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PERSPECTIVES AND BARRIERS IN THE IMPLEMENTATION OF INNOVATIONS IN BULGARIAN AGRICULTURE

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Abstract

The implementation of innovation is of great significance for the scientific and technological progress in the agrarian sector. The paper examines the possible prospects for introducing innovations in the agrarian sector of Bulgaria as well as the factors limiting the spread of new practices and innovations in the Bulgarian agriculture. The tasks to achieve the goal are 1) Different perspectives of authors working on the topic have been explored 2) Basic models for introducing innovations have been developed. 3) The attitudes towards the introduction of innovations in the sector are summarized. The collected and analyzed information is based on a project survey NID NI-16/2018(Integrated approach to risk management in the agrarian sector).

Key words**:** *innovation, agro innovation, innovative models,*

INTRODUCTION

Innovation can be found in all areas of science, technology and the economy, it is a catalyst for competitiveness and growth of business. Agriculture is part of the modern economy and needs updating and modernization as well, and this can be achieved best through the implementation of innovative practices and solutions in the sector. Bulgarian agriculture itself, as part of the world, must also accept innovation in order to make progress. The lack of sufficient quality innovations in Bulgaria's agrarian sector would lead to reduced competitiveness compared to the other countries, which in turn would aggravate trade relations and foreign policy as well as the image of the whole country in front of the world [4]. Innovations are needed for adaptation to the changing external environment and reduction of uncertainty at all levels: international, national, regional, economy [5], [10], [7]. Implementing innovations in the economy is a good strategy for the survival on the national and especially the international market. Greater sustainability, higher production quality and minimization of unnecessary production costs can be achieved through innovative methods for growing different types of crops and animal breeds. New machines and technologies help the precision and speed of production processes and facilitate the farmers. Thus, agricultural productivity enhances competitiveness and creates preconditions for expanding the market share. Every farmer strives simultaneously with increasing the yield and quality of his crop, to reduce and/or limit his/her costs. The goal of science and technology, on the other hand, is to increase efficiency and improve production processes while respecting environmental protection, the effect of their efforts is to create or improve a method, technology, machine, i.e. innovation. Examples of innovations that have increased the competitiveness of the farm are many, as innovations themselves can be extremely different: chemical; biotechnological; informational; biological; technological; new marketing solutions; new robotic manufacturing processes, etc. As bio-agriculture has emerged as a separate niche in the agrarian sector, innovations have also become significant and necessary in modern agriculture.

Innovations have two dimensions: 1) the degree of innovation (i.e. whether the innovation is new to the company, new to the market, new to the industry or new to the

world); 2) the type of innovation (i.e. whether it is a process or innovation of product service systems)[9]. In business and in the economy, innovations can become a catalyst for growth. With rapid improvements in transport and communications over the past few decades, old world concepts of factors and comparative advantages focused on the unique investments in the region have become obsolete in today's global economy. The economist Joseph Schumpeter, who contributed significantly to studying the economy of innovations, back in 1943 argued that the industries must continually revolutionize the economic structure from within, i.e. innovations with better or more efficient processes and products, as well as market distribution as the link from the craft store to the factory [9]. The main author's views are outlined in Table 1.

Table 2 Literary review of the main theoretical framework of innovation.

Authors	**Author's views**
[8]	-Innovations in agriculture make it easier to produce more food without increasing the pressure on the environment. - They explore the implications of different combinations of technologies, institutional arrangements and agricultural and environmental policies. - They make a bridge between the world resource management discussion and the real situation of farmers in developing countries. -4 strategic goals: ensuring adequate food production, alleviating poverty, achieving better health and nutrition for the growing population and preserving natural resources. - Opportunities to apply policies and technologies that allow more crops to be produced in smaller areas, with more efficient inputs and under conditions of global change - The need to respect the principles of sustainability through innovations in order to link science and the interaction between farmers and communities is a major discovery.
[3]	-Threshold, diffusion models and the impact of risk, uncertainty and dynamics and the factors for adopting innovations. - They describe the impact of institutions and state interference in adopting innovations. -They define innovation as new methods, customs or devices that perform new tasks. -They differentiate between several categories of policy innovation or modeling. - They give an example with the difference between innovations embodied in capital goods or products (such as tractors, fertilizers and seeds) and those that are invertebrates (i.e. integrated pest management schemes), which is useful for directing public investment towards creating innovations. - Private farms are less likely to invest in generating unsecured innovations because of the difficulty in selling the finished product, so it is an area for public action. - The innovation classification is useful for addressing policy issues and understanding the forces behind the creation and adoption of innovations. -Innovation classification: mechanical innovation, bio-innovation, chemical innovation, agronomic innovation, biotechnological innovation and information innovation. -The economic forces and the state of scientific knowledge have an impact on the forms of innovation created and adopted in different places. -They demonstrate how intellectual property rights and regulations affect the development of innovations and the distribution of benefits stemming from them. - Innovations differentiated from their impact on economic agents and markets: increasing profitability, reducing costs, improving quality, reducing risk and protecting the environment; and extension of the shelf life. Most innovations fall into several of these categories.
[1]	They provide a conceptual framework for the decisions of individual farmers to accept innovation, using an example of new types of crops. - The framework is presented as an opportunity to implement in the dynamics of solutions covering at least several years and includes the farmer's personal perceptions, managerial abilities, and whether he is able to take risks. - The model allows generating potential valuable information from the innovation survey due to the development of ideas over time as well as reducing uncertainty about the long-term sustainability of the innovations. It is based on "Static Mode of Individual Acceptance", "Dynamic Reception Model" and „Bayes theorem". - In spite of the numerous studies, the results of research in this area are disappointing. Many of the developed statistical models have low levels of explanatory power despite long lists of explanatory variables. - The results of various studies are often contradictory in terms of the importance and impact of each variable. Risk is considered to be a major factor in reducing the rate of perception of innovations.

[6]	-They view innovations as a co-evolutionary process, i.e. combined technological, social, economic and institutional changes, with the production and exchange of technical knowledge not being the only prerequisites for innovation. - They explore additional factors that play a major role, such as politics, legislation, infrastructure, financing and market development. -Innovations are not only the adoption of new technologies but also a balance between new technical practices and alternative ways of organizing. -Agrarian innovations are normatively loaded and managed by different views. - Agrarian innovations are viewed as a result of numerous interactions between components of agricultural systems, supply chains and economic systems, political environment, etc.
[11]	- The variety of observed patterns among different farm categories and differences in socio-economic areas and the environment is underlined. -An attention is drawn to the commonly used methodologies used in surveys for acceptance of innovations and suggestions for improvements of the work by using appropriate economic methods. - The focus is put on accepting and spreading agricultural innovations in less developed countries. -Innovations involving higher fixed costs are easier to accept by large farmers. - Non-scale related innovations are accepted by all groups of farmers, but larger farmers are among the first to implement them. - "Intensity" through the acceptance of new varieties reflects on the quantity of fertilizer per hectare, which is higher in small farms.

Source: own determination based on literature findings from multiple authors.

Based on the theories examined, two models attract the researchers' interest (Figure 1 and Figure 2) of agricultural research and technological diffusion. The first one is the " central source of innovation model" [2]. The central source of innovation model is the most dominant model in the scientific research. On the periphery are farmers who find it harder to adopt new technologies, followed by those who are innovative. At the center are international research institutes in the field of agriculture as well as national agricultural research systems. The information given by the farmers returns to the center via feedback. Thus, the priorities and programs of the institutions from the center remain focused on technical problems for farmers. A main accent in the system is the transfer of knowledge and technologies from research centers to farmers. The national and international systems for agricultural research are connected via a network of technology and exchange of information. These networks include information exchange on research methods and techniques.

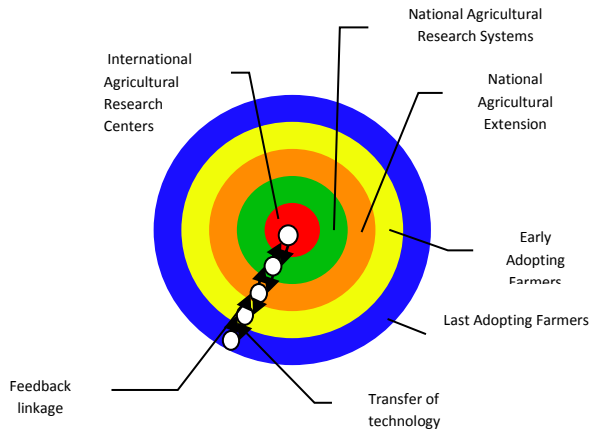

Fig. 1. A central source of innovation model
Source: Adapted by BIGGS, 1990, [2]

The central source of innovation model's characteristics are the following:
- The role of institutions - the most important role is given to institutions and groups of people (of an international or national nature).
- Stages in the field of research and enlargement. Scientists develop technology at the center, which is adapted in the subsequent stages before it is demonstrated to farmers and accepted by them in the final stage.
- Hierarchical structure. The generation process is hierarchical, new technologies and practices are being developed that are transmitted down the chain. Feedback goes back the same way.
- Networks for materials and information. In addition to hierarchical links, the central source of innovation has "neutral" networks for exchange of materials and information. These are two-way exchanges between scientists.

- Sources of innovation The central source of innovation model determines the system's center as a source of innovation.
- Political, financial and institutional concerns. The central source of innovation model does not mention the role that political, economic and institutional factors play in generating, promoting and using agricultural products and technologies. Because of the fact that no such "unscientific" problems are mentioned, the model supports the idea that there is a natural, evolutionary process through which the right technologies and research institutions are introduced, provided that political and financial deviations remain in science.

The second one is the „multiple source model "and it is based on research and diffusion in the historical, political, economic, agroclimatic and institutional context, in which the technological changes are created.

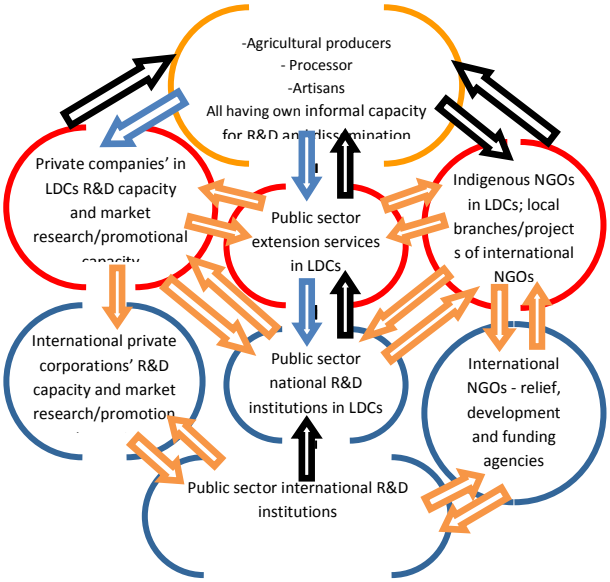

Fig. 2. A multiple source model
Source: Adapted by BIGGS, 1990, [2]

In the multiple source model the main accent is put on the idea that innovations come from different sources. These are various private, public and institutional participants in the research system, as well as farmers, craftsmen etc. in agriculture conducting informal research. Innovations come not only from those identified as "researchers" but also from "practitioners" in the numerous stages of research, expansion and production system. The figure illustrates the wide range of institutions for research and expansion, found in international, national and local research and publicity systems. The arrows illustrate some of their complex connections and two-way flows of information and knowledge. The multiple source model in a historical context, allows a better understanding of the various factors contributing to technological change. The creation of technology in the multiple source model does not have a unique classification of what is "technology" or what is "modern" or "traditional" technology. Technology consists of many old and new components; it has evolved and has been modified over the years. Evidence and reasons for the dominance of the central source of innovation model are presented, but also the importance of the multiple source model for the development of the agrarian sector is also described, as technologies are fundamentally integrated over time with political, economic and institutional events.

MATERIALS AND METHODS

The methodological framework of the report corresponds with the main objective - to analyze and determine the barriers and prospects for introducing innovations in the Bulgarian agrarian sector. The first part of the report addresses some research needs and emerging issues regarding the needs and opportunities for implementation of innovation in the agrarian sector. On the basis of the presented theoretical model, a questionnaire was developed which aims to organize the agrarian types of economic activity according to their susceptibility for perceiving and implementing the innovations in the Bulgarian agriculture and to identify the main obstacles that stop the modernization of the sector. The participants in the survey are experts in the field of agriculture and / or innovation. The results are part of scientific research project NID, NI 16/2018, "Integrated risk management approach in the agricultural sector". Used methods are descriptive statistics and system approach. The survey with questioner was conducted in 2018.

RESULTS AND DISCUSSIONS

The conducted research covered issues related to the susceptibility of the Bulgarian agrarian sector to the introduction of innovations, the factors that have the most impact on the acceptance or rejection of the innovations and the most feasible innovative solutions in the two main sectors of agriculture.

The research identified the susceptibility to innovation both in the plant and livestock sectors. The results show that grain - 65% and oilseed crops - 70% are most prone to innovation in crop production, but the sector has a relatively high level of succession of about 60% and a good attitude towards the innovation. In the livestock sector, the differences in susceptibility to innovation across sectors are more pronounced. The most prone to innovation, according to the research is poultry farming - 75%. Respondent experts in the field have pointed out pigs, sheep and goat farming as well as cattle and buffalo farming as being more prone to innovation by 60%. The research has identified the horse farming sector as the least prone to influence by the novelties by 25%.

The determination of the factors that influence or restrict the implementation of innovations in Bulgarian agriculture is based on an inquiry by farmers and specialists in the field of agrarian policy. The most important factors influencing the introduction of novelties in agriculture are the following factors:

(i)The size of the farm – 80%.

(ii)The willingness of farmers to take risks – 80%.

(iii)Financing by bank and non-bank institutions – 80%.

(iv)Access to information on opportunities for implementation of innovation – 70%.

The least influential factors of the implementation of innovations are the following:

-Access to the labor market – 30%.

-Environmental protection – 40%.

-Infrastructure – 45%.

-User requirements – 45%.

Other factors listed in the assessment of the introduction of innovations are the following: Access to markets; Government policy and support; Specialization of the farm; Processor requirements. They have been evaluated with an impact of 50-60% on the acceptance of innovations in plant and livestock farming.

Respondents point to four main barriers to the implementation of innovation; they have the most negative impact on farm entrepreneurs and are the reason for the slow spread of innovation in the sector. These are:

-The cost of investment for innovation – 75%.

-Lack of information on possible innovations – 70%.

-Low willingness for risk-taking by the farmer – 70%.

-Age of the farm manager – 65%.

Environmental Protection; Competition; farming specialization and the lack of developed infrastructure occupy the last places of factors limiting innovation in the agrarian sector with 30-40%.

It can be summed up that most farmers in Bulgaria are not sufficiently well informed about the innovations in the sector, which may be the result of the country's agrarian policy. The credit conditions offered by banking institutions are unattractive and not flexible enough to meet the needs of farmers, and aging managers with traditional thinking not willing to take risks tend to contribute to the lack of promotion of innovations in Bulgarian agriculture. Figure 3 and Figure 4 showcase the feasibility of innovative solutions in Bulgarian agriculture. They show how the sectors of plant and livestock breeding react to the implementation of identical innovative solutions.

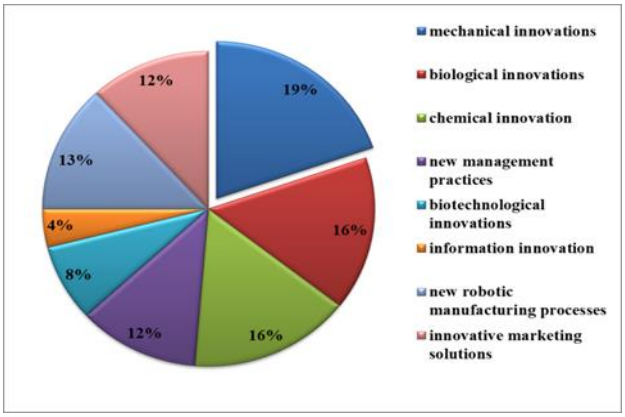

Fig. 3. Feasible innovative solutions in the plant breeding sector.
Source: Own calculation.

Mechanical innovations (machines and equipment) are best accepted in both sectors - plant breeding - 75%; livestock breeding - 70%.

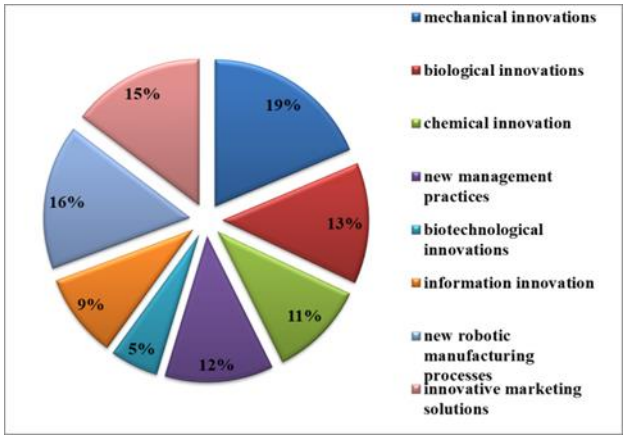

Fig.4. Feasible innovative solutions in the livestock sector.
Source: Own calculation.

After the mechanical innovations in plant breeding the most preferred innovations are: biological innovations (new seed varieties) – 60% and chemical innovations (fertilizers and pesticides) – 60%. In livestock breeding the respondents have indicated the new robotic manufacturing processes – 60% and innovative marketing solutions – 55%, as the most possible ones for implementation in the sector after mechanical innovations.
Biotechnological innovations and information innovations have been identified as the least possible innovative solutions for both sectors, which are estimated by the respondent specialists by no more than 35%.

CONCLUSIONS

From the analysis of the different theories on agrarian innovations and with the aid of the research, it can be concluded that in the different types of economic activity of agriculture the degree of readiness and continuity of innovations is different. Plant breeding was more susceptible, and in particular - oil crops and grain production. In livestock breeding, attitudes towards innovation are more dynamic. Poultry farming is determined as the most innovative sub-sector with 75%, and Horse breeding occupies the last place in both livestock breeding and the entire agrarian sector, with 25% inclination to adopt innovative practices. The factors influencing the acceptance of innovation the most are the size of the farm and the willingness of the farmer to take risks. The most restrictive of the implementation of innovations, according to the research, is the cost of investment for innovation and the lack of information on possible innovations. The possible feasible innovative solutions in Bulgarian agriculture are, for the most part, mechanical innovations. Chemistry and biological novelties are more easily accepted in plant breeding, while livestock breeding has a better attitude towards new robotic processes and marketing decisions.
The prospects for the introduction of innovations in Bulgarian agriculture are increasing every year, the country is getting closer, despite the fact that it is a difficult process, to the European and world practices of modern agriculture. The barriers restricting the introduction of innovative practices in the agrarian sector of Bulgaria are many and different in nature. The traditional way thinking of the Bulgarian farmer is the first thing that needs to be changed so that information on the benefits of innovation can be assimilated, realized and applied in practice.

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