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CONSERVATIVE CULTIVATION TECHNOLOGIES – A NEW CHALLENGE FOR THE AGRICULTURE OF THE REPUBLIC OF MOLDOVA

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Abstract

The agriculture of the Republic of Moldova is particularly prone to natural risks, especially droughts. The purpose of this paper is to present the state of sustainable development of the agricultural sector and opportunities for implementation of the innovative land cultivation technologies. There are a number of socio-economic constraints for increasing the productivity in the traditional agricultural systems. In order to meet the growing competition on the regional markets of agricultural products, modernization of agriculture in the Republic of Moldova is very important. For investigation of the actual state of implementation of the conservative land cultivation technologies were used specific methods and techniques such as statistical and economic analysis of economic indicators, case study approach, semi-structured interviews of agricultural producers. The study is also based on the statistics received from the National Bureau of Statistics and the Ministry of Agriculture and Food Industry of Moldova. Economic analysis confirms that implementation of the No Till technology will reduce essentially the direct production costs compared to traditional technology. However a more visible effect occurs starting with the 5-6 year of the conservative land cultivation technologies' implementation.

Key words**:** *climate change, conservative agriculture, no-till technologies*

INTRODUCTION

Recent approaches to agricultural development, including food production and food security, have largely failed to reduce the absolute numbers of the food insecure or to ensure environmental sustainability. From other side the community of farmers is more and more concerned regarding production respecting the environment, and they are changing some of their ways of production choosing more environmental friendly systems and technologies (Marta-Costa and Silva, 2013, Pretty et al., 1996).

In the Republic of Moldova the conservative agriculture is practiced by a limited number of agricultural farms. Among most experienced one can mention "Civea Agro", Edinet, that is involved in conservative agriculture since 2002. The largest area is cultivated under No-till technologies by the agricultural company "We trade" that use it since 2010. Another large agricultural company that practices conservative agriculture is the "Kelly Grains" (Jigau, 2011).

More recently four demonstration plots were implemented in different regions of the country in order to further promote de development of the conservative agriculture in the Republic of Moldova.

This article provides a description of the implementation of the conservative agriculture technologies in the Republic of Moldova and Ukraine, comparative analysis of the conventional and conservative agricultural systems and results of discussions with the key stakeholders on the most recent evolutions in the farm modernization.

MATERIALS AND METHODS

In order to present the state of sustainable development of the agricultural sector and opportunities for implementation of the conservative land cultivation technologies in the Republic of Moldova and neighboring countries, the following research methods were used, such as: time series, analysis of the economic indicators, methods of comparative analysis and the case study approach. The

quantitative methods of data analysis were completed with qualitative methods such as focus group discussions and interviews with key stake holders from the Republic of Moldova.

Participatory approach was used in order to take into account different perceptions and views of the problem.

For the analysis were used data provided by the Ministry of Agriculture and Food Industry, National Bureau of Statistics, and also data presented by private agricultural companies from the Republic of Moldova and Ukraine.

RESULTS AND DISCUSSIONS

As mentioned by Northern Territory Government, Australia (2014), "Conservation farming is any system or practice which aims to conserve soil and water by using surface cover (mulch) to minimize runoff and erosion and improve the conditions for plant establishment and growth. It involves planting crops and pastures directly into land which is protected by a mulch using minimum or no-tillage techniques".

According to authors such as (Basch et al., 2012), the major contribution to enhancing farm incomes and competitiveness in the future must be attained through: (i) a reduction of production factor inputs and costs, i.e. an improved efficiency of the resources used, and (ii) an improvement of the quality of the resource base that can maintain or improve farm output and also harness a range of environmental services needed by the society.

Both outcomes are achievable concomitantly only through farming practices based on an alternate paradigm that enhances soil quality and its productive capacity, while maintaining or improving yield levels at reduced input levels.

In conditions of the Republic of Moldova a competitive commercial agriculture can be developed only with the condition of the mechanization of agricultural works. For the mechanized farmer, the concept of a conservative agriculture implies the need to have access to more specific and, as rule, more expensive equipment.

This equipment encompasses but is not limited to seed drills, fertilizer applicators, some other sophisticated equipment and harvesters.

In other circumstances the additional tillage equipment such as subsoiler, a chisel plough, and other implements, depending on the type of soil and the climate is needed.

The information collected from discussions with agricultural producers revealed that the necessity in such equipment is rather limited during the agricultural year, but also much of this equipment will not even need to be used every year. This implies that farmers will have a very high level of investment tied up in his machinery. That creates one of the major barriers in implementation of the conservation technologies.

These changes are important and above all, expensive and risky for the farmer. Without specific financial and technical assistance and other incentives, it will be difficult to initiate the process of transfer from conventional to conservation agriculture.

That is why it is expected that farmers will change their production and soil management systems practiced for many years only gradually, and according to their priorities.

The farm size and the level of production have a great impact over the implementation of the conservative agriculture technologies due to the fact that they require large initial investments in machinery and so are not feasible for small scale farmers with low levels of income.

Possibilities to successfully introduce new production systems are reduced also due to the shortage of economic resources, difficulties in obtaining necessary inputs and low crop prices. Another problem is access to credits and other financial resources.

The possibility to introduce conservative technologies is influenced by the marketing opportunities for the cultivated crop.

The availability and costs of the qualified labor force will influence also the selection and profitability of production and soil management systems.

Farmer organizations could play an important role in agricultural modernization and implementation of the conservative technologies through access to technical assistance, and technical services provided to the members.

In case of the Republic of Moldova land tenure problems are among the most difficult to overcome and have a considerable influence on the soil management systems. The main reason of this is that land rent contracts are concluded for a period of 3-5 years that is not sufficient in case of conservative cultivation technologies because they yield benefits only over the long period of time.

Agriculture is the sector of the national economy with the highest exposure and vulnerability to natural risks and climate change. The main factor that determines the amount, the quality and stability of the agricultural production in the Republic of Moldova are the agricultural and climate conditions of the territory, particularly the lack or surplus of humidity, largely conditioned by the current climate changes.

Short-term droughts have transformed in some places in a dangerous phenomenon and became almost chronic. At the same time, every 2-3 years, agriculture becomes a subject of intense droughts, which cover almost the entire territory of the Republic of Moldova. In such a way, the damage of the drought from 2007 that affected agriculture can be estimated, according to some sources, between 600 million USD to 1 billion USD. The negative effect of the drought from 2012 has been recorded during the whole vegetation period (Ministry of Agriculture and Food Industry of the Republic of Moldova, 2012).

Recent trends of the global agricultural production in Republic of Moldova are characterized by high fluctuations of the global agricultural product, depending first of all to changing climate and weather conditions (Fig. 1).

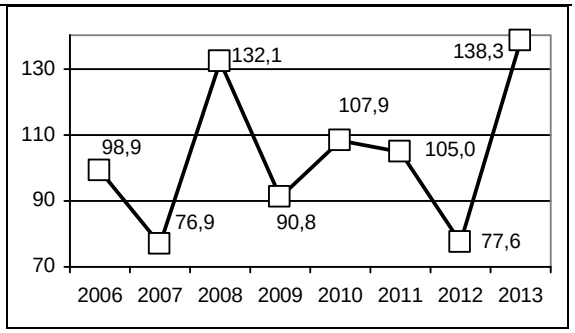

Fig. 1. Index of the Global Agricultural Product (previous year=100)

Quite unfavorable climatic conditions in recent years caused considerable losses to many farmers all over the country (see table 1).

Table 1. The average yield per hectare and variation coefficient for selected agricultural crops, 1981-2011, quintals

Agricultural crops	1981-1990		1991-2000		2001-2011	
	AVG (q)	Var. coef.	AVG (q)	Var. coef.	AVG (q)	Var. coef.
Wheat	35,9	12,8	28,5	24,7	22,5	32,8
Corn	37,7	16,7	31,3	27,0	28,0	26,4
Sun flower	19,0	10,5	11,7	15,1	12,7	20,2
Grapes	63,6	22,6	40,3	30,9	41,7	15,4
Vegetables	157,1	5,8	85,7	23,4	86,4	18,3

Source: own calculation on the basis of data from National Bureau of Statistics, 2014

The biggest problem in this regard is the shortage of rainfalls which are very uneven distributed during the agricultural year.

Another problem for Moldovan agriculture as well as in other countries is the high temperatures during the agricultural year, which in recent years exceeded the annual average with 3-4 CO (Jigau, 2011).

Besides of these, increasing prices for fuel and other agricultural inputs is another challenge faced by agricultural producers.

From this point of view, farming systems are faced with a double challenge to be successful: socio-economic performance has to be maximized, while environment and natural resources need to be protected in order to assure the sustainable growth of the agricultural production.

Adoption and implementation of soil conservation technologies are followed by three major economic benefits, namely: a) saving time and thereby reducing the needs in labor force, b) reducing costs for fuel, holding and maintaining the technology and farm

equipment and for labor, and c) higher efficiency in the sense of higher yields with lower costs.

Analysis of data collected from the agricultural company "Agro-Soyuz", Ukraine, shows that during the period of 15 years since the implementation of conservative agricultures started, the consumption of diesel fuel per hectare of cultivated land was reduced by almost 5 times (Fig. 2).

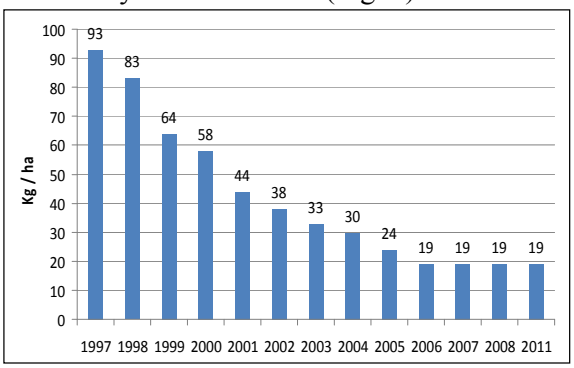

Fig. 2. Diesel fuel consumption in the agricultural company "Agro-Soyuz", Ukraine, 1997-2011, kg/ha

crops shows a steady increase during the same period despite of changing climate conditions. Thus comparing with the average yield in other agricultural farms from this region the average yield of wheat in the agricultural company "Agro-Soyuz" was more than twice higher (Fig. 3).

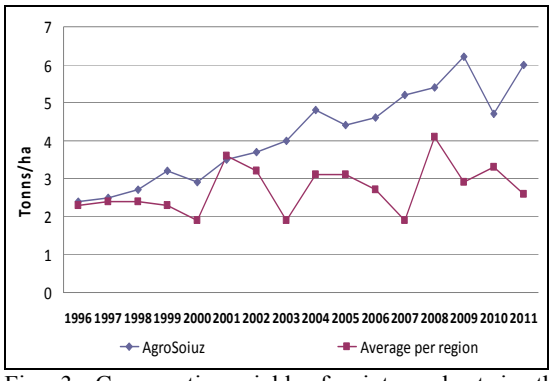

Fig. 3. Comparative yield of winter wheat in the agricultural company, Agro-Soyuz, Ukraine and average per region, 1996-2011, tons per ha.

However it is worth to mention that this difference is increasing specially during the most recent years, when long term effects from the implementation of the No-till technologies became more evident.

Analysis of the economic indicators from this company shows an increase in labor productivity for field crops, that being associated with less consume of labor force, fuel, and other expenditures gives strong arguments for implementation of these technologies in other regions with similar conditions.

Moreover, another positive indicator is the increase of the humus content in fields of this company (Table 2).

Table 2. Economic results for field crops in the agricultural company "Agro-Soyuz", 1998-2011

Indicators	1998	2001	2007	2011
Labor productivity, $/man/hour	25	37	57	204
Consume of labor force per 1 ha, man/hour	29	16	4,5	4,4
Consume of diesel fuel, kg/ha	83	44	18,9	18
Expenditures for spare parts and reparations, $/ha	32	24	17,5	14
Depreciation, $/ha	105	76	58	46
Humus content in soil , %	4,41	4,48	4,51	4,54

Source: Agro-Soyuz Holding, 2014

Comparing differences in cost structures for conventional and No-till technologies one can see the significant reduction of costs for fuel and lubricants, depreciation, spare parts and reparations, while costs for seeds, fertilizers and plant protection means has increased (Table 3).

Table 3. Cost differences between conventional and no-till technologies in the agricultural company, Agro-Soyuz, 2011

	Technologies		
	Conventional	No till	Difference
Fuel and lubricants, $/ha	72	24	48
Depreciation, $/ha	60	45	15
Spare parts and reparations, $/ha	22	10	12
Seeds, $/ha	20	40	-20
Fertilizers, $/ha	10	20	-10
Plant protection, $/ha	5	20	-15
Total costs per ha, $/ha	**189**	**159**	**30**
Number of technological operations	13	3	**10**

Source: Agro-Soyuz Holding, 2014

Implementation of the conservative agriculture technologies in the Republic of Moldova

The legal framework for the practice of conservation agriculture in the Republic of Moldova is provided by the Government Decision no. 1157 from 03.10.2008 regarding the approval of the Technical Regulation "Measures of soil protection in agricultural

practices", published in the Official Monitor Nr. 193-194, Article No. 1195 of 28.10.2008.
This regulation foresees the use of such measures to prevent the degradation and restore the soil structure as:
-priority practicing of the minimal soil tillage system, which consists in the plowing once in 4-5 years and reduction of the mechanical pressure on the soil during the growing season;
-practicing of the varied crop rotation, with the long term crop rotation (5-7 years), which include improvement crops such as perennial grasses and legumes;
-applying annual crop rotation and incorporation of the fresh organic matter in order to ensure a positive balance of humus and enhance the activities of living organisms in the soil;
-using low pressure tires and tires with large width, which increases the area of contact with the ground;
-covering irrigated area with crop residues, manure, sawdust and other organic material of natural origin harmless to the soil and the environment;
Thus all these stipulations present the important elements of the conservative agriculture.
Agriculture results during the last years, when droughts and other climate risks seriously affected the agri-food production demonstrated clearly the need to shift from the conventional system of land cultivation to the conservative techniques.
The Ministry of Agriculture and Food Industry of the Republic of Moldova recognized this problem as one of a major importance and established as a major objective the promotion and implementation of conservative tillage technologies.
To achieve these objectives under the direct support the Rural Financial Services and Agribusiness Development Project (PSFRDBA) financed by the International Fund for Agriculture Development (IFAD) in 2012 was planned to set up several demonstration plots in agricultural companies located allover the country.
Based on these demonstration plots during the period of 2013-2015 have been implementing in field conditions, minimum soil processing technologies. Experience from these demo plots have been used to train a local team of experts that disseminates it through other agricultural companies.
In the framework of this project were carried out such activities as:
-Economic analysis of agricultural activities on demonstration plots during the agricultural year;
-Analysis of the effectiveness of the production capacity utilization;
-Analysis of the effectiveness of utilization of plant protection means and fertilizers;
-Developing methods and descriptions of primary evidence of expenses incurred during the agricultural year and training of the beneficiaries of demonstration plots in keeping track of expenses.
-Monitoring economic indicators from business plans for each demonstration plot separately;
-Dissemination of the results obtained through seminars, roundtables, media, conferences, scientific publications, etc.
As a result of implementation of this project under the auspices of the Consolidated Implementation Unite of the IFAD Program in the Republic of Moldova have been created four demonstration plots in Edinet, Făleşti, Orhei and Cantemir regions with a total area of 350 hectares for a period of three years.
Experience gained from these demonstration plots is used for training and promotion of modern conservative land cultivation technologies.
Despite the limited period of the project implementation and scarce data collected from agricultural companies involved in the project one can mention the increase of the yield of field crops in selected agricultural farms. Discussions with farmers revealed that conservative soil cultivation technologies have several economic advantages the main of which are:
-Reduced soil erosion and improved soil fertility
-Improved water infiltration, moisture efficiency and lower soil temperatures
-Reduction of costs

-Reduction of the number of agricultural works
-Increasing the wage of employees without increasing the payroll
-Increase and stabilize the crop yields
In the same time they mentioned a range of specific disadvantages of the conservative agriculture technologies, the most specific being the followings:
-Implementation of the conservative land cultivation technologies requires a set of specific agricultural machinery and equipment that essentially differs from those used in conventional agriculture;
-The high costs of the specific agricultural machinery and equipment;
The period necessary to obtain visible results out of the implementation of the No-till technologies is pretty long, e.g in case of the "Agro-Soyuz" it was 5-6 years;
-The increased consume of herbicides during the yearly phase of the conservative technologies implementation and necessity in specific filed crop varieties resistant to high dosage of herbicides;
-The conservative soil cultivation technologies are more appropriate to be implemented in large scale agricultural companies with an acreage larger than 1000 ha and which are specialized predominately in cultivation of filed crops.

CONCLUSIONS

As main conclusion one can state the necessity of new approaches in assuring the sustainable development of crop production. Their importance is obvious in conditions of increasing instability in the agriculture production of the Republic of Moldova.
Conservative agriculture technologies could be a real opportunity for natural risk alleviation. However implementation of these technologies requires a set of sustained activities, namely:
Promoting sustainable agriculture and resource-conserving technologies and practices;
Supporting implementation of the national policies and strategies for conservative agriculture;
Implementation of the conservative agriculture requires longer term planning and commitment to sustainability;
Conservative agriculture needs more specific and deep skills in soil management and crop protection;
It also requires more active information campaign in rural communities about opportunities offered by conservative agriculture;
Supporting land consolidation in order to assure larger areas for implementation of the conservative agriculture technologies.

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