number of constraints in agricultural production; these includes inadequate fund, inadequate training and extension support, inadequate irrigation facilities, high cost of farm inputs and road conditions among others.

CONCLUSIONS

Based on the study, it was concluded that 85.4% were males, most (35.4%) of the respondents were between the age 30-39 years with mean age of 37 and 78.2% had attended formal education. The result of regression analysis showed that gender (X_1, 0.024) and household size (X_3, 0.0307) are significant at 5% while formal education (X_4, 0.0002) is significant at 1% which revealed that the respondents level of education, gender and household size positively and significantly influence their information needs. It was finally concluded that the respondents are influence by their levels of education as majority of them are males. Based on the finding of the study, the following recommendations are suggested to improve access to and productivity by farmers in the study area.

(a)Government should create other source or channel of information by working with local stake holders as this may give the farmer comfort to easily access information at their convenient.

(b)Farmers growing fluted pumpkin should create a cooperative association which will sensitize them on how to borrow not only for production but for the value chain, thus local processing, marketing and distribution.

(c)Extension service for farmers should be strengthened by the extension institution situated within the study area by making frequent visits to farmers, so as to encourage farmers who lacked the zeal on fluted pumpkin production and apply good agronomic practices for improving fluted pumpkin productivity.

REFERENCES

[1]Abu, O. Asember, D.J, 2011, Opportunities for smallholder spinach farmers in Nigeria: A profit efficiency analysis. Journal of Economics. 2(2): 75-79.

[2]Adebayo, A. A., Tukur, A.L., 1999, Adamawa State in Map, Publish by Derpartment of Geography, Federal University of Technology Yola, Adamawa State, Nigeria Pp. 1-35.

[3]Badifu, G.I.O., Ogunsina, A.O, 1991, Chemical composition of kernels from some Species of cucurbitaceous growth in Nigeria. Plant Food Human Nutrition. 41: 35-44.

[4]Balogun, O.L., Bello, T.A., Afodu, O.J., 2015, Determinant of farm productivity among fluted pumpkin (*Telfairia occindentalis* Hook L.). farmers in Ikenne Local Government Area, Ogun State, Nigeria. Ethiopian Journal of Environmental Studies and management. 8(2):152-160.

[5]Chah, J.M., Abugu, R.O., Nwobode, C., Asadu, A.N., Igbokwe, E.M., 2013, Agricultural extension needs of farmers in telfairia production and marketing in Enugu State, Nigeria. Journal of agricultural Extension. 17(1): 49-60.

[6]Deere, C.D., Doss, C.R., 2006, Gender asset gap: what do we know and why does it matter? feminist economics 12 (1and 2) 1-52.

[7]Emenyonu, C.A., Odii, M.A., Ohajianya, D.O., Henri-Ukoha, A., Onyemauwa, S.C., Ben-Chendo, G.N. and Munonye, O.U., 2010, Effects of waste water use on vegetable crop production in Imo State, Nigeria. Researcher. 2(10): 47-56.

[8]Estolas, W.R., 1996, Extent of utilization of farming technologies recommended by Benguet State University. MS Thesis. Benguet State University, La Trinidad, Benguet.

[9]Food and Agriculture Organization (FAO), 2002, Report of the second consultation on agricultural information management. Rome, Italy. Available on http://www.fao.org/docrep/,

[10]Food and Agriculture Organization (FAO), 2010, The state of food insecurity in the world 2010. addressing food security in protracted crisis. Rome: FAO

[11]Ibekwe, U.C, Adesope, O.M., 2010, Analysis of dry season vegetable production in Owerri West Local Government Area of Imo State, Nigeria. Journal of Development and Agricultural Economics. 2(6): 245-249.

[12]Mgbada, I.D., 2006, Effectiveness of information sources on improved farming practices to women farmers in Enugu State, Nigeria. Global Approaches to Extension Practice, 2(1): 67-78.

[13]Nizamuddin, K., Mohd, S., and Anisur, R., 2009, Vegetable revolution and rural sustainable development; a case study. Journal for Geography. 4(1): 177- 188.

[14]Nwachukwu, I.N., Onyenweaku, C.E., 2009, Allocative efficiency among Fadama Telfairia Production in Imo State Nigeria. Online at http://mpra.ub.uni-muenchen.de/27249/ MPRA Paper No. 27249.

[15]Nwaru, J.C., 2004, Rural Credit Markets and arable crop production in Imo State of Nigeria, Ph. D. Dissertation, Department of Agricultural Economics, Michael Okpara University of Agriculture, Umudike, Nigeria.

[16]Nwauwa, L.O.E., Omonona, B.T., 2010, Efficiency of vegetable production under irrigation system in Ilorin Metropolis: A Case Study of Fluted Pumpkin (*Telferia occidentalis*). Continental Journal of Agricultural Economics. 4, pp. 9 - 18.

[17]Odini, S., 2014, Access to and use of agricultural information by small scale women farmers in support to attain food security in Vihiga Country, Kenya. Journal of Emerging Trends in economics and management sciences. 5(2): 80-86.

[18]Ogusina, O.D., Begho, T., Ewolor, S. A., 2014, Resource use efficiency and profitability of fluted pumpkin production in Ukwani Local Government Area of Delta State Nigeria. American Journal of Agriculture and Forestry. 2(4): 129-134.

[19]Ogundari, K., 2008, Resource productivity allocative efficiency and determinants of technical efficiency of rain-fed rice farmers: A guide for food security policy in Nigeria. Journal for Sustainable Development in Agriculture and Environment. 3(2). 20-33.

[20]Opara, U.N., 2010, Personal and socio-economic determinants of agricultural information use by farmers in the Agricultural Development Programme (ADP) Zones of Imo State, Nigeria. http://unllib.unl.edu/LPP/

[21]Ozor, N and Cynthia, N., 2010, Difficulties in adaptation to climate change by farmers in Enugu State, Nigeria. Journal of Agricultural Extension. 14(2): 106-122.

[22]Sani, L., Boadi, B.Y. Oladokun, O. and Kalusopa, T., 2014, The generation and Dissemination of Agricultural Information to Farmers in Nigeria. A review. Journal of Agricultural and Veterinary Science. 7(2): 102-111.

[23]Sunday, B.A., Ini-mfon, V.P., Samual, J.U., Udoro, J.U. (2014). Choice of soil management technique as adaptation to climate change among fluted pumpkin farmers in Akwa Ibom State, Nigerai. African Journal of Agricultural Economics and Rural Development. 2(2):112-120.

[24]USAID (2005). Global horticultural assessment. The world vegetable centre, June. http://pdf.usaid.gov/pdf_docs/pnadh769.pdf.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE PRESENCE OF INDIGENOUS YEASTS WITH PROTEOLYTIC ACTIVITY ISOLATED FROM HOMEMADE-MOZZARELLA WHEY

Faysa UTBA[a], Roostita L. BALIA[b], Gemilang Lara UTAMA[a]

Universitas Padjadjaran, Faculty of Agro-Industrial Technology[a], Faculty of Animal Husbandry[b], West Java, Indonesia, Emails: faysautba@gmail.com, lugemilang@gmail.com

Corresponding author: lugemilang@gmail.com

Abstract

Whey, by product from cheese production, having high content of protein, can be a source of indigineous yeast with proteolytic activity. This research aims to identify indigenous yeasts with proteolytic activity from homemade-mozzarella cheese whey. There were 2 kinds of whey collected throughout the making of mozzarella, the first whey was collected after the coagulation process and the second whey was collected after mozzarella curdling process. Each types of whey were inoculated into Potato Dextrose Agar (PDA) media modified with 3% yeast extract and 10 ppm Amoxicillin and were further incubated for 48 hours in room temperature. Each colony formed were then differentiated macroscopically and purified in a separate modified PDA media for 4 times. Purified colonies were further identified under microscope and only the colonies having yeasts morphology were tested for its proteolytic activity with paving block method using Nutrient Agar plus 3% Skim Milk, with formation of clear zone were measured as proteolytic activity. Yeasts with proteolytic activity were identified using RapID yeast plus system. The results showed 7 yeasts colonies found and proteolytic activity was only found in 1 isolate with ±9.5 mm diameter of clear zone. The isolate was further brought to identification and revealed as Trichosporon beigelii.

Key words**:** *Indigenous yeast, mozzarella, proteolytic activity, Trichosporon beigelii, whey*

INTRODUCTION

Whey is a byproduct produced in cheese making and often causes environmental problems due to improper handling. Whey is formed from the separation between casein and milk fat when the process of adding acid to coagulate casein.

The nutrients contained in whey are lactose, fats such as triglycerides, diglycerides, fatty acids and phospholipids and minerals such as calcium, magnesium, phosphorus, potassium, chlorine, sodium, zinc, iron, iodine and copper, vitamins B5, B2, C , and B6, as well as minor proteins such as immunoglobulin, lactoferrin, lactoperoxidase, and lysozyme [8].

As a source of nutrients, whey is a really good environment for microorganisms to inhabit, such as yeast.

Natural whey starter, a traditional starter for the ripening of traditional Italian cheese, microbiota is mainly composed of thermophilic lactic acid bacteria but also contained some yeasts such as *Candida parapsilosis, Candida rugosa, Debaromyces hansenii*, *Kluyveromyces lactis*, *Kodamaea ohmeri*, *Torulaspora delbrueckii*, and *Zygosaccharomyces rouxii* [4].

Another natural whey starter collected from 9 factories of Tandil, Argentina showed to contain *Kluyveromyces marxianus*, *Saccharomyces cerevisiae*, *Clavispora lusitaniae*, and *Galactomyces geotrichum* [3].

Previous research has also showed the occurrence of *Candida lambica* from mozzarella whey [29].

A traditional Greek fermented whey product consists of *Zygosaccharomyces rouxii, Torulaspora delbrueckii*, *Debaromyces hansenii*, *Pichia farinosa*, *Candida mogii, Candida intermedia*, and *Saccharomyces cerevisiae* [16].

High protein that’s contained in whey, indicates that whey can contain indigenous micoorganisms especially that have proteolytic activity.

Therefore, the current study had the purpose to identify indigenous yeasts with proteolytic activity from homemade mozzarella whey.

MATERIALS AND METHODS

Materials

Fresh unpasteurized cow milk, purchased from Ciparanje Dairy Farm organized by Faculty of Husbandry, University of Padjadjaran, Indonesia, used for making of mozzarella cheese whey. Citric acid (Brataco Chemika), rennet tablet, salt (Cap Kapal) and ice were also used as the materials for mozzarella cheese. Agar media used were Potato Dextrose Agar/PDA (Oxoid Ltd.) modified with 3% of yeast extract (Kraft Foods) and 10 ppm of Amoxicillin (Kimia Farma) for isolation and purification of yeasts and Nutrient Agar/NA (Oxoid Ltd.) with 3% of Skim Milk (Prolac, Pendairy) for proteolytic activity assay. Nutrient Broth (Oxoid Ltd.) and NaCl 0,85% were also used. Identification of yeast with proteolytic activity done by RapID yeast plus system (Remel Thermo Scientific).

Methods

Making of Mozarella Cheese Whey

The making of mozzarella were done according to Seth & Bajwa (2015) [25] with modification. 1 liter of fresh unpasteurized cow milk was pasteurized at 60^{o}C for 3 minutes and brought to cool until 35-40^{o}C. 200 ml of citric acid added to milk and stirred followed by incubation for 5 minutes to let the milk acidify. 0.02 g/l of rennet tablet, crushed, added to milk, and stirred, followed by another incubation for 1 hour to let the milk coagulate and form curd. The curd were cut and drained to separate from all whey. This whey is collected and described as Whey 1. In a separate container, cold water with addition of 2 tablespoons of salt and 2 tablespoons of Whey 1 was prepared and described as cooling agent.

The next step is the cooking of mozzarella, where a big pot, half full with water, was brought to boil and another smaller size pot filled with full water was put inside the big pot. The pots were heated until the water inside small pot reached 75^{o}C. A strainer was then put above the small pot until soaked and the curd was put on the strainer. Curd was pressed and folded using a spatula for approximately 10 minutes and then collected, leaving the remaining liquid as Whey 2. The elastic curd formed after the folding was soaked inside the cooling agent until harden and formed mozzarella cheese.

Isolation and Purification of Indigenous Yeast from Mozarella Cheese Whey

Isolation of indigenous yeast(s) were done by pour plate method using modified PDA, incubated for 48 hours at room temperature. Colonies appeared on the surface (aerobic) or at the base of media (anaerobic) were observed macroscopically for its characteristics and further differentiated from each other. Each colony were then purified by streak method on modified PDA for 4-5 times. Purified isolates were observed under microscope and only isolates having the morphological characteristics of yeasts were tested for proteolytic activity.

Proteolytic Activity of Indigenous Yeasts and Identification

Proteolytic activity assay done by paving block method as described by Putranto et al. (2015) [21]. Each isolates of indigenous yeasts were identified for its proteolytic activity with Na+3% skim milk. Each isolates was propagated by swabbing 1 loopful on the surface of modified PDA, incubated for 48 hours at room temperature. Meanwhile, NA with 3~~1~~% skim milk was pour into a petri dish, let harden, and a hole was punched on the agar. Isolate formed on the modified PDA were collected by the same way as the hole formed in NA and the collected agar was put inside the hole of NA skim milk. Incubation was done for 48 hours at room temperature and proteolytic activity was described as the formation of clear zone, which later being measured. Indigenous yeast showing proteolytic activity was identified using RapID yeast plus system.

RESULTS AND DISCUSSIONS

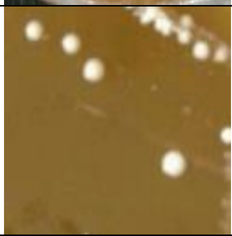
Morfological Identification of Yeast

Isolation of indigenous yeasts done with 2 type of mozzarella cheese whey.

Whey 1 attained from curdling process, while whey 2 attained after the curd was cooked and folded. Each of the whey inoculated and incubated in room temperature for two days.

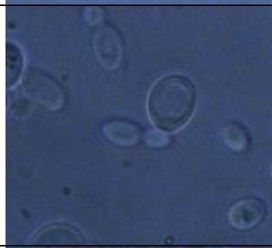
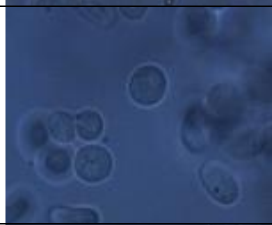
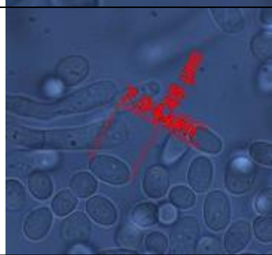
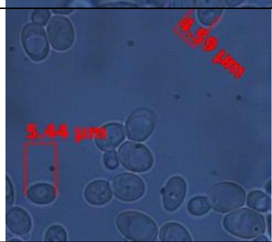
There were seven colonies formed based on macroscopic morphology that shown in Table 1. The colonies were further identified in microscope, which can be seen in Table 2.

Table 1. Macroscopic morphology of colonies

Colo-nies	Image	Morphology
A		Round; concave; yellowish colony
C		Round-shape; flat; white colony
D		Round-shape; yellowish
F		Round-shape; small; transparent
G		Round-shape; yellowish
H		Round-shape; yellowish
M		Oval shape; flat; white colony; small

Source: Own results.

Table 2. Microscopic morphology of colonies

Colo-nies	Image	Morphology
A		Round; oval; size ± 7.00 µm
C		Round; pseudomycelium; size ± 7.00 µm
D		Round; pseudomycelium; size ± 5.00 µm
F		Oval; pseudomycelium
G		Oval; pseudomycelium
H		Round/ oval
M		Long, cylindric

Source: Own results.

All seven colonies are categorized in to yeast according where yeast cell has length around 1-5 µm until 20-50 µm, and width sized 1-10 µm. Mostly all seven colonies unicellular and have oval, round and long shaped, and the other shaped resemblance to pseudomycelium shaped [11]. Colonies formed can be classified as yeast, because they were all grown in media with addition of antibiotics (amoxycillin), according to [18]

Proteolytic activity of yeast

Positive proteolytic activity was only shown in isolate D, as shown below (Fig. 1).

Fig 1. Proteolytic Activity
Source: Own results.

The appearance of clear zone is a result of yeasts activity which degrades the casein added as skim milk [23]. Though generally yeasts have proteolytic activity such as caseinolytic, aminopeptidase, and carboxypeptidase, the types of proteases as well as its activity among species or strains can be very different [7]. Secretion of proteases also dependent towards some factors such as the composition of the medium. For instance, supplementation of medium with protein increased the acidic protease activity secreted by *Candida humicola*, while supplementation of amino acid and ammonium sulfate resulted in low activity of the mentioned protease [22]. Enzyme also known to work specifically and have different degree of specificity. Proteases specificity on cleaving peptide bonds depend on the two amino acids that are bounded to each other [15].

Proteolytic Yeast RapID Identification

The resulting of biochemical activity of the tested isolates were shown on table 4. Biochemical activity has been compared with Electronic RapID Compendium (ERIC) database and concluded the isolate tested was *Trichosporon beigelii*. The sugar reduction activity of tested isolate showed some similarity towards another *Trichosporon* species, *Trichosporon moniliiforme*, which was isolated from curdling milk (table 3) [2014].

Table 3. Biochemical activity of tested isolates and sugar reduction activity of *Trichosporon moniliiforme.*

Substrate	Tested Isolate	*Trichosporon moniliiforme*
Glucose	-	-
Maltose	-	-
Sucrose	-	-
Trehalose	-	-
Raffinose	-	-
Lipid	-	unknown
NAGA	-	unknown
αGlucoside	+	unknown
bGlucoside	+	unknown
ONPG	-	unknown
αGalactoside	+	unknown
bFucoside	+	unknown
PHS	-	unknown
PCHO	-	unknown
Urea	+	unknown
Prolyne	+	unknown
Histidine	+	unknown
Leucyl-Glycine	+	unknown
Yeast Name	***Tri.beigelii***	

Trichosporon beigelii is a basidiomycetous and yeast-like organisms that are often considered as an opportunistic pathogen that cause *trichosporon*osis in immune-compromised people [13, 17]. *T. beigelii* is classified into family of Cryptococcaceae, under genus of *Trichosporon*, and it is normal flora found in respiratory and digestive tracts of human and animal [12]. *T. beigelii* is also a saprophyte in soil, water and other substrate as well [26]. This species of yeast are also found in the cuticule of freshwater crayfish *(Astacus astacus)* in Amsterdam [26] and on Spanish fermented sausages [10].

Though considered as opportunistic pathogen, *T. beigelii* is also found in some food product and so far no reports have ever mentioned that *T. beigelii* could cause foodborne illnesses. *T.*

beigelii is often found in dairy based products, both fermented and not. *T. beigelii* are common yeast found in raw milk along with other kind of yeast : *D. hansenii* and *K. marxianus* [14]. Beside raw milk, *T. beigelii* were also found in Armada cheese which made from unpasteurized goat's milk [28]. Armada cheese is a variety of cheese that is made without any addition of starter cultures, so it is likely that the ripening is caused by the activity of indigenous yeast that live in goat's milk. *T. beigelii* is also found even in cheese brines, a byproduct of cheese [24]. This explain why *T. beigelii* could be detected in whey, because whey are byproduct of cheese.

The proteolytic activity detected was considered low, as it only showed a faded color of the agar and not totally creating a clear zone. But, the result agreed with other research that showed the presence of proteolytic activity among *Trichosporon* spp. Research by Bentubo & Gompertz (2014) revealed that out of 44 clinically isolated *Trichosporon* spp., 22 isolates showed to possess proteolytic activity and 41% of which have a strong proteolytic activity [2]. However, it disagreed with Anitha et al. (2015) where none of 45 isolates of *Trichosporon* spp. collected from various clinical samples showed proteolytic activity [1].

The disagreement among results are caused by several factors that can interfere with the identification of proteolytic activity. Research by Anitha et al. (2015) mentioned that the absence of proteolytic activity might be caused by the Bovine Serum Albumin Agar method used, that lack of sensitivity when it comes to a very small proteolytic activity [1]. Therefore, it should be considered that the method used to identify proteolytic activity, is among factors that will define proteolytic activity among *Trichosporon* or any other yeasts.

Incubation temperature is also considered to be a determinant factor in identifying *in vitro* proteolytic activity. *T. asahii* and *T. inkin,* favored 37^{o}C over 25^{o}C for its proteolytic activity to be well detected [2]. Species of *Trichosporon* spp. will also define the degree of proteolytic activity observed. Furthermore, *T. beigelii* included a wide range of species and now it has been replaced by 51 accepted *Trichosporon* species [17]. Therefore, it is possible that *T. beigelii* observed in this research should have been a more specific *Trichosporon* species. *Trichosporon* species that has been observed and showed positive proteolytic activity are *T. asahii*, *T. mucoides*, *T. ovoides,* and *T. inkin* [2, 19]. Proteolytic activity was present in 66,7% (12 out of 18) isolates of *T. asahii*, 50% (2 out of 4) of *T. mucoides*, 50% (5 out of 10) of *T. inkin,* and 25% (3 out of 12) of *T. ovoides*. Strong proteolytic activity existed on 33,3% of *T. asahii*, 16,7% *T. ovoides,* and 10% of *T. inkin* [2]. Another study by Montoya et al. (2015) resulted the same, where 3 isolates of *T. asahii* Genotype I showed strong proteolytic activity and 6 isolates of showed very strong proteolytic activity [19].

Proteolytic activity in yeast such as *T. beigelii* which considered as a pathogen is very common. Proteolytic activity is included as a virulence factor, which defines the growth of pathogen inside the host and the establishment of the disease it causes [9]. According to Mariné et al. (2015), proteolytic activity is needed to penetrate the host's immunological barriers [17]. However, it is important to remember that proteolytic activity of the same yeast species could not be considered the same if collected from different sources due to the different nutrients availability [5]. Though the proteolytic activity of clinical *T. beigelii* and other *Trichosporon* spp. have been well documented, there is still a few observation that determines the proteolytic activity of *Trichosporon* spp. collected from food source, including a research conducted by Cardoso et al. (2015) that revealed positive proteolytic actvity in 1 out of 3 isolates of *Trichosporon* spp. and 2 out of 2 isolates of *T. montevideense* collected from Brazillian Serro Minas Cheese [6].

CONCLUSIONS

The isolation and identification of indigenous yeast with proteolytic activities in home-made mozzarella cheese whey were later indentified as *Trichosporon beigelii. T. beigelii* is not a common yeast found in food product, and usually classified as pathogenic type of yeast. *T. beigelii* shows a weak proteolytic activity, as it only showed a faded color of the agar and not totally creating a clear zone. Though the proteolytic activity showed in agar, can vary depending on the substrate presence in the media.

ACKNOWLEDGEMENTS

Authors would like to thank the Ministry of Higher Education and Technology for the Research Grant with the scheme of Penelitian Berbasis Kompetensi and The Rector of Universitas Padjadjaran for the Academic Leadership Grant. Also thanked Syarah Virgina for the assisting the research.

REFERENCES

[1] Anitha, S., Premamalini, T.,Kindo, A.J., 2015, Virulence factors among Trichopsoron Species from clinical isolates in a tertiary care centre, Int. J., Curr. Microbiol. App.Sci, Vol.4(8): 493-501.

[2] Bentubo, H. D. L., Gompertz, O. F., 2014, Effects of temperature and incubation time on the in vitro expression of proteases, phospholipases, lipases and DNases by different species of Trichosporon, SpringerPlus, Vol. 3, no. 377, pp. 1-10.

[3]Binetti, A., Carrasco, M., Reinheimer, J., Suarez, V., 2013, Yeasts from Autochthonal Cheese Starters: Technological and Functional Properties, Journal of Applied Microbiology, Vol. 115, pp. 434-444.

[4]Borelli, B. M., Elaine, E. G., Ferreira, G., Lacerda, I. C. A., Franco, G. R., Rosa, C. A., 2016, Yeast Populations Associated with the Artisanal Cheese Produced in the Region of Serra da Canastra, Brazil, World J Microbiol Biotechnol, Vol. 22, pp. 1115–1119.

[5] Broach, J. R., 2012, Nutritional Control of Growth and Development in Yeast, Genetics, Vol. 192, no. 1, pp. 73-105.

6] Cardoso, V. M., Borelli, B. M., Lara, C. A., Soares, M. A., Pataro, C., Bodevan, E. C., Rosa, C. A., 2015, The Influence of Seasons and Ripening Time on Yeast Communities of a Traditional Brazilian Cheese, Food Research International, Vol. 69, p. 331–340.

[7] Chamba, J.-F., Irlinger, F., 2004, Secondary and Adjunct Cultures, in Cheese: Chemistry, Physics, and Microbiology, P. F. Fox, P. L. H. McSweeney, T. M. Cogan and T. P. Guinee, Eds., Oxford, UK, Elsevier, pp. 191-206.

[8]Coimbra, J. d. R., Teixeira, J., 2009, Engineering Aspects of Milk and Dairy Products, Boca Rato, Florida USA: CRC Press (Taylor & Francis Group).

[9] Colombo, A. L., Padovan, A. C. B., Chaves, G. M., 2011, Current Knowledge of Trichosporon spp. and Trichosporonosis," Clinical Microbiology Reviews, Vol. 24, no. 4, p. 682–700.

[10] Encinas, J.-P., Lopez-Diaz, T.-M., Garcia-Lopez, M.-L., Otero, A., Moreno, B., 2000, Yeast Population on Spanish fermented sausages, Meat Science, Vol. 54, pp. 203-208.

[11]Fardiaz, S., 1992, Mikrobiologi Pangan 1, Jakarta: PT. Gramedia Pustaka Utama.

[12]Georgiev, V.S., 2003, Trichosporon beigelii, in "Opportunistic Infections: Treatment adn Prophylaxis", Totowa, NJ, Humana Press Inc., pp. 291-292.

[13]Girmenia, C., Pagano, L., Martino, B., D'Antonio, D., Franci, R., Specchia, G., Melillo, L., Buelli, M., Pizzarelli, G., Venditti, M., Martino, GIMEMA Insfection Program, 2015, Program, "Invasive Infections Caused by Trichosporon Species and *Geotrichum capitatum* in Patients with Hematological Malignancies: a Retrospective Multicenter Study from Italy and Review of the Literature, Journal of Clinical Microbiology, Vol. 43, no. 4, pp. 1818-1828.

[14] Haridy, M. S. A., 1992, Yeast Flora or raw milk in El- Minia City, Egypt., Cryptog. Mycol, no. 13, pp. 321-326.

[15]Khan, M.K., Khan, F., 2015, Principles of Enzyme Technology, Delhi: PHI Learning Private Limited, 2015.

[16]Lioliou, K., Litopoulou-Tzanetaki, E., Tzanetakis, N., Robinson, R. K., 2001, Changes in the Microflora of Manouri, a Traditional Greek Whey Cheese, During Storage, International Journal of Dairy Technology, Vol. 54(3)100-106.

[17]Mariné, M., Brown, N.A., Riaño-Pachón, D.M., Goldman, G.H., 2015, On and Under the Skin: Emerging Basidiomycetous Yeast Infections Caused by Trichosporon Species, PLOS Pathogens, pp. 1-9.

[18]Montes de Oca, R., Salem, A. Z. M., Kholif, A. E., Monroy, H., Perez, L.S., Zamora, L.J., Gutierez, A., 2016, Yeast: Description and Structure. In the book:"Yeast additive and Animal Production, PubBioMed Central Research Publishing Services India, p.4-13.

[19] Montoya, A. M., Gonzalez, A. S., Palma-Nicolas, J. P., Gomez-Trevino, A., Gonzalez, J. G., Gonzalez, G. M., 2015, Genotyping, Extracellular Compounds, and Antifungal Susceptibility Testing of Trichosporon asahii Isolated from Mexican Patients, Medical Mycology, vol. 53, pp. 505-511, 2015.

[20]N. C. o. Y. Cultures, 2017, NCYC Catalogue: NCYC 2484 Trichosporon moniliiforme, NCYC.

[21]Putranto, W. S., Balia, R. L., Suradi, K., Chairunnisa, H., Wulandari, E., Pratama, A., Tyas, T., Nanah, Metode Tumpang dan Paving Block sebagai Teknik Screening Bakteri Asam Laktat dan Yeasts Isolat Potensial Pangan Fungsional Hasil Peternakan, Prosiding Seminar Nasional Peternakan Berkelanjutan 7, p. 5, 2011.

[22]Ray, M. K., Devi, K. U., Kumar, G. S., Shivaji, S., 1992, Extracellular Protease from the Antarctic Yeast Candida humicola, Appl. Environ. Microbiol., Vol. 58, no. 6, pp. 1918-1923

[23]Roostita, L. B., Putranto, W. S., Charoenchai, C.,

Wulandari, E., Gemilang, L.U., 2013, Purification Crude Extracellular Protease of Saccharomycopsis fibuligera strain R64 Isolated from Tape' Indonesian Fermented Food, Advance Journal of Food Science and Technology, Vol. 5, no. 8, pp. 1002-1004.
[24] Seiler, H., Busse, M., 1990, The yeast of cheese brine, International Journal of Food Microbiology, Vol. 11, pp. 289-304.
[25] Seth, K., Bajwa, U., 2015, Effect of Acidulants on the Recovery of Milk Constituents and Quality of Mozzarella Processed Cheese, J Food Sci Technol., Vol. 52(3)1561–1569.
[26]söderhäll, K., Rantamäki, J., Constantinescu, O., 1993, Isolation of Trichosporon beigelii from the freswater crayfish Astacus astacus, Aquaculture, Vol. 116, pp. 25-31.
[27]Tahoun, M.K., El-Merheb, Z., Salam, A., Yousse, A., 1987, Biomass adn lipids from lactose or whey by Trichosporon beigelii, Biotechnol. Bioeng, Vol. 10, pp. 358-360.
[28] Tornadijo, M. E., Fresno, J. M., Sarmiento, R. M., Carballo, J., 1998, Study of the yeast during the ripening process of Armada cheses from raw goat's milk, Lait, pp. 647-659.
[29]Utama, G. L., Kurmani, B.A., Sunardi, S., Roostita, L. B., 2016, The Isolation and Identification of Stress Tolerance Ethanol-fermenting Yeasts from Mozzarella Cheese Whey, International Journal of Advanced Science, Engineering and Information Technology, Vol. 6(2), 252-257.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IDENTIFICATION AND MONITORING OF USEFUL ENTHOMOPHAGOUS ARTHROPODS FAUNA FROM THE WINTER WHEAT CROP IN TWO AGROECOSISTEMS FROM THE CENTER OF TRANSYLVANIA

Ana-Maria VĂLEAN[1,2], Dana MALSCHI[1], Felicia MUREŞANU[1], Laura ŞOPTEREAN[1,2], Loredana SUCIU[1,2], Florin RUSSU[1], Ioana PORUMB[1,2], Ion OLTEAN[2]

[1]Agricultural Research-Development Station Turda, 27 Agriculturii Str, Turda City, Cluj County, România, Emails: pacurar.anamaria@yahoo.com, danamalschi@yahoo.com, diabrotica22@yahoo.com, ticulaura@yahoo.com, suciualexandra1@yahoo.com, rusuuflorin@yahoo.com, ioanaporumb18@yahoo.com
[2]University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Faculty of Agriculture, 3-5 Calea Mănăștur, Cluj-Napoca 400372, România, Emails: pacurar.anamaria@yahoo.com, ticulaura@yahoo.com, suciualexandra1@yahoo.com, ioanaporumb18@yahoo.com, ion.oltean@yahoo.com

Corresponding author: ion.oltean@yahoo.com

Abstract

Increase agricultural output is conditioned by a number of factors, among which the protection of plants against pests plays a very important role. Along with chemical methods, methods of biological and integrated control against harmful organisms in crops have recently taken on a large scale, and one of these methods is the use of entomophages (predators and parasites). In order to identify and monitor species of entomophagous arthropods from the winter wheat culture, in the years 2016, 2017, an experiment was carried out in two locations in the center of Transylvania, namely in Turda in open field agroecosystem and in Bolduţ, in agroecosystem with protective agroforestry curtains. The field results were calculated and interpreted using ecological indices (abundance, dominance, constancy, and W ecology significance index). In addition to the monitoring of the entomophages, production and some of its components were determined. Entomophagous arthropods identified in the two agroecosystems differ only in ecological indicators, belonging to the same groups of entomophagous. The positive role of the agroforestry curtains in Bolduţ reflected both on the abundance of entomophages and wheat production, obtaind an 8% production increase compared to the production made in the unprotected system in Turda.

Key words: *agroforestry curtains, ecological indices, enthomophagous, wheat culture*

INTRODUCTION

Entomophagous arthropods from wheat crops are represented by many species, having a great peculiarity for different pests, developing as a result of numerical growth of the host (the pest) and favorable conditions in agroecosystems [1,9].
Entomophagous show some remarkable particulars, including the high abundance of populations, many species present in different agroecosystems being recorded. Each pest is associated with several predatory or parasitic species that are capable of immediately or slowly destroying the various stages of its development: egg, larva, stern, or adult [15].
Maintaining biological balance of the agronomical ecosystem, play an important role in the presence and activity of entomophagus species, especially that of the predatory insects [13,19].
The entomophagous moves in a biotope for many reasons: food, reproduction, avoiding the enemies, or for better conditions of life. All these moments have a deep influence on the surviving and the reproduction rate [20,21].
In any kind of agroecosystem, with the number of pests that cause damage, certain organisms install themselves and are designed to limit the destructive action of pests. Among these, predator and parasitoid insects have a relevant importance in protection of plants and environment. Together they form the so-

called auxiliary entomofauna [17].

Pesticide spraying is the main method of integrated pest control [5]. However, after repeated appli-cations and increasingly higher rates of pesticide usage for a protracted period more than 500 species of pests have now developed resistance to pesticides, leading to increasing crop losses. For example,in the USA, farmers lost 7 % of their crops to pests in the 1940's, while since the1980's, the percentage lost has increased to 13 %, even though more pesticides are being used [3].

Under the conditions of warming and aridization of current climate change, the agricultural system with forest curtains is an ecotechnology with an important effect for the anti-erosion protection and sustainable development of agriculture in the center of Transylvania. Agroforestry protection curtains have a special role in the bioremediation of damaged agricultural land and also in organic farming [6,8,11].

The diversified systems and crops bordered with different vegetation (other crop fields, weeds and forests) recorded more entomophagous predators than monocrops and crops adjacent to vegetation-free fields. Agroforestry systems may have higher potential to reduce pests because of greater diversity among the entomophagous species than mixed annual crop systems [2,7,10].

Sustainable development of agriculture, based on long-term research on crop yield factors, on biodiversity, environmental protection and use of natural resources, has been an important objective for the research institutes in Romania [12,14].

MATERIALS AND METHODS

Considering the importance of protecting entomophages, in 2016-2017 period, their evolution was followed in an experience in two types of agroecosystems in the center of Transylvania, namely Turda and Bolduţ.

In addition to the land and experimental fields it owns, the Agricultural Research and Development Station Turda manages a field crop farm located in Bolduţ arranged in anti-erosion system with agroforestry protection curtains. Located at about 15 km from Turda, Bolduţ's farm comprises 323 hectares of agricultural land, grown in small lots (10-25 ha) , framed by a 32 ha agroforestry curtain network, which include about 36 arboreal and arbustic species planted in the years 1951-1953 [4,16].

The two locations are different in the first place from the point of view of the organization of the land, because at Turda the lots are large (100-200 ha), placed under open field conditions and are protected by acacia strips having a reduced width, located at a quite large distances between them, on the main access roads.

The main objectives of the paper were to identify and monitor the evolution of the entomophagous species from the winter wheat culture, to analyze the insect populations by calculating some ecological indices, but also to determine the production in the two agroecosystems.

The experience has been structured in two variants with large areas of about 1,5 ha in both locations in which all the integrated technological and phytosanitary recommendations have been applied such as insecticides and fungicides seed treatment, treatments with herbicides, fungicides and foliar fertilizers. Variant (V1) was untreated with insecticides, and variant (V2) was treated with insecticides in two phenophases: at the end of the tillering with Biscaya 100 ml/ha (s.a. tiacloprid), and in the booting phenophase with Fastac 100 ml/ha (s.a. alfa-cypermethrin). The biological material used for this purpose was the wheat cultivator Andrada, SCDA Turda, one of the most cultivated varieties in the area. The entomophagous collection was performed decadally using entomological net, 100 double sweep-nets for each sample. The filleting began in the first decade of April and continued until the physiological maturity of the wheat. Applied culture technology was the one specific to seed production with strict observance of a three-year rotation.

According to [16], field results were calculated and interpreted using different ecological parameters: abundance (A), dominance (D), constancy (C) and ecological significance index (W).

Abundance (A) is the total of individuals of a species in the catch from a certain place on a given date. Based on the value of this indicator, the other indicators are calculated.

Dominance (D) shows the percentage of participation of each species in the catch. Explains the relationship of a species with the sum of the individuals of the other associated species. This indicator is calculated according to the formula:

$$D_A = \frac{N_A x\ 100}{N_1}$$

N_A = total number of individuals of species A;
N_1 = the total number of individuals of all species collected.

Dominance classes include species whose percentage of spread falls within the next values:

D_1 – subrecedente species (<1.1%);
D_2 – recedente species (1.2 – 2.0%);
D_3 – subdominant species (2.1 – 5.0%);
D_4 – dominant species (5.1 – 10.0%);
D_5 – eudominant species (>101%).

Constancy (C) expresses the continuity of the occurrence of a species in the analyzed biotope. This characteristic is a structural indicator because it shows the proportion of participation of a species in the biocenosis structure. The higher the value of the indicator, the more the species is better adapted to the conditions offered by the biotope.

Constancy is calculated according to the mathematical formula:

$$C_A = \frac{n_p A}{N_P} x100$$

C_A – the constancy of species A;
$n_P A$ – the number of samples in which the species A is present;
N_P – total number of investigated samples.

Depending on the value of this indicator, the species is distributed in the following classes:

C_1 – accidental species (1 – 25%);
C_2 – accessory species (25.1 – 50%);
C_3 – constant species (50.1 – 75%);
C_4 – euconstant species (75.1 – 100%).

Ecological significance index (W) is the relationship between structural indicator (C) and the productive (D). The ecological significance index is calculated according to the formula:

$$W_A = \frac{C_A x D_A x100}{10,000}$$

W_A = the ecological significance of species A.
C_A = constancy of species A;
D_A = dominance of species A.

Depending on the values obtained, species are divided into the following classes:

W_1 – (<0.1%);
W_2 – (0.1 – 1.0%);
W_3 – (1.1 – 5.0%);
W_4 – (5,1 – 10.0%);
W_5 – (>10.0%).

Class W1 corresponds to accidental species, classes W2 and W3 of accessory species and classes W4 and W5 correspond to species characteristic for the given cenosis.

RESULTS AND DISCUSSIONS

The questionnaires on organic products consumption have been applied to a number of 488 respondents.

In both agroecosystems the same groups of entomophagous were identified, they differ only in terms of the environmental indicators (Tables 1 and 2).

Both in Turda and Bolduț the most abundant entomophagous are represented by the *Aranea* group, the oscillation of abundance between the two localities being accentuated. Another category well represented in the two areas is represented by parasite entomophagous, namely *Hymenoptera*. In this group the oscillation of abundance is much lower (compared to *Aranea*), so at Bolduţ the average abundance is 62, while in Turda it is slightly lower than only 43. Another well represented family and favorably influenced by the agroforestry curtains from Bolduţ is *Cantharidae*, the value of abundance being 54. In Turda agroecosystems, the species in this family have a much lower presence. *Nabidaele* find better development conditions at Turda, the abundance of 32 compared to Bolduț, where their abundance decreases considerably reaching only the value of 9 individuals. Between other groups of entomophagous there is a fairly stable equilibrium between the two biotopes with

growth or decrease tendencies in the two locations.
The eudominant species of the two agroecosystems are obviously spiders, followed by parasites. Another eudominant family but only in the system protected by the agroforestry curtains of Bolduţ is *Cantharidae*. In the unprotected Turda system, ants are also eudominant. Among the dominant species that have been identified are *Nabidae* and *Empididae* in Turda, and in Boltuţ *Syrphidae*. Other entomophagous are less well represented and represent only subdominant species (D3), recedent species (D2) or subrecedent species (D1). The euconstant species in both locations are represented by the group of spiders (C4). Although the parasites are more abundant in Bolduţ, the highest constancy is in Turda, classifying as euconstant species in this location. The species belonging to the *Cantharidae* family are classified as constant species (C3) in both localities. In Turda agroecosystem, another family belonging to class C3 is *Empididae*, and in the system with agroforestry curtains from Bolduţ the constant species are those of the *Syrphidae* family. Other groups of entomophagous have a lower constancy in both areas being accidental species (C1) or accessories (C2).

Table 1. Ecological parameter analysis of the species collected in the wheat culture, in untreated variant at Turda from 2016-2017 period (average)

Crt. No.	Entomophagous	A	D		C		W	
			%	Class	%	Class	%	Class
1	*Coccinellidae*	13.5	4.07	D3	45.71	C2	1.86	W3
2	*Cantharidae*	16.5	4.98	D3	53.57	C3	2.67	W3
3	*Malachiidae*	6	1.81	D2	36.43	C2	0.66	W2
4	*Nabidae*	32	9.65	D4	46.43	C2	4.48	W3
5	*Staphylinidae*	2.5	0.75	D1	17.14	C1	0.13	W2
6	*Chrysopidae*	6.5	1.96	D2	41.43	C2	0.81	W2
7	*Syrphidae*	14	4.22	D3	38.57	C2	1.63	W3
8	*Empididae*	28	8.45	D4	53.57	C3	4.52	W3
9	*Hymenoptere* parasitic	43	12.97	D5	80.71	C4	10.47	W5
10	*Formicidae*	39.5	11.92	D5	22.14	C2	2.64	W3
11	*Aranea*	130	39.22	D5	95.00	C4	37.25	W5

Source: Own results.

Table 2. Ecological parameter analysis of the species collected in the wheat culture, in untreated variant at Bolduț from 2016-2017 period (average)

Crt. No.	Entomophagous	A	D		C		W	
			%	Class	%	Class	%	Class
1	*Coccinellidae*	11	2.66	D3	35.71	C2	0.95	W2
2	*Cantharidae*	54	13.06	D5	64.29	C3	8.40	W4
3	*Malachiidae*	1	0.24	D1	14.29	C1	0.03	W1
4	*Nabidae*	9	2.18	D3	42.86	C2	0.93	W2
5	*Staphylinidae*	8	1.93	D2	28.57	C2	0.55	W2
6	*Chrysopidae*	9.5	2.30	D3	42.86	C2	0.98	W2
7	*Syrphidae*	37	8.95	D4	57.14	C3	5.11	W4
8	*Empididae*	20.5	4.96	D3	42.86	C2	2.12	W3
9	*Hymenoptere* parasitic	62	14.99	D5	50.00	C2	7.50	W4
10	*Formicidae*	11	2.66	D3	35.71	C2	0.95	W2
11	*Aranea*	190.5	46.07	D5	85.71	C4	39.49	W5

Source: Own results.

According to the classification of ecological index W, in both areas, spiders are those that correspond to characteristic species along with the parasitic *Hymenoptera*. In Bolduț, families are also classified as characteristic species is *Syrphidae* and *Cantharidae*. The other groups of enthomophagous qualify as accidental and accessories species (Table 1 and 2).

In addition, to the monitoring of entomophagous, some components of wheat production have been determined, but we will only present the role of agroecosystem, year, and insecticide treatments in production formation.

Of the three experimental factors represented by agroecosystem, treatment and year, the biggest role in harvesting is the year factor followed by treatment. All this is reflected in the value s^2 (Table 3).

Moreover, the "F" test is statistically assured for these two factors as being very significant.

An important contribution in the formation and realization of the productions is also the agroecosystem factor, but with a lower involvement, the value of the "F" sample being for this factor only significant. Reducing the involvement of the agroecosystem in production control is due to the fact that the two localities are located at a relatively close distance (about 15 km).

It can be said that there are no obvious differences between the two localities of the climatic factor.

Among the interactions, the most significant participation in the wheat production fluctuation is evident between the agroecosystem and the year (s^2 = 3.39), the value of the "F" test being very significant.

The positive role of Bolduţ agroforestry curtains extends to the production of wheat by an increase of 8% compared to the average production in Turda unprotected system (Table 4).

Table 3**.** The variance of the wheat production in the two types of agroecosystems (Turda and Bolduț, 2016, 2017)

No. crt.	**Source of variance**	**SPA**	**GL**	**s^2**	**F Test**
1.	Total	18.74	21		
2.	Agroecosystem (Ag)	2.51	1	2.51	80.17^{*}
3.	Treatment (T)	5.51	1	5.51	71.01^{***}
4.	AgxT	0.16	1	0.16	2.12^{ns}
5.	Year (Y)	5.68	1	5.68	68.95^{***}
6.	AgxY	3.39	1	3.39	41.12^{***}
7.	TxY	0.34	1	0.34	4.08^{ns}
8.	AgxTxY	0.14	1	0.14	1.64^{ns}
9.	Error Ag	0.06	2	0.03	
10.	Error T	0.31	4	0.08	
11.	Error A	0.66	8	0.08	

Source: Own results.

A microclimate with is created around the agroforestry curtains which is conducive to agricultural crops and it is also created conditions favorable to the development and efficient activity of auxiliary entomophages.

Application of the treatment increases yields of 12% (960 kg/ha) over the control untreated with insecticides (Table 4). Therefore, we can say that this production increase leads to a considerable profit.

However, we still need to make efforts to implement crop protection measures that have the least impact on agroecosystems, on auxiliary entomophages and ultimately the environment.

Of course, the year factor has the largest contribution to crop production, of the two experimental years in 2017 in both locations and in both variants (treated, untreated) the production increase was very significant, about 500 kg compared to the control (average years) (Table 4).

The role of agroforestry curtains from Bolduţ also derives from the data presented in Table 5. Average production of Andrada variety made in Bolduţ is 8.55 t/ha, superior to Turda of only 7.91. Also, the fluctuation of production from one year to another is much lower in Bolduţ (between the two years there are no statistically insured differentials) compared to the one from Turda (in 2017 cultivar Andrada registers very significant increases). Therefore, we can say that agroforestry curtains also play an important role in stabilizing the productions by reducing the oscillations of the annual values.

Table 4. Influence of factors: type of agroecosystem, insecticide treatments and year in production formation, to the Andrada variety

No. crt.	The type of agroecosystem	Yield t/ha	The relative value	The difference	Significance
1.	Turda	7.91	100.0	0.00	Mt.
2.	Bolduț	8.55	108.2	0.65	*
	DL (p 5%)	0.31			
	DL (p 1%)	0.72			
	DL (p 0.1%)	2.28			
No. crt.	Treatments with insecticides	Yield t/ha	The relative value	The difference	Significance
1.	Untreated	7.75	100.0	0.00	Mt.
2.	Treated	8.71	112.4	0.96	**
	DL (p 5%)	0.32			
	DL (p 1%)	0.52			
	DL (p 0.1%)	0.98			
No. crt.	Year	Yield t/ha	The relative value	The difference	Significance
1.	Average	8.23	100.0	0.00	Mt.
2.	2016	7.74	94.1	-0.49	00
3.	2017	8.72	105.9	0.49	**
	DL (p 5%)	0.27			
	DL (p 1%)	0.39			
	DL (p 0.1%)	0.59			

Source: Own results.

Table 5. The influence of double interaction (year x agroecosystem) in the formation of wheat production

No. crt.	**Variant**	**Yeld t/ha**	**The relative value**	**The difference**	**Significance**
1.	Turda average	7.91	100.0	0.00	Mt.
2.	Turda 2016	7.05	89.1	-0.86	000
3.	Turda 2017	8.77	110.9	0.86	***
1.	Bolduț average	8.55	100.0	0.00	Mt.
2.	Bolduț 2016	8.44	98.7	-0.11	-
3.	Bolduț 2017	8.66	101.3	0.11	-
	DL (p 5%)	0.38			
	DL (p 1%)	0.56			
	DL (p 0.1%)	0.83			

Source: Own results.

CONCLUSIONS

In field cereal agroecosystem open from the Turda area, in years 2016 and 2017 the most abundant group of entomophagous is represented by *Aranea*.

Organizing and arranging farmland with agroforestry protection curtains is an important means of the protection of fauna arthropod entomophagous and for the stability of productions one year to another.

Integrated protection of wheat crops against phytophagus is an important means of increasing production.

Application of insecticide treatments should be based on abundance of phytophagus in relation to the activity of natural fond of entomophagous in crops, at optimum times of application and only on warning within the integrated combat system. This is an important measure to reduce the impact of insecticides on the environment and useful entomofauna.

REFERENCES

[1]Baicu, T., A. Săvescu, 1986, Sisteme de combatere integrate a bolilor și dăunătorilor pe culturi. Editura Ceres, București, pp. 263.

[2]Girma, H., Rao M. R., Sithanantham, S., 2000, Insect pests and beneficial arthropod populations under

different hedgerow intercropping systems in semiarid Kenya. Agroforestry Systems Kluwer Academic Publishers. Printed in the Netherlands, (50):279-292.

[3]Liang, J., Tang, S., Cheke, R. A., Wu, J., 2013, Adaptive Release of Natural Enemies in a Pest-Natural Enemy System with Pesticide Resistance, Bulletin of Mathematical Biology 5(75):2167–2195.

[4]Lupe, I.Z., Spîrchez, Z., 1955. Cercetări privind tehnica de creare a perdelelor de protecție în Câmpia Ardealului. Analele Institutului de Cercetări Silvice. Edit. Agro-Silvică de Stat, București: 411-449.

[5]Malschi, D., Mustea, D., 1997, Cercetări entomocenotice privind impactul insecticidelor aplicate la culturile de cereale păioase în condițiile din centrul Transilvaniei. Pro-Plant, (1): 253-261.

[6]Malschi, D., 2003, Research on the integrated wheat pests control (Actual strategy of integrated pests management as part of agroecological system forsustainable development of wheat crop, inTransylvania). Romanian Agricultural Research, (19-20): 67-85.

[7]Malschi, D., 2004, The protective agroforestry belts as an ecological technology for the pests controland sustainable development of cereal crops inTransylvania. Buletin USAMV-Cluj Napoca, (60): 120-126.

[8]Malschi, D., 2005, The pest population evolutions and integrated control strategy for sustainable development of wheat crop in Transylvania. Buletin USAMV-Cluj Napoca, (61):137–143.

[9]Malschi, D., 2009, Integrated pest management in relation to environmental sustainability. Part I. Ecological management of wheat pests. Manual online. Faculty of Environmental Sciences, Babeş-Bolyai University, Cluj-Napoca. Bioflux Publishing House, Cluj-Napoca, pp. 200.

[10]Malschi, D., Tritean, N., Şerbănescu, R., 2010, Protective agroforestry belts and their environmental importance for sustainable agriculture development in Transylvania**.** Romanian Agricultural Research, (27): 279–292.

[11]Malschi, D., 2014, Mediu–Biotehnologie-Dezvoltare Durabilă. Biotehnologii şi depoluareasistemelor ecologice. Manual în format electronic. Faculty of Environmental Sciences, Babeş-BolyaiUniversity, Cluj-Napoca. Editura BIOFLUX.

[12]Malschi, D., Tărău, A. D., Kadar, R., Tritean, N., Cheţan, C., 2015, Climate warming in relation to wheat pest dynamics and their integrated control in Transylvanian crop management systems with no tillage and with agroforestry belts. Romanian Agricultural Research, (32): 279-289.

[13]Malschi, D., Muresanu, F., Tărău, A. D., Vălean, A. M., Cheţan, C., Tritean, N., 2016, Cercetări asupra situaţiilor de risc entomocenotic la cultura grâului la S.C.D.A. Turda**.** An. I.N.C.D.A. Fundulea, LXXXIV: 243-266.

[14]Malschi, D., Mureşanu, F., Tărău, A. D., Vălean, A. M., Dărab, I., Chetan, C., Tritean, N., 2017, The Current Importance of Pest and Entomological Risk Situations for Wheat Crops in Central Transylvania. in Vol: Resilient Society. Multidisciplinary contributions from economic, law, policy, engineering, agricultural and life sciences fields. Editura, Les Presses Agronomiques de Gembloux (Belgium), Bioflux Publishing House Cluj-Napoca, p.95-120.

[15]Perju, T., Lăcătușu, M., Pisică, C., Andreiescu, I., Mustață, Gh., 1988, Entomofagii și utilizarea lor în protecția integrată a ecosistemelor agricole, Editura Ceres, București, pp. 241.

[16]Popescu, E., 1993. Comportarea principalelor specii de arbori în rețeaua de perdele antierozionale Cean în raport cu condițiile staționale și tipul de cultură. Teza de doctorat. A.S.A.S. București, secția Silvicultură.

[17]Prelipcean-Bosovici, E. D., Moglan, I., 2016, Useful entomofauna from rye crop in the northern part of Moldova**.** Analele Ştiinţifice ale Universității „Alexandru Ioan Cuza” din Iași, Biologie animală, Tom LXII: p. 65-75

[18]Simionescu, V., 1983. Lucrări practice de ecologie. Editura Universității “Al. I. Cuza”, Iaşi. p. 174-190

[19]Stancă-Moise, C., 2016, The structure of an entomofauna characteristic for a spontaneous meadow in Sibiel village (Sibiu, România). Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 16(3):315-319.

[20]Stancă-Moise, C., Tănase, M., 2016, Ecological research on the dynamics of arthropods from grasslands on the outskirts of" Dumbrava Sibiului" forest (Sibiu, Romania) in the period 2012–2014, Analele Universităţii din Oradea, Fascicula Biologie, 23(1):22-31.

[21]Stancă-Moise, C., 2017, A study about the pest insects in the apple trees orchards, with local sorts, specific to Sibiel village (Sibiu county), in the conditions of the years 2015-2016. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 17(3):379-383.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

WHICH ARE THE MAIN MEDICINAL PLANTS THAT COULD BE HARVESTED FROM EASTERN ROMANIA?

Diana VASILE[1], Cristian Mihai ENESCU[2], Lucian DINCĂ[1]

[1] "Marin Drăcea" National Institute for Research and Development in Forestry (INCDS), 13 Cloșca Street, Brașov-500040, Romania; E-mail: diana_vasile@ymail.com, dinka.lucian@gmail.com
[2]University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăști Boulevard, 1st District, Bucharest-011464, Romania; Email: mihaienescu21@gmail.com

Corresponding author: dinka.lucian@gmail.com

Abstract

Worldwide, medicinal and aromatic plants play an important role for humanity. Thousands of medicinal plants are used across the world. Almost 300 medicinal plants are known and used in Romania. Their distribution is not uniform across the country, being depended in some cases of the presence of forest sites. The main goal of this paper was to estimate the maximum quantities of medicinal plants that could be harvested by the eight Forestry Directorates, managed by National Forest Administration Romsilva, from the eastern part of Romania. Several studies, papers, indicators and databases were taken into account. 38 medicinal plant species have potential in terms of harvesting in the Eastern Romania, with a total estimated quantity of more than 1.500 tons. The highest quantities could be harvested by Vaslui, Iași, Vrancea and Botoșani Forestry Directorates. The species with the highest potential were: bear's garlic, silver linden, elder, small-leaved lime, common nettle, large-leaved linden and common hawthorn. Harvesting and management measures aimed at protecting certain medicinal plant species were also proposed.

Key words: *Eastern Romania, elder, linden, medicinal plants, Romsilva*

INTRODUCTION

Nowadays, thousands of medicinal and aromatic plants are used in pharmaceutical, food, sanitary, cosmetic, agricultural and/or other related industries [12], [19], [22].
As regards the pharmaceutical use, it is estimated than 11% of main drugs are exclusively of vegetal origin [23]. Furthermore, in the recent decades, a rising interest for the alternative therapies that use products derived from plants was observed [26]. Natural products isolated from medicinal plants can constitute an essential component in searching for new remedies [1], as using primary biologic matter is in most of the cases much cheaper than using alternative chemical substances.
Even if it is difficult to assess the total number of plant species that were used for medicinal purposes at a certain time and even in the present, yet it is estimated that worldwide more than 70,000 plant species are used in popular medicine [11]. As a consequence, there is a high demand of biological products – both for domestic and commercial uses – which leads to a huge local, regional, national and international trade.
For example, in China, one of the countries with a great potential as regards the medicinal plants, 4,941 species from a total of approximatively 32,200 native species are used as medicinal plants in the traditional medicine [14]. If we take into account that worldwide, more than 422,000 superior plants were described [2], [13], we could say that China holds about 1.2% of the worldwide fund of medicinal plants.
Medicinal and aromatic plants with specific chemical profiles were important elements of religious and therapeutically practices from earlier world cultures [25]. Particularly, European countries have a long tradition of plant based medicine starting from the Greek and Roman periods [15].
Across European Union, more than 80 species of vascular plants are collected, consumed and recognized for their nutritional, economic and

cultural benefits [27]. Moreover, in many European countries, the harvesting of medicinal plants is a common recreational activity and sometimes even profitable [20].

On the current territory of Romania, medicinal and aromatic plants are used since two millennia ago, during the Thracians. The first medicinal Romanian book was published in 1862 and it described 217 phytotherapeutic remedies [17], [18] and the first European research institute dedicated to medicinal and aromatic plants was founded in 1904 at Cluj by Professor Béla Páter [18].

Due to the fact that Retezat Mountains (south-western part of Romania) is characterized by a high degree in terms of flora diversity, in 1916, Romanian botanist Alexandru Borza wrote a series of articles about the necessity of protecting certain regions from Retezat Mountains and initiated the establishment of the first Romanian national park [6], [17], that was done in 1935.

At present, it is estimated that approximately 283 medicinal plant species are harvested in Romania [21].

The main aim of this paper was to estimate the maximum quantities of medicinal plants that could be harvested by the Forestry Directorates from the eastern part of Romania. Secondly, a set of harvesting management measures aimed at reducing the impact on the environment was proposed.

MATERIALS AND METHODS

Eight Forestry Directorates from the eastern part of Romania (Bacău, Botoșani, Galați, Iași, Neamț, Suceava, Vaslui and Vrancea), managed by the National Forest Administration Romsilva, were the subject of the research.

It is well known that the plant's productivity depends on a complex array of ecological factors and based on them, oscillates from one year to another. The most important ones are in close connection with the biocenosis, together with all its attributes (species composition, percentage of soil coverage, age, production class).

Furthermore, the estimation of the quantities that could be produced by certain plants are influenced by the amount of local precipitations as well as by the region's specific type of soil.

In order to estimate the quantities of medicinal plants that could be harvested in 2018 from the spontaneous flora included into the forest fund managed by the eight Forestry Directorates, the followings were taken into consideration:

- the reports realized in the last years by specialists from "Marin Drăcea" National Institute for Research and Development in Forestry (INCDS);
- the current area of the forest fund managed by the eight Forestry Directorates (Fig.1);

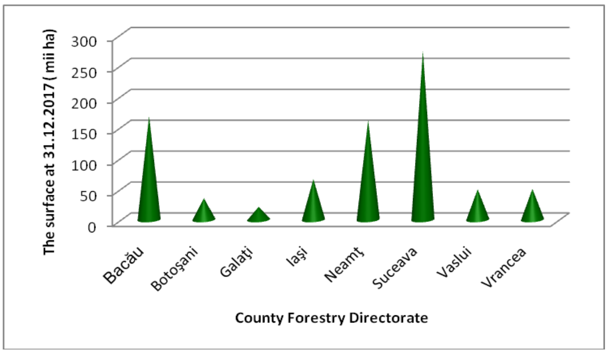


Fig.1. Surface of forest fund managed by the eight Forestry Directorates
Source: Romsilva, www.rosilva.ro.

- INCDS' databases regarding the medicinal plants;
- information present in special works (research themes, scientific papers, reports, etc.).

The restrictive ecologic factors that control the forest ecosystem's productivity were also taken into consideration, namely the altitude, quantity of average annual precipitations and soil type [4], [7], [8], [9]. Furthermore, the average quantities of the medicinal plants resources from the main forest formations (*i.e.* spruce stands, common beech-resinous mixed stands, oak stands) were also taken into consideration.

The meteorological prognosis for the current year is essential for estimating the resource productivity, due to the fact that these quantities can fluctuate very much from one year to another, depending on the humidity recorded during the blooming and growth seasons.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

RESULTS AND DISCUSSIONS

Based on all the ecological factors as well as the data from the forestry directorates management plans and the literature, the estimated quantity of medicinal plants that could be harvested in 2018 in the eastern part of Romania is of 1,565 tons.
40% of the total quantity could be harvested from Vaslui, 20% from Iași, 12% from Vrancea and 11% from Botoșani Forestry Directorates, respectively. Less percentages (4-5%) were obtained in the case of the other four counties (Fig.2).

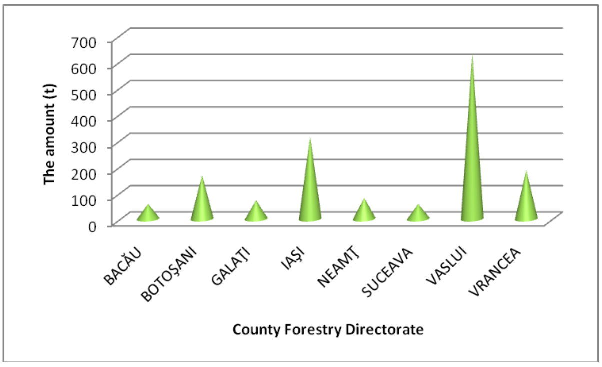


Fig.2. Quantity of medicinal plants that could be harvested from Eastern Romania
Source: Original.

Across the forest stands managed by the eight forestry directorates, it is estimated that 38 species of medicinal plants could be harvested, namely: silver fir (*Abies alba* Mill.), common yarrow (*Achillea millefolium* L.), horse-chestnut (*Aesculus hippocastanum* L.), bear's garlic (*Allium ursinum* L.), marsh-mallow (*Althaea officinalis* L.), edible burdock (*Arctium lappa* L.), absinthe (*Artemisia absinthium* L.), birch (*Betula pendula* Roth.), shepherd’s purse [*Capsella bursa-pastoris* (L.) Medik.], celendine (*Chelidonium majus* L.), common hawthorn (*Crataegus monogyna* Jack.), common horsetail (*Equisetum arvense* L.), European beech (*Fagus sylvatica* L.), alder buckthorn (*Frangula alnus* Mill.), St John’s-wort (*Hipericum perforatum* L.), Persian walnut (*Juglans regia* L.), white nettle (*Lamium album* L.), chamomile (*Matricaria chamomilla* L.), yellow melilot [*Melilotus officinalis* (L.) Pall.], squaw mint (*Mentha pulegium* L.), white mulberry (*Morus alba* L.), Norway spruce [*Picea abies* (L.) H.Karst.), Scots pine (*Pinus sylvestris* L.), common knotgrass (*Polygonum aviculare* L.), cowslip primrose (*Primula officinalis* L.), pedunculate oak (*Quercus robur* L.), block locust (*Robinia pseudocacia* L.), raspberry (*Rubus idaeus* L.), elder (*Sambucus nigra* L.), common dandelion [*Taraxacum officinale* (L.) Weber ex F.H. Wigg], wild thyme (*Thymus serpyllum* L.), small-leaved lime (*Tilia cordata* Mill.), large-leaved linden (*Tilia platyphyllos* Scop.), silver linden (*Tilia tomentosa* Moench), coltsfoot (*Tussilago farfara* L.), common nettle (*Urtica dioica* L.), European blueberry (*Vaccinum myrtillus* L.) and mistletoe (*Viscum album* L.).
Among them, the medicinal plant species for which higher quantities could be harvested are represented by: bear's garlic (24%), silver linden (16%), elder (8%), small-leaved lime (7%), common nettle (7%), large-leaved linden (5%) and common hawthorn (5%), respectively (Fig.3).

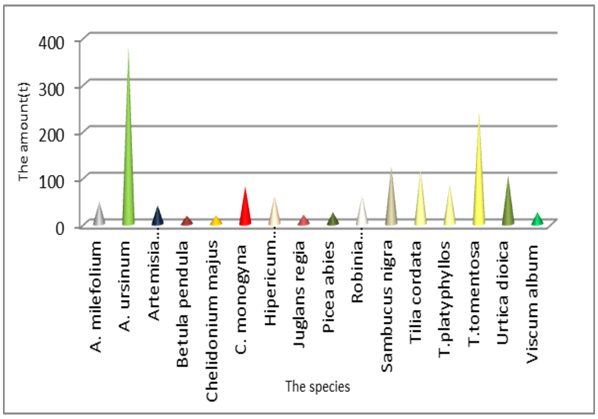


Fig.3. Medicinal plant species that could be harvested from Eastern Romania
Source: Original.

In Romania, only the three mentioned linden species occur. Among them, the most widespread is small-leaved linden, while the less common are large-leaved linden and silver linden [16].
Silver linden commonly grows in pure stands in the hilly area, and rarely in mixed plain or mountain forests.
Small-leaved linden is resistant to drought, being sensitive to temperatures. As such, it grows well in plain forests from the eastern

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

part of the country.

Large-leaved linden has higher requirements as regards temperature and light. As such, it is rarely found at the limit between plain and hill.

These species bloom between June-July, when the flowers (*Flores Tiliae*) are mainly harvested. The harvesting is very difficult to be done mainly due to the height of the trees.

Thanks to special mucilage, the linden flowers are reducing respiratory inflammations, especially in bronchitis. Furthermore, there are good as sedative in nervous conditions or insomnias [3].

Widespread in Europe, Asia and North Africa, in Romania, the elder is a common species in plain and hilly areas, reaching even inferior mountain areas.

The plant is exigent to climatic conditions, especially in regard with the soil. As such, it prefers warm areas and fertile soils, rich in humus [28].

It develops well in semi shadow, a reason for which it can be found especially in forest clearings, at the forest edges or near fences. The flowers are harvested during May-June, while the fruits (*Fructus Sambuci*) in September-October, in the same way as the flowers.

The flowers are used as sudorific in feverish states, coughs, congestion, bronchitis, pharyngitis, gout, rheumatism or urinary infections. The fruits can be used, in moderation, for constipation. As an external usage, compresses with elder infusions are used for treating abscesses, eyesores, acne, gout, conjunctivitis or frostbites [3], [10].

Management measures concerning the harvesting of medicinal plants

Long-lasting and sustainable harvesting is more and more seen as the most important conservation strategy for most medicinal and aromatic plants harvested from the wild (spontaneous) flora, by taking into consideration their current and potential contribution for local economies and their high value for people involved in their long term harvest.

In order to achieve a non-destructive harvesting of medicinal plants from the spontaneous flora, it is recommended to follow some management measures that will ensure the maintenance of populations, species and also the ecosystem's biodiversity, such as:

- species of plants with a special protection regime, according to the Romanian legislation, will not be harvested;
- medicinal plants will be harvested only in favorable climatic conditions, without significantly affecting the ecosystem's equilibrium and biodiversity and by respecting the special recommendations for each species;
- medicinal plants will not be harvested from areas belonging to natural protected areas, as they are defined according to the legislation [24], regardless of the protected area's objective;
- the plants will be harvested in the period of the maximum concentration of active principles (generally in the moment preceding the anthesis) for above-ground organs and at the end of the vegetation season for the subterranean ones;
- for a rational exploitation, we recommend the alternation of the harvesting period at one to three years;
- a partial harvest of medicinal plants will be realized, keeping provisions in order to ensure a trophic base for the existing dependent fauna;
- the harvest of medicinal plants must be realized by trained persons and under the close supervision of specialists who are able to recognize the taxa for which special recommendations or restrictions regarding the protection regime exist;
- in order to maintain the spontaneous flora basin's productive potential, the spontaneity method is recommended to be applied [5];
- harvestings will not be realized from isolated populations or represented by a small number of individuals;
- in order to obtain the necessary quantities of medicinal plants both for the internal and external markets in remarkable and advantageous economic conditions as well as for protecting and conserving the spontaneous flora's biodiversity, rare or endangered species should be promoted through specialized and controlled cultures.

CONCLUSIONS

The remarkable importance of medicinal plants in conservation refers to the values that they represent for humanity. These values encompass the contributions that medicinal plants can bring towards health, financial income, cultural identities or security of livelihoods.

From among the 283 plant species that are harvested from our entire country, it is estimated that 38 species (or parts of) are collected from the eastern part, some of them being the most harvested (bear's garlic, linden, elder, nettle and hawthorn).

The conservation methods and management measures must respect future provisioning and dispositions regarding species conservation for all these medicinal plants that are estimated to be harvested from the eastern part of our country.

We support the ideas of IUCN, WHO and WWF, according to which the cultivation of medicinal plants represents the best and most promising method to satisfy the extended market request for these prime material.

However, there is an economic-social aspect that assists in the future collecting of medicinal plants from the spontaneous flora as this endeavor can become an additional income or even the only income of people from rural or poor areas of some countries.

Regardless of these future directions, the medicinal plants that are highly requested and the ones that are crucially under threat of supra-exploitation or loss of habitat, the cultivation is certainly the only method of stopping the population’s decline and for ensuring their long term survival.

REFERENCES

[1]Balunas, M. J., Kinghorn, A. D., 2005, Drug discovery from medicinal plants, Life Sciences 78: 431-441.

[2]Bramwell, D., 2002, How many plant species are there? Plant Talk, 28: 32-34.

[3]Bojor, O., 2003, Medicinal and aromatic plant guide. From A to Z, Fiat Lux Publishing House, Bucharest, pp.268.

[4]Costandache, C., Dincă, L., Nistor, S., Crișan, V., 2016, Cauzele degradării terenurilor în Vrancea. Măsuri silvice de ameliorare a terenurilor degradate. Factori şi Procese Pedogenetice din Zona Temperată, 1(15): 57-68.

[5]Crăciun, F., Alexan, M., 1979, Ridicarea potenţialului bazinelor de plante medicinale din flora spontană, Comunicări la al VII-lea Congres Naţional de Farmacie, Bucharest.

[6]Cristea, V., 1995, La conservation de la nature en Roumanie.- L’uomo e l’ambiente, 18: 1-104.

[7]Crișan, V., Dincă, L., Oneț, A., Oneț, C., 2017, The description of forest soils from Brăila County, Natural Resources and Sustainable Development: 21-26.

[8]Dincă, M., Cadar, N., 2017, The chemical properties of forest soils from Vaslui County, Journal of Horticulture, Forestry and Biotechnology, 21(1): 23-28.

[9]Dincă, L., Lucaci, D., Iacoban, C., Ionescu, M., 2012, Metode de analiză a proprietăţilor şi soluţiei solurilor, Tehnică Silvică Publishing House. pp: 173.

[10]Enescu, C.M, Houston Durrant, T., Caudullo, G., 2016, *Sambucus nigra* in Europe: distribution, habitat, usage and threats. In: San-Miguel-Ayanz, J., de Rigo, D., Caudullo, G., Houston Durrant, T., Mauri, A. (Eds.), European Atlas of Forest Tree Species. Publ. Off. EU, Luxembourg, pp.172.

[11]Farnsworth, N.R., Soejarto, D.D., 1991, Global importance of medicinal plants. In: Akerele, O., Heywood, V. and Synge, H. eds. The conservation of medicinal plants: proceedings of an International consultation 21-27 March 1988, Chiang Mai, Thailand. Cambridge University Press, Cambridge: 25-51.

[12]Gorecki, P., 2002, Vitafoods und Kosmetika: Arzneipflanzen erobern sich neue Wirkungsbereiche. Drogenreport (28): 9-15.

[13]Govaerts, R., 2001, How many species of seed plants are there?– Taxon 50: 1085-1090.

[14] Groombridge, B., Jenkins, M., 1994, Biodiversity data sourcebook. Cambridge, UK, World Conservation Press, pp. 237.

[15]Gurib-Fakim, A., 2006, Medicinal plants: Traditions of yesterday and drugs of tomorrow, Molecular Aspects of Medicine, 27: 1-93.

[16]Ivanov, P., Loghin, C., Enescu, C.M., 2014, Morphological differentiation between Romanian lime species (Tilia spp.): A case study, Bulletin of Transilvania University of Brașov, Series II: Forestry, Wood Industry, Agricultural Food Engineering, 7(1): 21-28.

[17] Kathe, W., Honnef, S., Heym, A., 2003, Medicinal and Aromatic Plants in Albania, Bosnia-Herzegovina, Bulgaria, Croatia and Romania. Bundesamt für Naturschutz (BfN) (German Federal Agency for Nature Conservation), Bonn, Germany, pp. 201.

[18]Kupke, J., Schwierz, A., Niefind, B., 2000, Arznei- und Gewürzpflanzen in Osteuropa. Anbau, Verarbeitung und Handel in 18 ausgewählten MOE-Ländern.- Materialien zur Marktentwicklung, 34; 95 pp. Zentrale Markt- und Preisberichtstelle GmbH (ZMP), Bonn, pp. 95.

[19]Lange, D., 1996, Untersuchungen zum Heilpflanzenhandel in Deutschland: ein Beitrag zum

internationalen Artenschutz. Bundesamt für Naturschutz, Bonn-Bad Godesberg, pp. 128.
[20] Molina, M., Pardo-de-Santayana, M., García, E., Aceityno-Mata, L., Morales, R., Tardío, J., 2012, Exploring the Potential of Wild Food Resources in the Mediterranean Region: Natural Yield and Gathering Pressure of the Wild Asparagus (Asparagus acutifolius L.), Span J Agr Res, 10(4): 1090.
[21]Murariu, D., 2002, Status of the Romanian medicinal and aromatic plants collection, Suceava Genebank, Unpublished report. 17 pp.
[22]Ohrmann, R., 1991, Pflanzenextrakte in Haushaltsprodukten, Dragoco Report (Holzminden) (3), 67-76.
[23]World Health Organisation, 1992, Quality control methods for medicinal plant materials, World Health Organization, Geneva.
[24]Ordonanța de Urgență nr. 57 din 20.06.2007 privind regimul ariilor naturale protejate, conservarea habitatelor naturale, a florei și faunei sălbatice aprobată cu modificări și completări prin Legea nr. 49/2011. (Emergency Ordinance no. 57 of 20.06.2007 on the regime of natural protected areas, conservation of natural habitats, wild flora and fauna approved with amendments and completions by Law no. 49/2011).
[25] Samuelsson, G., 2004, Drugs of Natural Origin: a Textbook of Pharmacognosy. 5th Swedish Pharmaceutical Press, Stockholm, pp. 620.
[26] Rates, S.M.K., 2001, Plants as source of drugs, Toxicon, 39: 603-613.
[27] Schulp, C.J.E., Thuiller, W., Verburg, P.H., 2014, Wild food in Europe: A synthesis of knowledge and data of terrestrial wild food as an ecosystem service, Ecological Economics, 105: 292-305.
[28]Stănescu, C., Șofletea, N., Popescu, O., 1997, Flora forestieră lemnoasă a României, Ceres Publishing House, Bucharest, pp. 452.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

BENCHMARKING OF INVESTMENT AND THEIR RECOVERABILITY IN THE BERRIES SECTOR

Andrei ZBANCĂ[1], Ghenadie NEGRITU[1], Dumitru STRATAN[2]

[1]The State Agricultural University of Moldova, 44 Mircesti, 2049, Chisinau, Republic of Moldova
Phone: +373 22 432 432, Fax: +373 22 312 276, E-mail: andzbanca@yahoo.com, ghenadie.negritu@gmail.com
[2]Inspiro Consulting SRL, Director, Chisinau, 43 Ion Creanga Str., PhD, Szent Istvan University, Hungary, Phone: +373 69 448 664, E-mail: dumitru.stratan@gmail.com

Corresponding author: andzbanca@yahoo.com

Abstract

Small agricultural producers of the Republic of Moldova focus on developing berries sector, which provides the greatest profits and, due to this fact, could become an important source of increasing income in the rural sector. The paper presents the results of economic calculations (performed by the authors) related to the amount of investments and terms of investment recovery (calculated per 1 hectare) for 15 berries crops, as well as to the economic results of the operational activity of growing these crops (sales incomes, sale costs, gross profit, economic profitability). The authors developed cost budgets and their components for each berries. The presented calculation data will enable farmers to select the correct berries based on the economic indicators and to deliberately investment the financial resources.

Key words: *berries, high value crops, economic results, cost of sales, gross profit, profitability, sales income*

INTRODUCTION

The development of the horticultural sector in the Republic of Moldova is a practical way of modernizing and diversifying agriculture and, at the same time, a source of income in rural areas. Domestic farmers do not have access to economic information (analyses, relevant marketing studies) on the high value agricultural sector and face problems in properly selecting crops for cultivation on their land holdings. The purpose of the study is to develop budgets and comparative economic analyses of cultivation of berries. The output of the study is the establishment of an economic information support system on the major bacciferous crops, which would allow small farmers to adequately select crops based on economic indicators and to invest funds based on evidence.

Currently, agricultural entrepreneurs aim at developing high value agriculture (HVA), while small and young entrepreneurs show a high interest in the production of berries, as this allows to obtain a high profit on small areas while ensuring an efficient business management. The results of the study are important to all stakeholders in the bacciferous crop cultivation sector, who are interested in its development, including entrepreneurs and external donors (funding agencies).

MATERIALS AND METHODS

Statistical annual reports of the Republic of Moldova, the data of the Ministry of Agriculture and Food Industry regarding the development of the agricultural sector and especially of the high value agriculture as well as the relevant literature were used as sources of statistical data for the study. The comparative advantages of bacciferous crop cultivation were analysed by economic analysis of income and costs for 15 berry crops.

The research was carried out as part of the Project "Improving Productivity and Market Access for Berry Producers" (AMIB), implemented by the Business Advisory Center

NGO and funded by HEKS Moldova. For each multi-annual plantation, annual financial models including investment budgets (vegetation period) were developed. The comparative analysis of obtained data served as a basis for identifying comparative advantages of bacciferous crops cultivation and for developing recommendations for agricultural producers.

RESULTS AND DISCUSSIONS

Global trends in the development of the bacciferous crops sector are positive, and there is a steady growth trend: (a) international trade in soft berry fruit has an annual growth of 15-20%, while the annual growth for hard berries is 7-10%; (b) the demand for fresh berries is growing three times faster than for frozen ones; (c) the most commonly sold soft berry fruits are strawberries, raspberries, blueberries; (d) the most attractive niche berries are blackberries, redcurrants, gooseberries, caprifoliaceae; (e) the largest consumer in the berry market is Eurpe (Germany, France, UK), while the highest growth in consumption is found in the Asian markets.

Agriculture remains the main sector of the national economy in the Republic of Moldova, as it has a share of 11.7% in the GDP and 50% in the volume of exports, while employing about 30% of the country's active population.

The bacciferous crop sector has good prospects for the future in the Republic of Moldova. The farmers who intend to develop a business focused on production of berries need to consider the following major issues:

-whether the selected fruit(s) and technology allow ensuring quality, productivity and ultimately competitiveness.

-production of competitive berries is a key element for marketing on regional markets (where the end consumer should be identified immediately and the technology needs to be adjusted to meet the customer’s needs in the product).

-only the quality/competitiveness will allow to compete and sell such products on the strategic berry sales markets.

Further, the authors analyse the development of the bacciferous crops sector in the Republic of Moldova, where a rapidly growing trend was noted over the last years. This sector has a high potential for development, which should be followed by the development of value chains for berries (Fig.1. and 2).

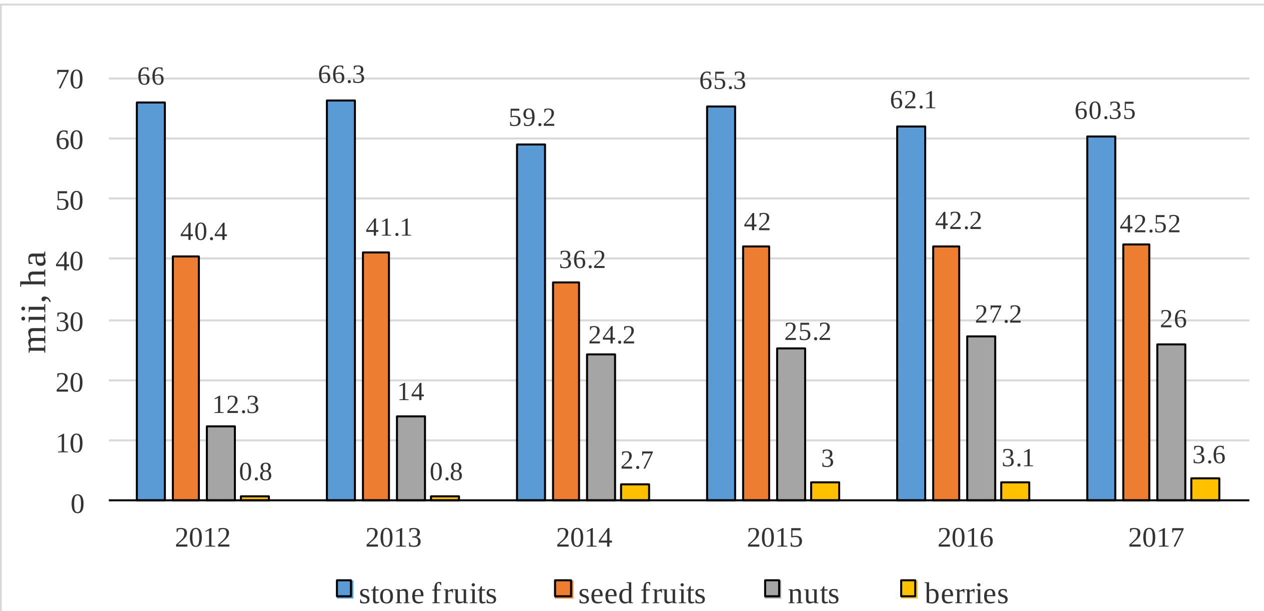


Fig. 1. Dynamics of areas of fruit plantations in Moldova.
Source: Developed by authors based on NBS data [1].

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The areas cultivated with bacciferous crops in Moldova were 4.5 times higher in 2017 as compared to 2012, which is an additional evidence of the high interest of small farmers in practicing such business due to its profitability.

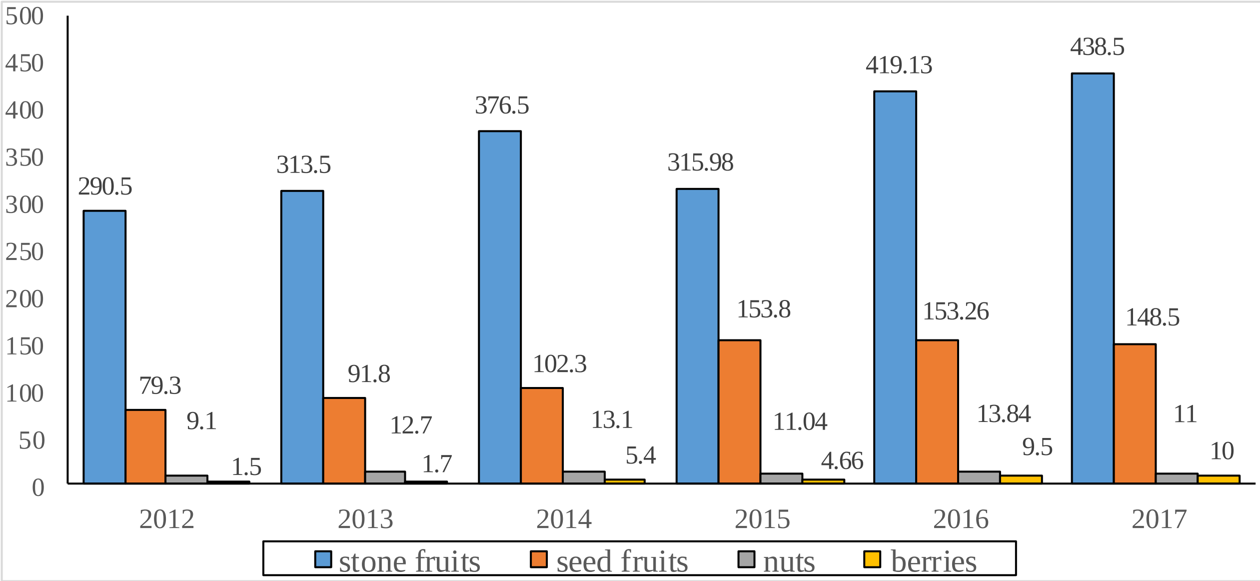


Fig. 2. Dynamics of fruit and berry production, tons.
Source: Developed by authors based on NBS data [1]

In case of berry production, in the Republic of Moldova, the growth is even faster, showing a 6.67 times higher growth in 2017 as compared to 2012. In the bacciferous crop sector, domestic producers face the biggest challenge – the need to increase the competitiveness, which primarily requires upgraded technologies (the yield per hectare is low) and higher economic efficiency.

Berry producers need to identify the most relevant and optimal answers to the questions below in order to manage their business in an efficient and sustainable way:

(i) Do they have all the production factors required for berry cultivation (irrigation, adequate land, labour force, knowledge)?

(ii) Which is the end consumer and segment in the sales market (processing, sales in a market or supermarket)?

(iii) Analysis of supply and demand of berries on a monthly basis for finding own niche;

(iv) Distance from the sales market and selection of the bacciferous crops (degree of perishability, ripening time, etc.);

(v) Ensuring the harvesting and sales conveyor, which allows for more efficient management of the business;

(vi) Selection of the crop(s) (type and range of varieties is very important) and selection of cultivation technology (which provides comparative advantages in respect to competitors and the competitiveness of products);

(vii) Proper information on berry crop cultivation, access to a flow of specialized information and technology transfer in the sector;

(viii) Feasibility study and business plan for bacciferous crop business and accumulation of economic data and analyses for correct and efficient decision-making;

(ix) Optimal harvesting time, correct harvesting methods, produce conditioning, adequate packaging;

(x) The need and willingness to invest in cultivation of bacciferous crops and to develop the value chain for berries in order to minimize risks and create added value in price;

(xi) Producer’s willingness to associate and cooperate – these two prerequisites provide real possibilities for practicing a sustainable berry business.

High value production is a way to obtain a higher profit. The bacciferous sector consists of two subsectors: the fresh and processed berry subsectors. The processed berry sector also includes four major groups of products: preserved, dried, frozen berries and juices. The production of fresh berries for the market provides the highest value for farmers, making it the most profitable, if the high quality of the product is ensured throughout the entire value chain and if the deliveries are ensured for a longer period. The production of berries for the processing industry offers lower incomes to farmers. However, the requirements for fruit quality are also lower, and thus lower production costs are incurred.

The table below shows the results of economic calculations regarding the amount of investments, the subsidies that can be obtained and investment recovery terms for the cultivation of berries (Table 1).

Table 1. Estimation of the required investments and of the recovery term for the cultivation of bacciferous crops in the Republic of Moldova (calculated per 1 hectare)

No	Crop specification	Operating period, years			Investment recovery term from planting, years	Yield per hectare, t / ha	Number of plants per hectare, plants	Required investment, Eur / ha	Possible subsidies to be obtained, Eur / ha
		Total, years	including						
			Vegetation period	Period of fructification					
1	Annual strawberry	1		1	0.95	29.59	51,020	11,243.3	3,106.8
2	Multi-annual strawberry	3	1	2	2.92	22.96	51,020	14,273.5	3,106.8
3	Strawberry - green house	3	1	2	3.95	29.44	55,556	106,219.5	36,998.4
4	Raspberry - seasonal	9	2	7	2.46	12.00	10,000	6,128.9	3,495.1
5	Raspberry Removable	9	2	7	2.35	14.00	10,000	6,510.1	3,495.1
6	Blackberry	14	2	12	2.89	13.33	2,667	10,698.5	3,430.4
7	Black currant	15	2	13	3.03	10.00	5,000	7,638.3	1,974.1
8	Red currant	20	2	18	3.01	12.80	4,000	6,701.1	1,974.1
9	Gooseberry	18	3	15	3.97	12.80	4,000	8,670.7	1,974.1
10	Black Scorpion (Chokeberries)	25	5	20	3.70	14.44	2,222	7,471.9	1,909.4
11	White seabuckthorn	26	3	23	3.93	11.43	2,286	7,826.2	1,423.9
12	Bilberry	25	5	20	7.37	6.00	2,222	41,564.1	2,912.6
13	Goji	10	2	8	3.28	8.33	3,333	28,140.3	582.5
14	Dogwood	25	3	22	4.02	15.56	2,222	7,184.9	453.1
15	Dogrose	25	3	22	4.60	5.80	2,222	5,252.3	453.1

Source: Authors' calculations based on investment budgets [2, 3, 4, 5, 6].

Based on the information shown in the table above, entrepreneurs/farmers can make quality decisions on what bacciferous crops to produce. At the same time, the owner should analyse the dynamics of the end consumer's demand, and namely whether it will increase, remain unchanged or decrease. Only after such complex analyses, the decision on implementation should be made regarding the production sectors that offer fewer risks and have a number of comparative advantages in respect to other agricultural activities.

The chart below shows the analysis of the amount of investment required to grow berries on a unit of area (Fig. 3). While analysing the investment budget, we can see that the production of strawberries in protected areas requires the largest investment, followed by the cultivation of blueberries and Goji.

Based on the study of income and costs for 15 bacciferous crops, the authors managed to systematize data and perform a complex data analysis (Table 2).

The bacciferous crop sector is favourable for small farmers, because all berry crops allow for income generation and are highly profitable, provided that the organization and management of the business are efficient. Application of intensive technologies in bacciferous crop plantations ensures the best economic results.

Further, we analyse the gross profits obtained from cultivation of berries (Fig. 4).

The analysis of income and costs for

bacciferous crops allowed for the systematization of data on cumulative economic indicators that can be obtained for the optimal period of operation of bacciferous crop plantations (Table 3).

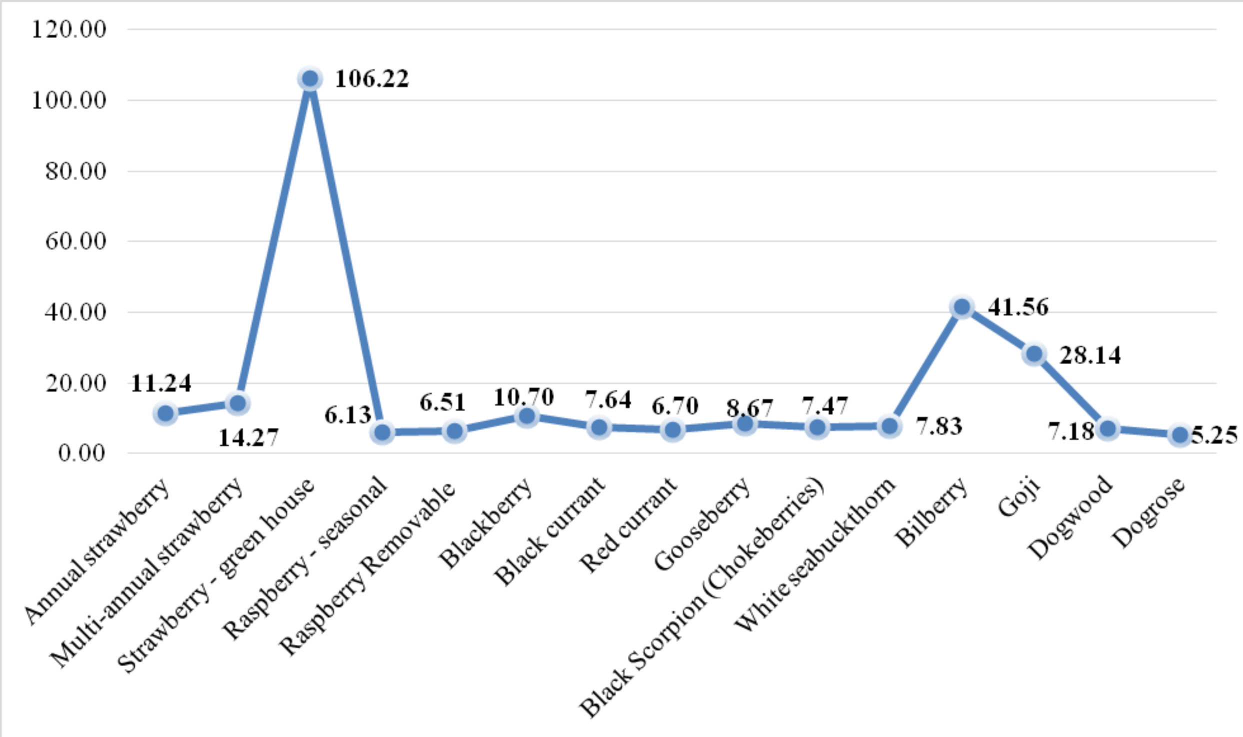


Fig. 3. Analysis of investments needed to cultivate bacciferous crops (area = 1 ha), thou. Eur
Source: Developed by the authors based on investment budgets [2, 3, 4, 5, 6].

Table 2. Estimation of economic results for the cultivation of berries in the Republic of Moldova (per 1 hectare)

	Crop specification	**Income from annual sales, Eur / ha**	**Cost of annual sales, Eur / ha**	**Annual profit, Eur / ha**	**Annual rentabilit y, %**	**Analyse the economic effects for a production unit, Eur / kg**		
						Average selling price	Unit cost	Gross margin
1	Annual strawberry	32,752.1	18,304.5	14,448	78.9%	1.11	0.62	0.49
2	Multi-annual strawberry	25,745.5	11,942.8	13,803	115.6%	1.12	0.52	0.60
3	Strawberry - green house	54,315.0	18,810.8	35,504	188.7%	1.84	0.64	1.21
4	Raspberry – seasonal	13,281.6	4,373.0	8,909	203.7%	1.11	0.36	0.74
5	Raspberry Removable	18,213.6	5,146.5	13,067	253.9%	1.30	0.37	0.93
6	Blackberry	14,886.7	5,010.7	9,876	197.1%	1.12	0.38	0.74
7	Black currant	11,165.0	4,228.3	6,937	164.1%	1.12	0.42	0.69
8	Red currant	10,563.1	4,375.1	6,188	141.4%	0.83	0.34	0.48
9	Gooseberry	13,669.9	5,238.1	8,432	161.0%	1.07	0.41	0.66
10	Black Scorpion (Chokeberries)	14,724.9	4,579.3	10,146	221.6%	1.02	0.32	0.70
11	White seabuckthorn	15,534.0	6,989.8	8,544	122.2%	1.36	0.61	0.75
12	Bilberry	22,281.6	5,963.3	16,318	273.6%	3.71	0.99	2.72
13	Goji	30,946.6	9,347.9	21,599	231.1%	3.71	1.12	2.59
14	Dogwood	11,175.8	4,590.1	6,586	143.5%	0.72	0.30	0.42
15	Dogrose	7,038.8	3,106.3	3,932	126.6%	1.21	0.54	0.68

Source: Authors' calculations based on budgets for cultivation for the fructification period [2, 3, 4, 5, 6].

The analysis of the cumulative economic data that can be obtained for the optimal period of operation of bacciferous crop plantations shows very good results of the analysed sector and proves that these crops provide over 100% profitability for most berries, which is favourable and highly interesting for small farmers.

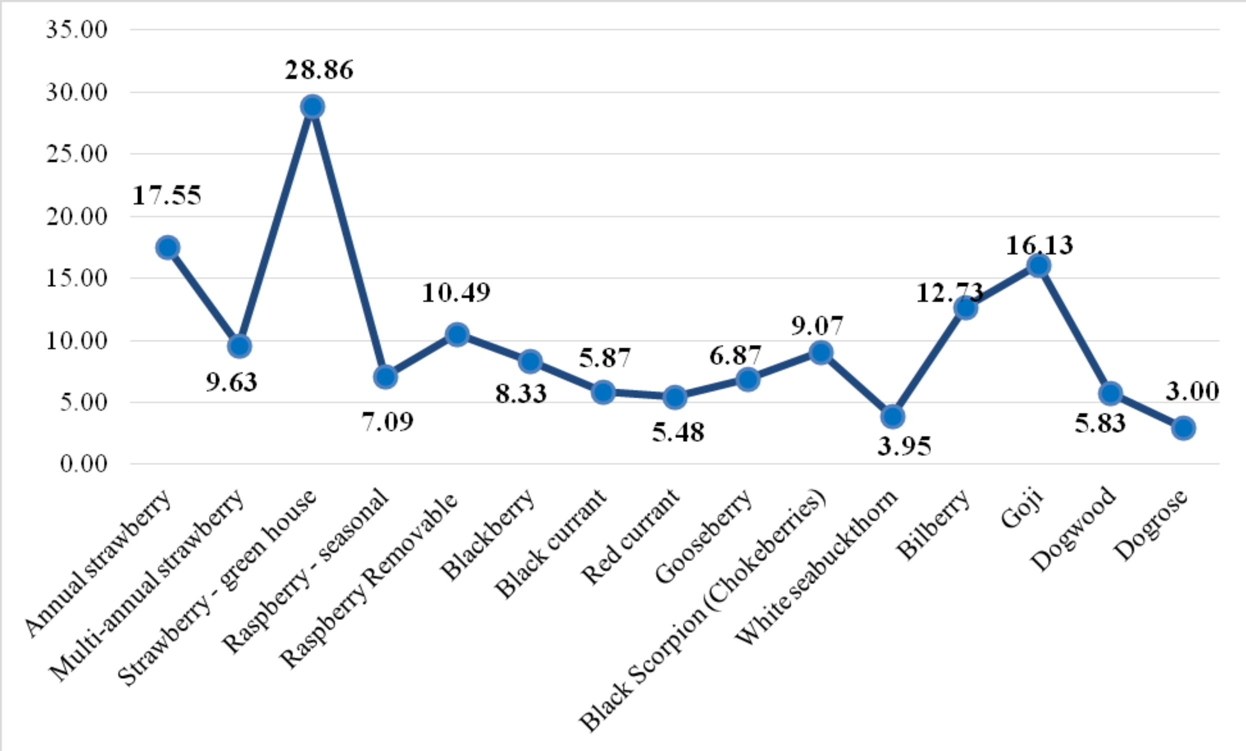


Fig. 4. Analysis of the gross profit obtained from the cultivation of berries, thou. EUR
Source: Developed by the authors based on budgets for cultivation for the fructification period [2, 3, 4, 5, 6]

Table 3. Cumulative analysis of the economic results that can be obtained for the optimal period of operation of bacciferous crop plantations (calculated per 1 hectare)

	Crop specification	**Basic indices for the fruiting period of the plantation, Eur**				**Cumulative economic profitability, %**
		Costs of cumulative sales	Income from cumulative sales	Gross profit (gross margin) cumulative	Gross profit (gross margin) cumulative in the average per year of exploitation	
1	Annual strawberry	18,304.5	32,752.1	17,554.4	17,554.4	95.9%
2	Multi-annual strawberry	40,778.3	69,668.9	28,890.7	9,630.2	70.8%
3	Strawberry - green house	54,356.6	140,950.2	86,593.7	28,864.6	159.3%
4	Raspberry - seasonal	38,869.6	102,711.1	63,841.5	7,093.5	164.2%
5	Raspberry Removable	44,866.3	139,256.4	94,390.2	10,487.8	210.4%
6	Blackberry	73,038.6	189,660.6	116,622.1	8,330.1	159.7%
7	Black currant	64,710.8	152,761.9	88,051.1	5,870.1	136.1%
8	Red currant	87,725.4	197,369.8	109,644.4	5,482.2	125.0%
9	Gooseberry	90,159.9	213,857.6	123,697.7	6,872.1	137.2%
10	Black Scorpion (Chokeberries)	102,976.7	338,059.4	226,667.1	9,066.7	220.1%
11	White seabuckthorn	92,418.3	195,246.8	102,828.5	3,954.9	111.3%
12	Bilberry	163,608.0	481,768.8	318,160.8	12,726.4	194.5%
13	Goji	103,606.7	264,900.6	161,293.9	16,129.4	155.7%
14	Dogwood	103,309.8	255,562.8	145,664.1	5,826.6	141.0%
15	Dogrose	73,344.8	146,248.8	74,911.4	2,996.5	102.1%

Source: Authors' calculations based on budgets for cultivation for the fructification period [2, 3, 4, 5, 6].

The chart below shows the analysis of the cumulative economic results obtained during the cultivation of berries for the optimal period of operation of plantations (Fig. 5).

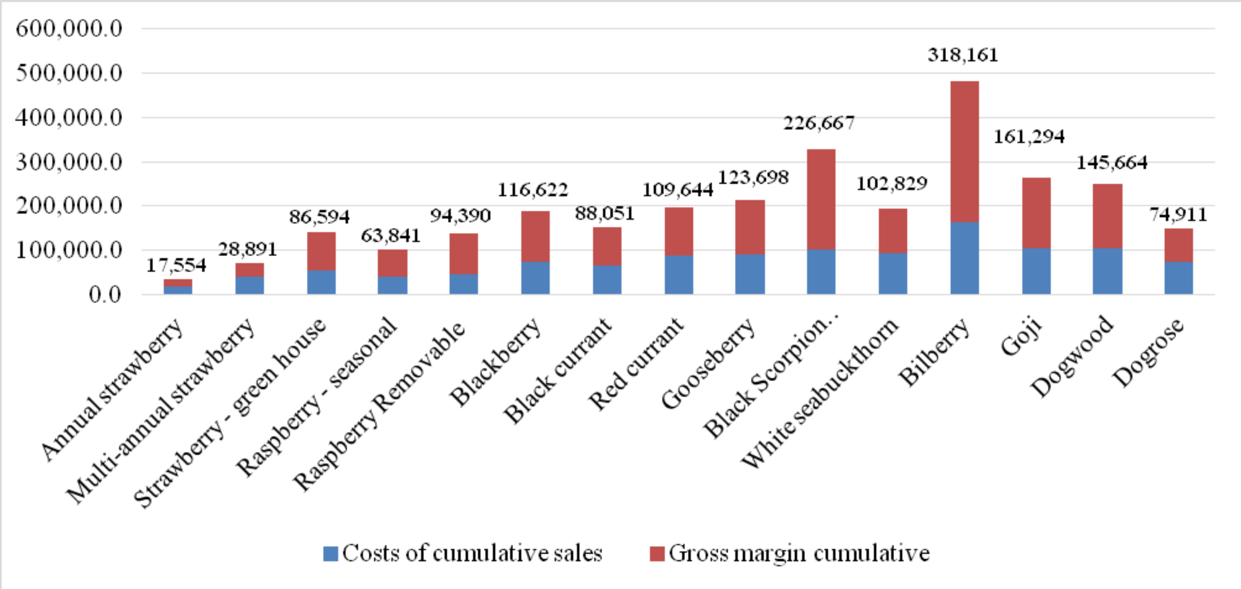


Fig. 5. Analysis of the cumulative economic results obtained during the cultivation of berries for the optimal period of operation of plantations, Eur.
Source: Developed by the authors based on budgets for cultivation for the fructification period [2, 3, 4, 5, 6].

While analysing the data in the Chart, we concluded that production of berries is profitable, as the farmer can obtain high profits as compared to production costs.
The main conclusion based on the results and comparative economic analyses is that in the context of market economy, small agricultural holdings (with an area of 1 to 10 hectares) should focus on implementation of intensive agriculture based on advanced technologies of bacciferous crops cultivation.
The economic analysis shows positive results for bacciferous crops. The comparative analysis of data shows a specific dependency: the economic efficiency and the results from the operational activity increase when the intensiveness increases.
The chart below shows the analysis of the recovery investment term for the cultivation of berries (Fig. 6).

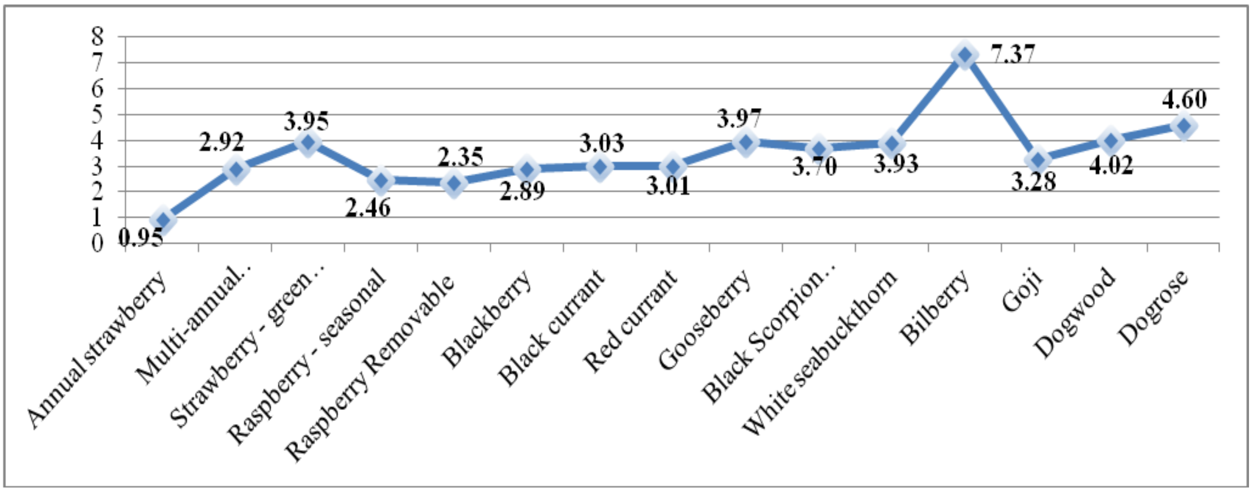


Fig. 6. Analysis of the recovery investment term for the cultivation of bacciferous crops, years
Source: Developed by the authors based on budgets for cultivation for the fructification period [2, 3, 4, 5, 6]

The bacciferous crop sector is a sector that requires considerable investment. However, the period of investment recovery is relatively short and it is often influenced by the period from planting to fructification (which is relatively short except for blueberries). Based on this aspect, as well as the fact that production of berries will continue to be in higher demand among end consumers, it may be concluded that it is profitable for farmers.

Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

The development of agricultural businesses should be based on competitiveness of products, assurance of quality and compliance with marketing requirements according to the demands of the end consumer. The market economy requires that agricultural producers guide their business by maintaining a business, which meets and observes the following important issues: implementation of modern and intensive technologies, development of product value chain, practice of commercial agriculture, development of marketing infrastructure, association in professional organizations based on common interest and homogeneous products, cooperation to promote and penetrate new favourable markets, etc.

The Moldovan agriculture should develop by practicing a sustainable and environmentally friendly agriculture.

CONCLUSIONS

Research and study of the berry sector allowed us to draw the following conclusions:

- Berries are fruits that are in high demand, easily perishable, have difficult distribution logistics and a complicated value chain that can only be implemented through joint efforts of all stakeholders, especially producers.
- A practical and applicable recommendation for small and medium-sized agricultural holdings is to practice commercial agriculture because it is the only effective and sustainable development solution in the market economy.
- Farmers should implement modern technologies and practice intensive cultivation of berries – a priority in ensuring competitiveness in regional and export markets.
- Production of berries allows for highest profits and presents a major potential for increasing the income of small farmers and diversifying the sources of income in rural areas.
- An important issue for small producers - it is absolutely necessary to identify and promote methods of association of agricultural producers for irrigation of bacciferous crops, supply with means of production and joint provision and use of agricultural services (including development of value chains).
- Cooperation of producers is required to ensure the uniformity of technologies and quality of berries, creating industrial quantity batches and selling them at favourable prices both in local and export markets.

REFERENCES

[1]Anuarele statistice ale Republicii Moldova pentru anii 2012-2017
[2]Balan, V., Zbancă, A., Companici, A., Dodica, D., 2017, Cultura arbuştilor fructiferi şi căpşunului. Manual. Chişinău, pag. 420, 422.
[3]Mazilu, C., Duțu, I., 2014, Ghidul pepinieristului pomicultor, Finanțată de Ministerul Agriculturii și Dezvoltării Rurale, Editura Invel Multimedia, 68 pag.
[4]Ghena, N., Braniște, N., Stănică, F., 2010, Pomicultura generală, Editura Invel Multimedia, 562 pag.
[5]Zbancă, A., Panuța, S., Morei, V., Stratan, A., Litvin, A., Fala Iu, 2017, Bugetarea activităților din sectorul vegetal al Republicii Moldova. Ghid. UASM, Chişinău, 350 pag.
[6]Zbancă, A., 2014, Developing of generic budgets for businesses in high-value farming. Informative guide, Agricultural Competitiveness and Enterprise Development Project (ACED), Contract: AID-117-C-11-00001, Chisinau 2013-2014.