

# AGRICULTURAL INNOVATIONS IN EUROPEAN AND CENTRAL ASIAN COUNTRIES

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**Abstract.** The article analyzes the importance of agriculture for the economies of European and Central Asian countries, proves that it occurred due to the impact of innovations which help realize the potential of this industry which, in its turn, opens up promising ways for further development. It has been established that the need to stimulate innovation in the agricultural sector arises due to a number of factors, the most significant of which are: growing consumer demand for products, the need for production of environmental products, reduced production costs, rational use of resources, environmental protection. That is why the promotion of innovative technologies implementation for the sustainable development of agriculture in the countries of Europe and Central Asia is becoming an important element of the countries' steady development in the region. The article describes the innovative processes in the agricultural sector of the country's economy. Particular attention is paid to the consideration of the parameters of the EU Common Agricultural Policy.

**Keywords:** innovations, agriculture, sustainable development, general factor productivity, agricultural innovations, Common Agricultural Policy.

**JEL:** O13, Q16.

## Introduction

Innovations play a significant role in the development of any branch of the world economy. Agriculture in Europe and Central Asia has particular

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advantages in terms of innovation. This is due to the features of extensive industry development which have prevailed in recent years, as well as the use of outdated agricultural technologies and machinery. The introduction of innovative technologies into the agrarian sphere of the countries in the region gives opportunities not only for attracting additional investments, but also helps preserve the ecological balance, which in turn conforms with the principles of sustained development.

**Analysis of recent research and publications.** The following researchers have devoted their attention to the issue of innovative technologies that will help to provide the continuous development of agriculture: R. Soloshenko, N. Pozhydaieva, D. Ziukin, V. Ambrosov, M. Kropyvko, O. Datsii, M. Zubets, P. Muzyka, P. Sabluk, O. Krysalnyi, V. Trehobchuk, V. Sytnyk, O. Shubravska, etc.

Despite the presence of some scientific developments aimed at supporting agricultural producers, pressing issues such as the search for new innovative methods of sustainable agricultural development provision remain poorly understood, which has determined the topic and purpose of the study.

**The purpose of the research** is to analyze the introduction of innovative technologies with the aim to provide the sustained development of agriculture in Europe and Central Asia.

## 1. Theoretical foundations of agricultural innovation

In today's economic development conditions, an important feature of both the entire economy of a country and the agriculture is the need to accelerate scientific and technological progress, which is based on innovative processes that allow people to continuously update the agricultural production on the basis of scientific and technological development. At the same time, innovative processes must be constantly operated by the state through appropriate policies that include budgetary funding, subsidies and other forms of financial support.

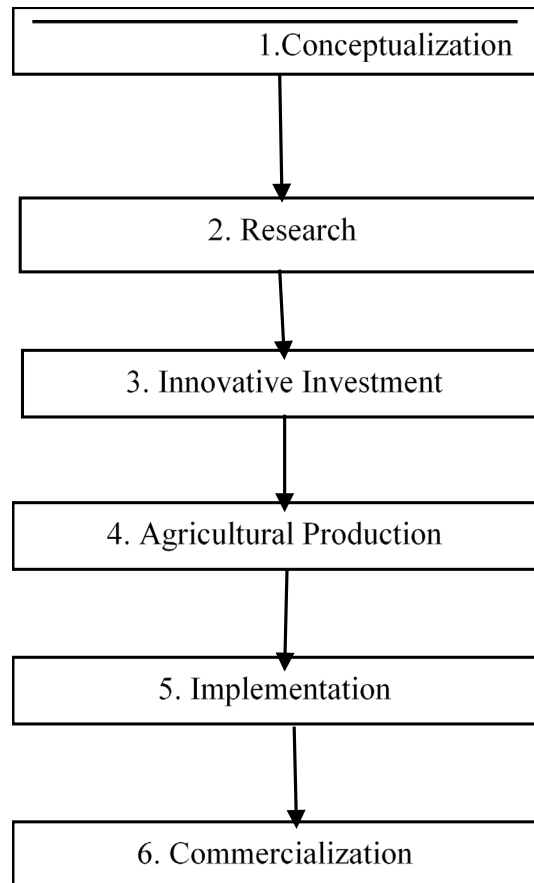
One of the typical features of the agriculture is the unification of the economic branches (including agriculture, processing industries, the feed

and microbiological industry, agricultural engineering and mechanical engineering for light and food industry) into a single innovative policy. Such a variety of branches with a certain specificity requires the development of unified management practices aimed at achieving a common goal of the state's Food Programme implementation (Samuelson and Nordhaus, 2011).

In our opinion, the key moments in the development and implementation of the agriculture innovation policy is the presence of investments, which characterizes the degree of willingness and the desire of business entities at all hierarchical levels of management to implement innovative models and projects of agricultural production development, as well as innovative potential that provides availability of financial, material and workforce resources needed to accomplish the tasks.

Continuous implementation of innovative activities in agriculture at different hierarchical levels causes the formation of innovative processes, which help implement the research and development achievements in agricultural enterprises. Innovations could be introduced in the form of new plant varieties, breeds and species of animals, new or improved foods and materials, brand new technologies in plant and animal husbandry, new fertilizers and means of plant and animal protection, animals and poultry treatment and prevention methods. At the same time, each innovation has a life cycle (Commerzbank AG., 2011 №6. p. 36).

Summarizing the experience of well-known economists, we believe that in order to manage the innovation activity in agriculture, we should first define the chain of interrelated stages, the consistent realization of which will turn the idea (innovation) into the final innovative product, and both its implementation and consumption will ensure the commercial effect. Adapting the innovation process to the current level of development of agricultural production, we consider it is advisable to divide it into six stages for the purpose of managing the innovation activity (White, CatoJournal, 2010, vol.9, no.2).



Source: [What Kind of Monetary Institutions Would a Free Market Deliver//London, CatoJournal. - 2010. - vol.9. - No.2]

*Fig.1 Stages of the innovation process in the innovation management activity of agriculture*

The initial stage of the agricultural innovation process is conceptualization, which is the formation of new ideas (generation of ideas), concepts and areas of research to create innovation. We need to select the most promising and potential ones aimed at the development of agriculture,

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the management system of agricultural production, raising the social level of the population.

The research stage is defined by creation and modelling of innovation, development of an innovative project that requires the utilization of foreign experience, exchange of scientific and technical information, acquisition of patents, certificates and licenses, and finally the conduction of joint research.

The availability of the created innovation leads to a search for means of financing, the implementation of the investment process, attracting investors, the search for internal resources and reserves of production investments along with development of the investment project, the elaboration and regulation of investment policy at different levels of management.

Development of innovation and availability of financial resources allow to start creating a new product through the organization of agricultural production with the use of new technologies, production modernization, purchase of new equipment. This stage is characterized by manufacture of an innovative product, achievement of economic and social criteria. (output volume of agricultural products, unit production cost, labour productivity, etc.)

An innovative product that has been produced must be placed on the domestic and foreign markets in order to meet the needs of customers. At the stage of realization, one should look for sales markets, study the counterparties demand, develop a pricing policy, consumer delivery, monitor sales as well as assessing the product competitiveness.

The final stage of the innovation process should include commercialization, which is related to the commercial effect, obtaining economic benefits, expressed by the added value of the innovation project and its profitability.

Each of the selected stages performs its function, contributing to the implementation of the innovation process stages and the functioning of the entire agriculture innovation system in order to achieve the end result and obtain a commercial effect.

Innovation process management should be carried out in a certain sequence:

1) development of ideas, search of concepts, research direction. The purpose of this stage is to understand the needs of the agricultural sector in innovation, the possibility of changes in agricultural production technologies, to understand the impact of economic phenomena and to create new patterns of its development, to generate promising ideas, their selection and development, as well as to determine the feasibility of the implementation;

2) research programmes and projects development. This stage involves the elaboration of technical documentation, project modelling, patent registration, certification, production and testing of prototypes;

3) attracting investment involves the development of investment policy, determining the amount of capital investments, forms and volume of budget allocations at all levels, attracting foreign investment, use of organizations' own funds;

4) implementation of research and development projects. At this stage, practical implementation of innovation into production, development of new technologies and organization of innovative product agricultural production are being carried out;

5) implementation of an innovative product. At this stage, the implementation of the innovative product is being executed depending on the forms and hierarchical levels of the innovation process management, as well as the needs of the consumers, the development of temporary recommendations, instructions, guidelines, etc., which, in turn, are subsequently tested in industrial and agricultural conditions;

6) obtaining economic benefits - evaluation and analysis of the innovation product realization. The final stage involves the evaluation of the product obtained through the use of new technologies of agricultural production, thereby determining the effectiveness of the innovation.

## **2. Analysis of agricultural innovation in Europe and Central Asia**

Sustainable agricultural development in Europe and Central Asia is gaining momentum. With the development of science and technology, one of the promising innovative areas in agriculture for the sustainable

development of the regions is the use of digital technologies and the Internet of things. The utilization of such technologies in the context of steady development implementation makes it possible to meet human nutritional needs, increase the environmental friendliness of products, expand the natural resource base of the agricultural sector, support the economic viability of agricultural enterprises, improve the quality of life for farmers, forest managers, fishermen, workers and communities at large.

According to UN estimates, the total population will grow to 9.1 billion by 2020. For the sake of satisfying food needs, the amount of food produced must also increase by at least 70%. As the extensive type of agricultural development has proven to be futile in the face of such huge challenges, the only thing that is capable of providing such an increase in food production is the introduction of innovative solutions in the agricultural sector.

Today, the following innovative technologies are the most demanding for ensuring sustainable development of agriculture:

1. Electronic charts for fields and gardens, software for easy handling. Thanks to this method, one can accurately record not only the area of each field but also the location of all adjacent objects. Unlike a paper card, the electronic field shows the characteristics of the field much more clearly, which simplifies the planning of production processes. With the help of electronic charts, it is easier to calculate the exact amount of seeds, fertilizers, fuel for machinery, to better plan the order of the field cultivation etc.

2. High-precision agrochemical field survey. Although agricultural enterprises have data on soil characteristics in each field, this data is often very generalized and sometimes outdated. As a result of creating an accurate soil map (which can be combined with an electronic map), which contains many soil parameters and characteristics, the company can maximize the use of this area due to the fact that fertilizers will meet the needs of a specific culture and account for the agro-climatic conditions. In addition, soil condition data is crucial for the selection of crops and their sequential sowing.

3. Navigation systems for agricultural machinery. Unlike car navigators, these devices are not designed for finding the shortest route between two locations. They help a combine or tractor driver cultivate the

field more accurately - making minimal double-striping between adjacent passages, easily navigate the field at night, in heavy fog or in dusty conditions.

4. Technology monitoring. This technology is similar to GPS-based transport monitoring, which is now actively used by commercial and utility companies to monitor the operation of service car drivers. Nevertheless, when it comes to crop production, it is important to monitor not only the traffic routes and transport locations, but the amount and quality of work performed as well. The monitoring systems control a number of specific parameters: from the volume of fuel consumed for processing one hectare to the depth of immersion in the soil of the ploughs and maintaining the optimum speed of transit of the combine through the passage.

The implementation of digital technologies and the Internet of things for sustainable agriculture in Europe and Central Asia provides for:

- creation and control of natural biological cycles;
- mindset restructuring of both producers and consumers of agricultural products;
- priority of qualitative indicators over quantitative ones;
- protection and restoration of both soil fertility and natural resources;
- optimizing the use of resources at the enterprises both in quantitative and qualitative parameters;
- reducing the use of non-renewable resources with their consistent abandonment altogether;
- ensuring a stable income for the rural population;
- making use of family and community farming opportunities;
- minimizing the adverse impact of anthropogenic activity on the environment (Petrov , Economics of AIC, 2013, vol.2, p. 100)

The Food and Agriculture Organization of the United Nations (FAO) which is responsible for agriculture sustainability is working in the agri-environment industry, focused on creating platforms for knowledge sharing between all sectors and entities. At the local level, agri-environmental approaches, practical methods and related curricula are included in the Farmers' Schools Programmes as part of integrated pest management projects. These activities are aimed at strengthening the capacity and



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disseminating knowledge on development potential of agricultural innovation among local practitioners and small farmers.

The particular challenge of innovating the agriculture is to establish sustained production and increase resilience to climate change. The last five years have been marked by a rapid rise in global temperature, which is of concern to experts. Particular emphasis is placed on working in arid territories and in regions with a high proportion of urban population that have low levels of food security.

The process of innovation in the agricultural sector on a global scale has some political implication. First of all, it is related to the disproportion of world development. Countries with high levels of socio-economic development are becoming more affluent through the introduction of innovative technologies, increased labour productivity and the use of modern management technologies in the agricultural sector. The poorest countries, on the other hand, have many problems with food security. Every year the situation gets worse for them. This is partly due to the specific demographic situation in these countries. All of them belong to the second type of population reproduction, which is characterized by significant natural population growth. As a result, there are problems with providing food to the population. Tajikistan is a vivid example of this kind of countries located in Europe and Central Asia. This country has the worst food security situation in the whole region.

However, in Europe and Central Asia, there are significant differences in the pace of innovation in agriculture. This is mainly due to the agrarian policy of a particular country, agro-climatic features, traditions of agricultural development and changing global market conditions.

Some developing countries have been showing high agricultural development rates in recent years. However, they are inferior to developed countries in terms of development and productivity in the agricultural sector.

What is interesting, when analyzing the development of agriculture of the countries, is the comparison of GDP indicators, the share of agriculture in the GDP structure, the expenditure of countries on research and development (Table 1).

*Table 1*  
*World Development Indicators: Structure of output*

	Gross domestic product \$ billions 2010	Gross domestic product \$ billions 2018	Agriculture % of GDP 2010	Agriculture % of GDP 2018	Research and development expenditure % of GDP
World	66,036.9	85,804.4	4	-	-
Europe & Central Asia	20,947.2	23,041.5	2	2	-
Belarus	58.7	59.7	9	6	0,59
Belgium	483.5	531.8	1	1	2,61
Bulgaria	50.6	65.1	4	4	0,77
Czech Republic	207.5	245.2	2	2	1,79
Estonia	19.5	30.3	3	2	1,32
Greece	299.4	218.0	3	4	1,14
Kazakhstan	148.0	170.5	5	4	0,13
Poland	479.3	585.8	3	2	1,04
Romania	166.2	239.65	5	4	0,50
Spain	1,431.6	1,426.2	2	3	1,21
Ukraine	136.0	130.8	7	10	0,45
Uzbekistan	39.3	50.5	18	29	0,19

Source: <http://wdi.worldbank.org/table/4.2>

Analysis of the statistics shows that the vast majority of European and Central Asian countries have significantly improved their socio-economic development indicators over the period from 2010 to 2018, as indicated by GDP growth. However, the role of agriculture in the structure of the economy has diminished. Instead, in countries with low or negative GDP growth, the share of agriculture in GDP has grown over the observation period (Uzbekistan, Ukraine, Greece, Spain)

Regarding the relationship between the growth rate of the economy and the cost of research, we get a fully predictable result. Countries with high spending on science have a higher level of socio-economic development.

Political processes have a significant impact on the state of innovation in the agricultural sector. Developing countries often play victims and require assistance from developed countries. The most developed

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countries, in collaboration with organizations such as FAO, the World Bank and others, are working hard to assist the least-protected countries in implementing modern technologies in the agricultural sector. It is enough to mention the Green Revolution, which has led to a significant number of developing countries having achieved considerable results in increasing agricultural productivity and yields.

However, the most developed countries in the world are not ready to just feed the inhabitants of the least developed countries. Assistance is provided on the condition that developing countries are ready and willing to follow the sustainable development action plan rather than simply waste money. (Shubravska, Moldovan, Paskhaver, 2012).

In order to implement innovative technologies for steady agricultural development in Europe and Central Asia, it is necessary to:

- develop effective their state policy, legal framework and normative documents for the development of the agricultural sector;
- promote social innovation in the field of research, development and dissemination of experience;
- increase public investment in the form of research, the provision of statistics, implementation of tailor-made programmes, provision of loans and creation of conditions for income-generating activities of agricultural producers;
- ensure recognition and promotion of small and family farms, advocacy of rights and equality of rural women and young people in terms of biodiversity conservation, including through traditional and farmed varieties of plant and livestock breeds;
- move towards sustainable management of natural resources on the principles of agroecology;
- ensure recognition of agri-environment potential in terms of adaptation to climate change and strengthening of climate resilience;
- provide small and family farms with access to natural resources and adapted social markets through agri-environment.

In order to address the main goal of steady development - the elimination of hunger, it is necessary to monitor productivity growth on a regular basis, as it is considered to be the main indicator of sustainable development. It is the growth of labour productivity in the agricultural sector

that can solve the problems of providing the population with food and improving food security.

Efficiency means adopting technologies and manufacturing practices that lead to increased output from used resources, measured by total factor productivity (TFP).

The total factor productivity is the ratio of agricultural output (gross yield and livestock production) to the resources used (land, labour, fertilizers, feed, machinery and livestock). TFP measures the changes in the efficiency, with which all the spent resources convert to results. Producers, governments and agribusinesses that take this approach are not just interested in growing agricultural products, but to some extent, in making more efficient use of available resources through the use of sophisticated products, technologies and practices - innovative operations. The Global Factor Productivity Study (TFP) is the best way to get information on where improvements are needed in agricultural systems, how to make investment decisions and which policies support more productive and sustainable agriculture.

Improved TFP rates come from the adoption of innovations such as higher yields, pest and / or drought resistant and flood-prone crop varieties. The growing bioinnovation sector involves the precise use of germs (bacteria and fungi) to help farmers get more yield from a unit of agricultural land. Microbes also protect plants from dry conditions and increase yields, as well as protect plants from pests. TFP rate can also be increased by implementing practices and knowledge that allow to use more efficient and timely cultivation methods, as well as the use of accurate data and information technology in agricultural equipment for the targeted application of fertilizers, water and plant protection.

When it comes to animal husbandry, TFP rate could be increased in selected animals with favourable genetic qualities, as well as when animals receive vaccinations and high-quality feeds that provide more nutrition per volume. In forestry, genetically enhanced trees provide faster growing of pre-harvesting products and greater amount per tree.

Providing farmers and producers of any scale with the best innovative technologies, as well as training for best practices, will increase

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TFP and reduce the impact on soil, water and air quality, as well as effectively exploit the labour shortage in agriculture.

Placing productivity growth as a central policy goal can accelerate economic growth and increase revenue. With increased productivity, workers enable other workers to produce more in less time, freeing up both labour and capital investment to move to other industries in order to produce more or different goods and services.

### **Conclusion**

An analysis of the introduction of innovative technologies to ensure the sustainable development of agriculture in Europe and Central Asia shows that there are certain factors that impede the transition to sustainable growth of the agricultural sector through innovative development. There are considerable differences in the pace of development of the agricultural sector in Europe and Central Asia. The main factor in the development of agriculture in the region is the introduction of innovation and increased productivity, which will guarantee the creation of more productive, efficient and sustainable innovation ecosystems in agriculture, which are needed by society to meet its food needs in the future.

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