

Innovation process management in agriculture: International practice

Gestión de procesos de innovación en agricultura: práctica internacional

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ABSTRACT:

The contemporary agrarian production is characterized by a range of various attributes characterizing its essence and development areas that have ambiguous and different impacts on production volumes and sales. Unlike other sectors of the national economy or kind of activities, agriculture is characterized by a number of specific peculiarities, which lead to objective laws necessary for its development. This concerns primarily the fact that exactly agriculture globally provides people with food, and thus is the basis of human life-sustaining activity. The purpose of this article is to study the features of international practice of innovation process management in agriculture and the possibility of its application in domestic practice. The article defines innovation in agriculture as changes implemented by the economic entity in the enterprise's activity aimed at increasing the products' competitiveness on the market. The authors show features of innovation implementation in agricultural enterprises' activities and entities of their implementation, present a generalized technology of innovation implementation into agricultural enterprises' activities, as well as analyze innovative activity in agriculture of economically developed countries. In the capacity of research subject, special attention is devoted to the analysis of international practice in implementing innovation into the development of organic agriculture. In this regard the authors carry out analysis of different interpretations of the "organic agriculture" concept, as well as estimate the level of allotment of areas for organic agriculture, showing prospects for the implementation of organic production in national realities.

Keywords: innovation in agriculture, agro innovation, promotion of innovation, innovation policy, biotechnology, environmental biotechnology, organic agriculture, organic production.

RESUMEN:

La producción agraria contemporánea se caracteriza por una gama de diversos atributos que caracterizan su esencia y áreas de desarrollo que tienen impactos ambiguos y diferentes sobre los volúmenes de producción y las ventas. A diferencia de otros sectores de la economía nacional o tipo de actividades, la agricultura se caracteriza por una serie de peculiaridades específicas, que conducen a leyes objetivas necesarias para su desarrollo. Esto se refiere principalmente al hecho de que exactamente la agricultura a nivel mundial proporciona a las personas alimentos, y por lo tanto es la base de la actividad humana que sustenta la vida. El propósito de este artículo es estudiar las características de la práctica internacional de la gestión de procesos de innovación en la agricultura y la posibilidad de su aplicación en la práctica doméstica. El artículo define la innovación en la agricultura como cambios implementados por la entidad económica en la actividad de la empresa con el objetivo de aumentar la competitividad de los productos en el mercado. Los autores muestran características de la implementación de la innovación en las actividades de las empresas agrícolas y las entidades de su aplicación, presentan una tecnología generalizada de implementación de la innovación en las actividades de las empresas agrícolas, así como analizar la actividad innovadora en la agricultura de los países económicamente desarrollados. En la capacidad de la investigación, la atención especial se dedica al análisis de la práctica internacional en la aplicación de la innovación en el desarrollo de la agricultura orgánica. En este sentido, los autores realizan el análisis de diferentes interpretaciones del concepto de "agricultura orgánica", así como estimar el nivel de asignación de áreas para la agricultura orgánica, mostrando perspectivas para la implementación de la producción orgánica en realidades nacionales.

Palabras clave: innovación en agricultura, innovación agro, promoción de la innovación, política de innovación, biotecnología, Biotecnología ambiental, agricultura orgánica, producción ecológica.

1. Introduction

Dynamic development of agriculture causes increasing competition between enterprises on the agricultural products market. Therefore, intense innovation in agriculture is currently an urgent issue, since it will contribute to the growth of labor productivity, savings in material, labor and financial resources, increase production volumes, and the like.

According to the researchers, innovation is the creation or improvement of competitive technologies (products or services), which are implemented into the enterprise operation in given period of time (Gamidov, Kolosov and Osmanov 2000). Some scholars argue that innovation is the result of a creative process expressed in the form of new products, technology, method, etc. (Yankovsky, and Mukhar, 2001; Kharin and Kolinsky 2003), while others believe that innovation is a change in engineering, technology or organization, which in the future will lead to the satisfaction of certain social problems (Gokhberg and Kuznetsova, 2002; Kokurin, 2001). Also, there is a concept of "agro innovation", that is, innovations that are implemented in the agricultural sector (Makeenko, 2008).

There are many approaches to the definition of "innovation in agriculture". According to V.A. Ivanov (2008), innovation in agriculture is the implementation in the business practice of the research and development (R&D) outcomes in the form of new plant varieties, breeds and species of animals, poultry, new and improved food products, materials, new equipment, new technologies in crop production, animal husbandry and processing industry, new organization and management forms in various economy spheres, and new approaches to social services that can improve production efficiency. According to V. Nechaev (2010), innovation in agriculture is systemic implementation of the research outcomes into the agricultural sector that lead to positive qualitative and quantitative changes in the characteristics of the relationships between biosphere and technosphere, as well as improve the environment. According to I.A. Rodionova (2010), innovation in agriculture is the ultimate result of the implementation of novelty in the field of agriculture (plant varieties, animal breeds, plant protection or animal production technologies, etc.), which led to economic, social, environmental and other types of effect.

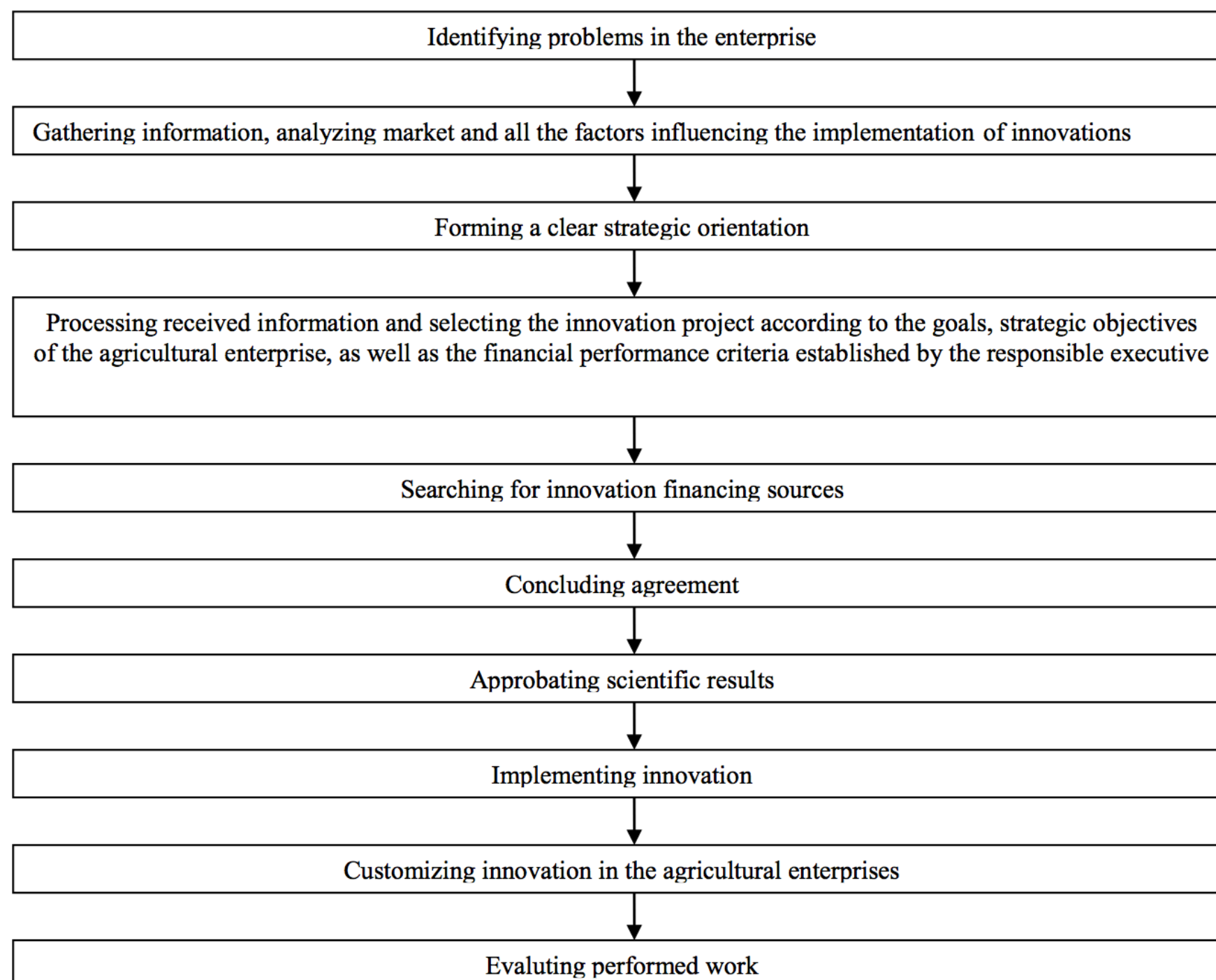
Thus, innovations in agriculture can be defined as the change brought by business entity into enterprise activities with the aim of increasing the market competitiveness of products.

Features of innovations' implementation into agricultural enterprises activities, and corresponding business entities are presented in Table 1.

Classification criterion	Type of innovation	The entities of innovations' implementation	Innovation payback time
The subject and scope of application	Biological, technical, technological, chemical, economic, social, and marketing management innovations	Agronomist engineer, economist, chemist, marketer, sociologist, manager	3 years
The period of implementation	Long-term, medium-term, and short-term innovations	Responsible executives, shareholders, seed farm, stud farm, engineering enterprise, biological factory	6 months – 5 years
Origin	External and internal innovations		3 years
Rate of changes that are made	Basic, improving, modification, and application-oriented innovations		6 months – 5 years
Form of implementation	In the form of a product, in the form of a process		6 months
The costs	Large and minimal investments with no additional cost		6 months – 5 years
Sources of funding	Own budget, credit, loan financial means, mixed financing	Bank, responsible executives, suppliers, shareholders, research funds, sponsors, state-financed institutions	6 months – 5 years
Risk score	Notable, partial, and complete uncertainty		6 months – 5 years

Implementation of innovations in agriculture should be considered as a sequence of four stages: development of innovations, their validation, reconstruction, and implementation. A range of innovations' classification criteria allows organizing the innovative activity of the enterprise on a rational basis. The innovation implementation technology into the agricultural enterprise activities is represented in Figure 1.

Figure 1. Innovation implementation technology with regard to the activities of agricultural enterprises



A leader in the field of innovations in agriculture is the USA, where agricultural sector activities are significantly influenced by the state. In the USA, the agricultural enterprises activities are regulated by the state, as well as by the effectively developed legal framework. Since agriculture is of strategic importance for the state, government has held a course for significant subsidizing of agriculture at the expense of the state budget. The USA has a long history of state supporting of innovation in agriculture. Thus, for example, a project to search for alternative energy sources for agricultural areas has become very popular. The US Department of Agriculture provides funding for many research and educational programs, innovation stimulating programs, and many others. The US Department of Agriculture includes more than a dozen agencies, departments, and services. Each of them has its own specialization and brings its own contribution to the development of the agricultural system. The Ministry performs an integrating role in regional economic systems by linking science, research and educational institutions, industry, rural communities and agricultural producers, as well as funds scientific research, implements educational programs and latest technologies into practice. (Vanclay, Russell, and Kimber, 2013).

The active extension of innovations into the agricultural enterprises activities is explained by functioning of integrated innovation mechanism, which is characterized by not only economic incentives, but also the interrelation of organizational structures and relationships.

Today, agriculture in Israel is the most productive and innovative in the world in terms of almost all indicators. The country has achieved such a result through the implementation of a large number of innovative solutions, which include careful use of water resources (drip and spray irrigation), the use of new types of fertilizers and plant protection agents, the latest methods of dealing with weeds and pests, use of greenhouses, etc. Limited land resources and adverse natural-climatic conditions for agricultural development served the impetus for such a development of agriculture in the country. In consequence of the food crisis in the previous years, lack of resources and increasing population, the country has rapidly began to develop agriculture, apply new varieties of plants and soil treatment systems, agricultural technology and so on. Also, intense implementation of innovation was supported by the state through the funding of the innovative developments and organization of the country's emergence to international markets. (Douthwaite, and Hoffecker 2017).

One of the features in innovation policy of Germany is the provision of financial support by government for the development of long-term and complex research in key areas. In Germany animal farming plays a key role. That's why the crop production is developing as an auxiliary branch of animal husbandry; 40% of all agricultural area is occupied by meadows and pastures. The country is constantly implementing many state programs, which are aimed not only at financial support from the state, but also the organization of innovative activity in agricultural enterprises (Ingram 2015).

The practices of other EU countries in promoting innovation activity are also quite positive. For example, in the Netherlands, France, Switzerland, and Italy these are tax benefits, which stimulate all the enterprises associated with the development and implementation of innovations. Finland and Sweden offer agricultural enterprises grants and loans at reduced interest rates. In most countries of the European Union the enterprises, which develop and implement new products and technologies, get state support because this business field is considered rather risky for investment. (Long, Blok and Coninx, I., 2016)

Today, there are also broad opportunities for the use of innovative biotechnologies in the agricultural sector. Implementation of biotechnology presents a significant potential for all areas of the agricultural sector of the economy and can provide the fast technological and productive progress, provided farms will be given access to such technologies. (Sarkar, Poon, Lepage, Bilecki, and Girard, 2017; Caira, and Ferranti, 2016)

The use of biotechnology in agricultural production will contribute to the solution of environmental problems related to soil fertility, their technogenic pollution, and soil salinization (Pardey, Alston, and Ruttan, 2010). Environmentally friendly direction of biotechnology is called environmental biotechnology.

The goal of environmental biotechnology is to neutralize the effects of negative human impact on the environment and ensure mankind high quality of living in ecologically clean ecosystems. This can be achieved by already developed applied technologies and methods such as biological treatment of waste water, recycling of organic wastes, biological deodorization of gases, as well as relatively new methods for purification of contaminated soils (bioremediation of soils), silt, settled sludge, reservoirs, restoration of soil fertility, surface-active substances, and preventing corrosion. Thus, in the United States, France, Germany, Austria and other countries, so-called biological agriculture, which is based on eco-biotechnology studies, has become quite popular. The essence of biological agriculture consists in "feeding the soil rather than plants" to minimize the negative effects of land depletion and degradation. (Materia, Pascucci, and Kolympiris, 2015; Ociepa-Kubicka, and Pachura, 2017)

One of the important innovative developments in this field, which is considered by the advanced countries to be the most important revolutionary technology in improving the efficiency of agricultural production, is zero tillage, as well as biological nitrogen fixation, and reduction in the need for chemical fertilizers that can be achieved by cultivating legumes. In Argentina and Brazil, for example, zero tillage is used on more than 40 million hectares (nearly 43% of total arable land), in the USA – on 25 mln hectares, in Australia – on almost 15 mln hectares. This practice is especially useful for farms, and it easily can be adjusted to local conditions, since it does not require considerable financial and material costs, though is one of process innovations (Welch, Fusi, Louafi and Siciliano 2017).

2. Methods

As a methodological base of the research we assume that the implementation of innovations in agriculture is associated with growing new varieties of plants, cattle strains breeding, production of equipment, new energy-saving technologies, and the like. Therefore, the innovation activities in agricultural enterprises are implemented in three directions:

- 1) innovations in the field of human factors: training of specialists, able to operate new equipment and technology, improving qualifications and conducting retraining of specialists.
- 2) innovations in the field of biological factors: the development of innovations that increase the fertility of agricultural lands, animal productivity, and crop yields;
- 3) innovations in the field of technological factors, which provide improvement of engineering and technological potential of agricultural enterprise.

In this regard, our study will be focused at the analysis of international practices in the implementation of innovations in the field of biological factor, namely the development of organic agriculture. "Based on the analysis of more than 200,000 information documents, including 16,000 documents in the field of agriculture and expert analysis of more than 650 documents, as well as working with 400 leading research organizations, universities, companies, and industry unions", special expert community has particularly distinguished organic agriculture among other potential points of growth. (Organic agriculture and land farming biologization are emerging in Russia).

3. Results

First of all, we note that the term "organic agriculture" was first proposed in the last century by the International Federation of Organic Agriculture Movements (IFOAM), which includes more than 50 countries worldwide. The functioning of the international agencies on issues of organic agriculture indicates the importance and relevance of this direction in the worldwide agricultural production. This concept was differently interpreted by different countries in different periods of time, however, its essence and its significance remain the same; organic agriculture concerns production of environmentally friendly products and environmental conservation using various measures and techniques.

Table 2 shows the different interpretations of the concept of "organic agriculture" in different countries indicating the periods of these definitions.

Table 2. The definition of the "organic agriculture" concept

No.	The interpretation of the concept "organic agriculture"	Year	Country
1	Organic agriculture is a system of agricultural production that prohibits or substantially limits the use of synthetic combined fertilizers, pesticides, growth regulators, and food supplements to fodder for fattening animals.	1980	The USA
2	Organic farming is the environmental management system of agricultural production that sustains and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of unnatural (synthetic) raw materials and farming practices that restore, maintain, and enhance ecological harmony.	1996	The USA

3	Organic agriculture is a holistic system of production management, which supports and improves the "health" of the agro-ecosystem, including biodiversity, biological cycles, and biological properties of soils.	1999	WHO
4	Organic agriculture is a special kind of management, which is characterized by taking care of all components of the environment through introducing the restrictions or prohibition of use of substances or agricultural practices that negatively affect the environment, spoiling or polluting the environment, increasing risks in the food chain.	2000	The Czech Republic
5	Organic agriculture is agricultural production system, the primary purpose of which is optimization of quality production without the use of artificial or synthetic fertilizers, pesticides or other chemicals. The main emphasis is placed on preserving the environment for future generations.	2001	Israel
6	Organic agriculture is agricultural production at organic agricultural enterprise, which is carried out in accordance with the principles of sustainable development, supporting and stimulating the natural mechanisms of agricultural production.	2001	Poland
7	Organic farming unites all agricultural systems, which make agricultural production environmentally, socially, and economically viable.	2002	IFOAM

Sufficiently precise and clear definition to this concept was given by the US Department of Agriculture in 1980. This definition explains in an accessible form, what "organic agriculture" is, what is allowed and what is prohibited to use in the production of agricultural products, as well as systematizes and indicates a list of factors that underlie the system of organic agricultural production. In 1996, the US Department of Agriculture gave the definition of what "organic farming" is and what are its underlying components. The World Health Organization (WHO) not remained aloof from this important issue either. The WHO indicates that this system of agricultural production improves the health of not only people, but the "health" of the agro-ecosystem, as well as specifies the relevant methods and techniques to achieve this goal (1999).

The concept of "organic agriculture" is interpreted also in the Czech Republic, Israel, and Poland, although with some differences. However, the major focus is directed to the fact that this is a special kind of management aimed at preserving the environment for future generations, ensuring the development of agriculture through the use of natural materials.

The IFOAM focuses on the development of organic farming, which brings together "all agricultural systems that support ecologically, socially, economically viable agricultural production" (Potts and Kastle 2017). This comprehensive statement should be accepted, because exactly arable farming is an important primary component, which provides organic direction in the development of agrarian production sectors.

The efforts of international organizations and individual countries, which in varying degrees relate to the organization of organic agriculture, provided certain results in organic agricultural production. This can be confirmed by the following quantitative indicators, which are given by the researchers, stressing that substantial amount of land in the world is allocated for organic agriculture. Thus, in Europe this land amounts to 5.1 mln hectares, in North America - 1.5 mln ha, in Latin America - 4.7 ha, and in Australia - 10.6 mln ha (Potts and Kastle 2017).

Organic agriculture can become not only a catalyst for the transition towards green economy through the creation of sustainable ecological systems and ensuring high standards of agricultural food products quality, but also positively impact indicators reflecting the efficiency of agrarian sphere, increase incomes and food security in rural areas, create favorable conditions for investment, stimulate the production of products with high added value, increase the impact of agriculture on the development of the national economy, including that through increasing the share of organic products in export and reducing costs for overcoming the negative effects caused by industrial farming (Cecere and Mazzanti 2017).

Therefore, contemporary conditions prove the objective necessity and importance of developing organic agriculture, where some progress has been already made in individual countries as well as in the activities of international organizations towards development of agricultural production. Focusing attention on this information, we rightly pose a question concerning the progress of organic production of agricultural products in Kazakhstan.

4. Discussion

In 2012, in his message "Kazakhstan-2050 Strategy" ("Kazakhstan-2050 Strategy": New political course of the established state, 2012) the President Nazarbayev staked on the development of farming, small and medium-sized business in the processing and trade of agricultural products. The message delivered major tasks, namely, to change the farming culture and revive it taking into account new scientific, technological, managerial achievements, and the Kazakh traditions of animal breeding, as well as to determine the major mass-production products of the agricultural sector in order to capture major export markets share. In this message, the Government was instructed to develop a system of legal and economic incentives ensuring use of innovative agricultural technologies, and to create nationally competitive brands with a focus on ecological compatibility. The agribusiness was tasked to become a global player in the field of environmentally friendly production. The opportunities for such production were discovered in 2013 in the framework of the Concept on transition of Republic of Kazakhstan to green economy for 2013-2020, which was approved by decree of the President of the Republic of Kazakhstan (The concept of transition of Kazakhstan to green economy, 2013). In implementation of this task, the government provided the development of standards for organic (ecological) products compliant with international requirements. At the end of 2015 the Parliament of the Republic of Kazakhstan adopted the law "On organic production" (On organic production, 2015), which was approved by the President of Kazakhstan. This law laid the foundations for the regulation of organic production. The law gives the chance to Kazakhstan to integrate into the global process of organic agricultural production. The possession of significant land and other natural resources, coupled with the availability of traditional culture of land cultivation without widespread use of synthetic fertilizers and chemical pesticides offers significant opportunities for the development of this market segment. At the same time, the formed centuries-old values of the people of Kazakhstan, who historically existed in harmony with nature, have built social relationships, which are pertinent to the system of ecological agriculture and animal husbandry.

In recent years there has been a growing interest among agricultural producers of Kazakhstan to farm management practices based on organic agriculture, as evidenced by both interviews with agricultural producers and a growing number of their appeals to consulting organizations involved in the issues of the organic agriculture.

Currently Kazakhstan keeps neither official statistics on organic agricultural production nor the state register of organic producers and processing companies. Despite this, the study (Grigoruk, and Klimov, 2016) has revealed 29 producers and 19 processors of certified organic products. According to the findings, the production and processing of organic products is carried out in Akmola, Aktobe, Almaty, and Kostanay regions, where organic crops occupy at least 303381 ha of lands. The main production concerns cereals, oilseeds, legumes, fodder crops, and medicinal herbs.

Also, in the Republic of Kazakhstan there is no official statistics on the organic products import and export. However, according to the study, Kazakhstan imports mainly long-life products, while the total volume of import of organic products is less than 0.1%. As for exports, Kazakhstan's organic products, which are certified according to international standards, are exported to Russia, Ukraine, Germany, Poland, the Netherlands and Italy, while the total volume of organic products' exports from the Republic of Kazakhstan in 2014 amounted to 10 mln US dollars.

Based on international practices, in the contemporary conditions of the organic products' market in Kazakhstan, the following common measures should be implemented to ensure its further development:

- improvement of the regulatory framework based on international recommendations and standards;
- further development and implementation of certification, control and labeling procedures of organic products that meet market requirements;
- creation of a "green" image of Kazakhstan and its individual regions;
- promotion of organic production in the community of agricultural producers;
- creation of support system ensuring application of the domestic and foreign scientific research outcomes by agricultural enterprises;
- development of educational programs, as well as educating the public through the mass media.

Similar measures were implemented in all countries, which are currently key players in the international market of organic products.

5. Conclusion

To address food security, humanity has selected certain development directions of agricultural production, which give the opportunity to significantly increase the yields of agricultural products. The use of chemical fertilizers, pesticides, genetically modified organisms, herbicides, preservatives, and the like was one of the most important directions in enhancing agricultural productivity. Through these and other measures it became possible to significantly increase agricultural production. However, over time the reality has shown that solving one problem gave rise to other problem, whose factors negatively affect human health, the environment, etc. That is why today our goal is using just those natural recourses and only within reasonable limits, which can be utilized not disturbing natural balance in the environment, rather than using all available recourses that we wish. One of the areas stabilizing the relationship between human and nature is production of organic agricultural products, i.e. development of organic agriculture.

In the current context of agricultural management by enterprises of the Republic of Kazakhstan, an issue concerning improving the quality and safety of agricultural products for the health of Kazakhstani people becomes extremely vital. One solution to this challenge is the implementation of organic production systems and the development of the domestic organic market.

Implementation of organic agriculture does not contradict the industrial agricultural production. We believe that both organic and industrial systems of agriculture are able to act effectively, transforming in course of time into agricultural technologies that will be able to meet present and future needs in organic products both in domestic and foreign markets.

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