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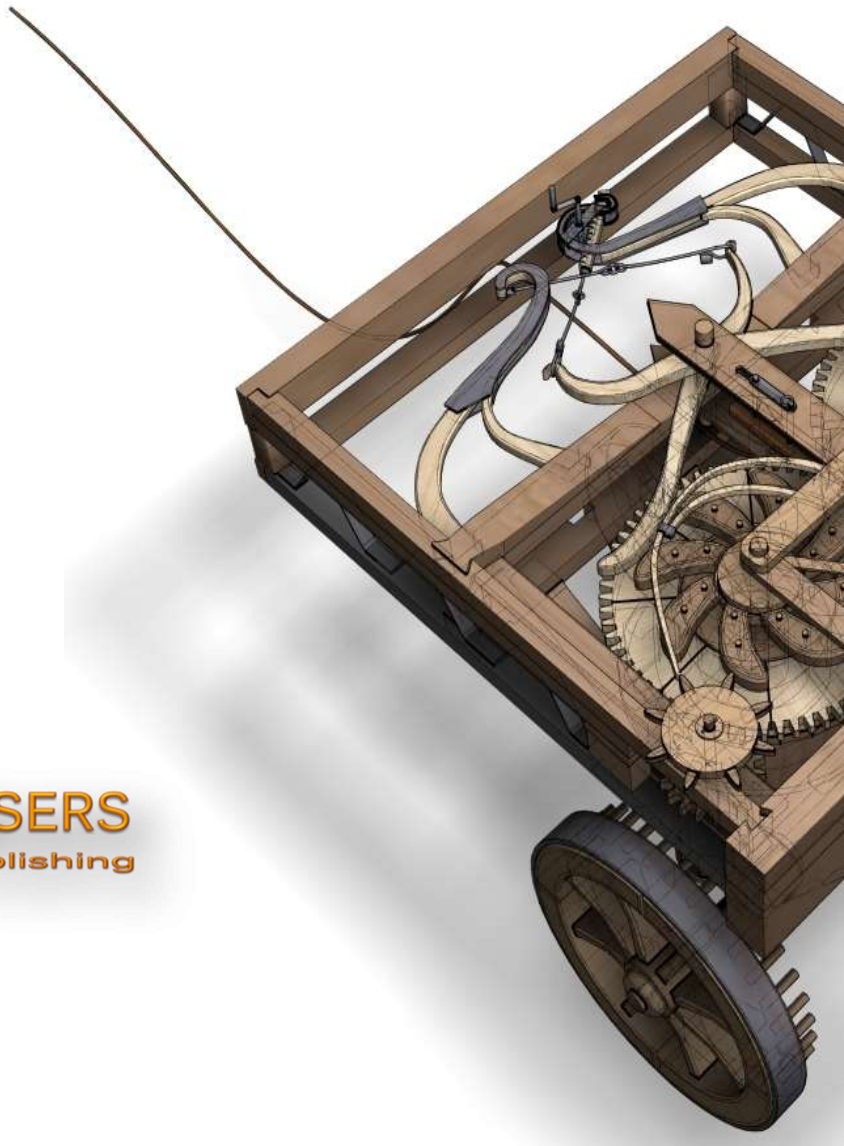

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Innovations – the Basis Tools of Development of Agricultural and Ecological Management

Olena V. MORAVSKA
Precarpathian Institute named of M. Hrushevsky of
Interregional Academy of Personnel Management,
State Scientific Research Control Institute of
Veterinary Medical Products and Fodder Additives, Ukraine
olena.v.moravska@gmail.com

Taras R. LEVYTSKYY
State Scientific Research Control Institute of
Veterinary Medical Products and Fodder Additives, Ukraine
taraslev@i.ua

Volodymyr O. VELYCHKO
State Scientific Research Control Institute of
Veterinary Medical Products and Fodder Additives, Ukraine

Olena M. ORLOVA
Precarpathian Institute named of M. Hrushevsky of
Interregional Academy of Personnel Management, Ukraine
olena.orlova54@gmail.com

Yurii A. SHULZHYK
Precarpathian Institute named of M. Hrushevsky of
Interregional Academy of Personnel Management, Ukraine
pimaup_doktorant@ukr.net

Svitlana SENYSHYN
Precarpathian Institute named of M. Hrushevsky of
Interregional Academy of Personnel Management, Ukraine

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Abstract:

The article considers the specifics and classification of innovations in the system of agro-ecological management of the agro-industrial complex of Ukraine. Priority directions of development of ecologically oriented innovation projects based on development and improvement of management system and production and technological processes are offered. Methodical developments of introduction of innovation-investment projects of research institutes and recommendations of educational institutions are presented. It is substantiated that the mechanism of intensification of innovations in the agro-industrial complex of Ukraine is a complex process - from research and development, experimental verification of scientific results to introduction into production and evaluation of innovation efficiency taking into account financial, economic, ecological and social spheres. Based on the conducted scientific and methodological work, it was concluded that the growth of the agro-industrial complex of Ukraine can be achieved through the production of competitive products with high added value in

compliance with environmental standards in the implementation of innovation - investment projects taking into account the experience of economically developed countries.

Keywords: innovations; investments; agricultural and ecological management.

JEL Classification: Q10; Q50; Q55; Q56; Q57; I23.

Introduction

From an economic point of view, the production of environmentally friendly raw materials and agricultural products requires the use of a wide range of innovation-intensive technologies, production processes and specialized management methods.

The main purpose of agricultural entrepreneurship is to make a profit from the production activities of agricultural producers, from the operation of processing enterprises of agriculture and to the bringing products to the final consumer**.** In turn, the stimulation of environmentally oriented behaviour of agricultural enterprises makes it possible to obtain the maximum number of high quality agricultural products while preserving agricultural and biological resources.

Innovative scientific and technological support of the agro-industrial complex - is the basis for improving the efficiency of production, scientific, technological activities of all spheres of the agro-industrial complex.

1. Literature Review

According to international standards (Illiashenko 2010; Carlsson *et al.* 2002; Mitter *et al.* 2019), innovation is defined as the end result of innovation, which is implemented in the form of a new or improved product marketed, a new or improved technological process, confirmed in practice, which allows maximum profit with observance of ecologically oriented norms.

It should have noted that the process of improving the innovative activity of agricultural enterprises is the basis for the development of agro-environmental management in the agro-industrial complex of Ukraine (Babchinska 2020; Kozhushko and Skrypchuk 2007). Agro-ecological management, according to the literature, is a diverse science and practice of management in the sectors of agricultural production management, in compliance with the norms aimed at the rational use and protection of the environment from pollution. The main mechanism of modern agro-ecological management is an innovative direction aimed at advanced technologies for managing production processes and advanced management practices of agricultural workers to achieve reasonable goals and objectives (Demianenko 2018; Kozhushko and Skrypchuk 2007; Kupalova *et al.* 2021; Loizou *et al.* 2019).

Implementation of the program of agrarian and ecological management is progressive - profitable under the condition of attraction of investments - own, budgetary, foreign, etc. (Aranchiy *et al.* 2017; Atkeson *et al.* 2019; Herasymenko and Kozlovs'kyy 2017). At the same time, the introduction of innovation-intensive technologies and processes of agricultural production gives the most effective results compared to extensive technologies and production processes, as they are more advanced and less dependent on external factors (Demianenko 2018; Gorb and Yasnolob 2017). In particular, the costs of financing innovation-intensive technologies are recouped in the short terms by reducing production and operating costs (resources), waste processing (including savings on their disposal), reducing waste, reducing environmental payments (Gorbach 2016; Herasymenko and Kozlovs'kyy 2017; Yasnolob *et al.* 2019).

In the agro-industrial complex, innovations are the development and implementation of a set of innovations in various sectors in agricultural practice. In particular, there are the introduction of new technologies in crop production, animal husbandry and the processing industry. In addition, the introduction of new forms of organization and management of various sectors of the economy, new approaches to social services to improve the efficiency and effectiveness of production (Demyanenko 2018; Gorbach 2016; Kotsumbas 2013).

In addition, introduction and implementation of new forms of the organization and management of various sectors of economy, new approaches to social services for increase of working capacity and efficiency of production (Demianenko 2018; Gorbach 2016; Kotsiumbas 2013).

The purpose of our work was to analyse the scientific, methodological, and specialized literature in this scientific field and highlight the main directions and forms of implementation of innovative technologies and processes, development of scientific and methodological provisions and practical recommendations for the formation of management mechanisms, justification of the need to involve research institutes in the program of implementation and calculation of innovation and investment projects in the agro-industrial complex in compliance with environmental standards.

2. Methodology

We were conducted an analysis of scientific and methodological and specialized literature of professional scientific sources in this field of research. The main types, directions, and forms of introduction of innovative technologies and processes in the agro-industrial complex were developed and allocated. The analysis of these results of works carried out based on educational institutions, research institutes and farms are carried out. In the process of research were use the methods of system-structural and comparative analysis, methods of quantitative analysis of financial and economic indicators, factor and statistical analysis, methods of economic-mathematical modelling and expert assessments are applied.

3. Case Studies

Note that the main purpose of innovation is to increase the efficiency of the production and technological process with maximum profit in compliance with environmental standards (Voloshchuk 2011; Demianenko 2018: Aranchiy *et al.* 2017; Kupalova *et al.* 2021). The structure of the innovation process includes four main phases: research, production, implementation and outcome (Voloshchuk 2011; Illiashenko 2010). Obtaining the results of innovations is impossible without consistent implementation of the components of the structure of the innovation process. According to the type of results obtained (table 1), it is advisable to distinguish innovations of producing (with the receipt of the product) and innovations of processes.

Table 1. Innovations in agro-industrial complex by type of the received results

Innovations, according to the type of results obtained, are divided into:	
Innovations of producing (with the receipt of the product):	– introduction of new (based on new technologies) or improved existing products, feeds, feed additives, drugs, etc.; – introduction and application of new materials, means; – introduction and application of new semi-finished products, components;
Innovations of processes:	– ecological and technological (new production technologies are oriented in the ecological direction); – organizational and managerial (new methods of organization of production, transport, sales and supply, new organizational management structures); – social – environmental (improvement of working conditions, recreation, meeting human needs in health care, education, etc.);

Source: Demianenko 2018; Voloshchuk 2011

Table 2. The main directions of the innovative system of development of agro-industrial enterprises

The main areas of innovation in agriculture complex	Branching of the main directions of innovations in agro-industrial complex
Technological:	– development and implementation of technologies for production and storage of agricultural products; – the use of resource-saving technologies that are characterized by the most useful result; – development, implementation and application of the latest technologies (environmentally-oriented veterinary drugs, feed additives, tools) in the field of animal husbandry; – development, implementation and application of the latest technologies (environmentally-oriented chemical and biological means) in the field of crop production; – improvement of technological processes in order to reduce the duration of the production cycle of processing of agricultural raw materials while ensuring the required product quality; – development and implementation of environmentally-oriented own packaging lines that meet the technological specifics of manufactured goods; – improvement of containers, packaging and methods of transportation
Assortment:	– development and production of environmentally friendly mass consumption products; – improving the consumer qualities of products; – certification and product standardization
Marketing:	– market research and identification of new consumer segments; – search and formation of information databases on the market environment and consumer properties of goods of competing firms; – search for partners for the implementation and financing of the innovation project
Infrastructure:	– formation of institutional structures covering the entire cycle of innovative support of production activities, from the generation of new scientific and technical ideas and their development, to the production and sale of agricultural products

Source: Illiashenko 2010; Kozhushko and Skrypchuk 2007

The large-scale use of scientific technical-technological, biological-chemical and organizational-managerial research with the intensification of innovation processes is a determining factor for economic growth in all sectors of the agricultural economy (Gorbach 2016).

Given the main purpose of innovation, data from specialized professional literature sources (Demianenko 2018; Voloshchuk 2011; Kozhushko and Skrypchuk 2007; Illiashenko 2010) and the results of methodological, scientific and experimental developments (Kotsiumbas 2013; Levytskyi 2015; Moravska *et al.* 2020; Shvets et. al. 2013) based on data of institutes and research farms we were analysed the state of innovative development of the agro-industrial complex of Ukraine. We were established and substantiated (table 2) the main directions of innovative development system.

In terms of subject and scope of application in the agro-industrial complex (table 3), we have identified and substantiated four types of innovations: breeding and genetic (applies only to the agricultural and biological industries); production and technological; organizational and managerial and economic; socio-ecological (Demianenko 2018; Kozhushko and Skrypchuk 2007; Gorbach 2016; Kotsiumbas 2013).

Table 3. Types of innovations in accordance with the subject and scope applying in the agricultural sector

Subject and scope applying	Types of innovations
Organizational, managerial and economic:	– development of cooperation and formation of integrated structures in the agro-industrial complex; – creation of new organizational and managerial forms in agro-industrial complex; – creation of new forms of work organization and motivation of employees; – development of a detailed business plan, with the calculation of financial investments and payback, for the implementation and solution of specific innovative tasks; – conducting trainings, refresher courses for managers, specialists and workers;
Socio-ecological:	– development of the country's personnel resources in the field of scientific and technical support of the agro-industrial complex; – creation of new improved working conditions, solution of social problems of the rural population (health care, education and culture); – environmental protection and improving the quality of its products; – compliance with environmental standards for the use of natural resources and the creation of favourable environmental conditions for the population;
Production and technological:	– application of new equipment; – application of new technologies for growing crops; – introduction of industrial technologies in animal husbandry; – application of scientifically based systems in agriculture and animal husbandry; – creation and application in the field of animal husbandry of new types of feed, feed additives, premixes and veterinary drugs; – creation and application of new types of fertilizers and plant protection products; – introduction of biologization and greening of agriculture; – introduction of new resource-saving technologies for food production and storage, aimed at improving their quality and safety;
Selection-genetic:	– obtaining new varieties and hybrids of plants; – obtaining new breeds and species of animals, poultry, crossbreeds; – formation of plant species adapted to the influence of pests and adverse environmental factors; – formation of species of animals and birds resistant to diseases and adverse environmental factors;

Source: Voloshchuk 2011; Kozhushko and Skrypchuk 2007

Note that the innovation process in agriculture has seen as a single process of transformation of specific technological, technical, economic, marketing, organizational and managerial ideas, which are the result of scientific and technological progress, new technologies and methods, which allows their implementation in production with the result. At the same time, the main task of introducing innovations in the agro-industrial complex is to increase production, economic and environmental indicators (Demianenko 2018; Kozhushko and Skrypchuk 2007; Gorbach 2016; Levytskyi 2015). Characterizing the implementation of innovations in the agro-industrial complex (table 4) should highlight the qualitative and quantitative characteristics.

Table 4. Types of characteristics of innovations of the agro-industrial complex

Type	Characteristics of innovations
Qualitative characteristics:	– product quality standard; – environmental safety of finished products (according to requirements and standards); – characteristics of the independence of the innovation process; – characteristics of ecologically-oriented direction of innovation process (ecological indicators); – characteristics of the level of enterprise and personnel management; – characteristics of economic-financial and organizational-social directions of the innovation process (indicators of each sphere of activity)
Quantitative characteristics:	– financial (capital structure and liquidity); – market (turnover, growth and market share); – economic (profit and profitability)

Source: Kozhushko and Skrypchuk 2007

Analyzing the state of Ukraine's agro-industrial complex over the past 10 years, it becomes clear that this industry was used mainly outdated and imperfect technologies of agricultural production, unprofitable and time-consuming organizational and management methods and forms, which was led to negative consequences in all areas of agriculture (Voloshchuk 2011; Demianenko 2018; State Statistics Service of Ukraine 2020).

Table 5. The structure of the production cost of products (works, services) of agriculture in private farms for 2018–2020

Types of costs	Private farms					
	2018		2019		2020	
	mln.UAN	% to the total costs	mln.UAN	to the total costs	mln.UAN	% to the total costs
Costs – total	**68 397.4**	**100**	**78 580.2**	**100**	**76 567.4**	**100**
Direct costs – total	**41 524.8**	**60.7**	**47 299.5**	**60.2**	**44 138.4**	**57.6**
Including:						
Seeds and planting materials	7 585.1	11.1	8 335.2	10.6	8 076.6	10.5
Fodder	2 434.2	3.6	2 774.4	3.5	3 065.4	4.0
Including purchased fodder	1 195.8	1.7	1 299.3	1.7	1 492.6	1.9
Other agricultural products	330.9	0.5	309.5	0.4	262.1	0.3
Inorganic fertilizers	13 150	19.2	16 364.3	20.8	14 805.8	19.3
Oil products	9 362.3	13.7	9 995.2	12.7	7 956.8	10.4
Electric power	424.4	0.6	536.8	0.7	523.1	0.7
Fuel	385.2	0.6	220.6	0.3	190.5	0.2
Spare parts, repair and construction materials to repair	4 266.8	6.2	4 661.6	5.9	5 030.1	6.6
Labor costs	**3 467.8**	**5.1**	**4 435.4**	**5.6**	**4 682.1**	**6.1**
Other direct costs – total	**15 597.1**	**22.8**	**18 696.2**	**23.8**	**19 718.9**	**25.8**
Including:						
Deductions on the social purposes	803.1	1.2	1 029.0	1.3	1 066.3	1.4
Rent payments for:						
Land shares (stocks)	7 308.6	10.7	8 485.4	10.8	8 605.7	11.2
Property shares	63.6	0.1	44.2	0.1	38.9	0.1
Depreciation of fixed assets	5 566.8	8.13	7 129.1	9.1	7964.7	10.4
Indirect costs – total	**7 807.7**	**11.4**	**8 149.1**	**10.4**	**8 028**	**10.5**
Including:						
Payment of services and job of other organizations	4 082	6.0	4 413	5.6	4 235.9	5.5

[1]Data exclude the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and a part of temporarily occupied territories in the Donetsk and Luhansk regions.
[2]Information is compiled by enterprises with the main economic activity "Growing of non-perennial crops", "Growing of perennial crops", "Plant propagation", "Animal production", "Mixed farming","Support activities to agriculture and post-harvest crop activities" and "Processing and preserving of poultry meat" (codes 01.1 − 01.6 and 10.12 by NACE 2006).

Source: State Statistics Service of Ukraine 2020

However, in recent years there has been an intensive introduction of new and renewal of obsolete technologies, taking into accounts the experience and direction of European countries. The introduction of new technologies leads to a significant increase in costs, which requires the involvement of investment projects for the development of agro-industrial enterprises. From the given data in the table 5 it is possible to see growth of expenses, including on introduction of innovative projects, in private farms of agrarian and industrial complex of Ukraine. The data are presented (table 5) confirm the increase in costs and the need to attract investment for further innovation in the agro-industrial complex of Ukraine.

Note that the peculiarities of agricultural production have characterized by a high level of risk in the implementation of innovative processes in the agricultural sector. Risk of financing research and production projects, the risk of a temporary gap between costs and results, the risk associated with the impact of the external environment (climatic and biological factors), that requires careful development, analysis and preparation of a business plan (Demianenko 2018; Herasymenko and Kozlovs'kyy 2017; Comin *et al.* 2021; Herrendorf *et al.* 2018).

Note that to calculate and prepare a financial plan for the costs of attracting investment in innovative projects use:

a) Coefficient of calculation of economic efficiency (Ce):

$$\boldsymbol{Ce = \Delta P / \Sigma C} \qquad 3.1$$

where: **ΔP** - increase in profit from the investing - innovation project;

ΣC - total costs of this investing - innovation project;

b) Payback period of the investing - innovation project:

$$\boldsymbol{Pp = 1/Ce} \qquad 3.2$$

The obtained payback period (Pp) is compared with the normative coefficient of economic efficiency of the investing - innovation project (Cne), which is accepted in practice and theory in relation to investments and is equal to 0.15, which corresponds to a period of 6.7 years.

When choosing an investing - innovation projects, the calculation of the comparative economic efficiency of projects for investment is performed.

The indicator of comparative efficiency (Ec) is equal to the possible level of reduced costs (Ci):

$$\boldsymbol{Ci = Cii + Cne \times ICi \leq Copt} \qquad 3.3$$

where: **Cii** - the cost of production of the investing - innovation project;

Cne - normative coefficient of economic efficiency

(1.5 = term 6.7 years);

ICi - investment (costs) in the innovation project;

Copt - optimal costs (acceptable to the subject of innovation activities in this period);

An investing - innovation project is considered the best if the amount of reduced costs is acceptable, and the quantitative and qualitative indicators of the project - the highest.

The payback period of additional investments (Ppi) when comparing investing in innovation projects are calculated by the formula:

$$\boldsymbol{Ppi = Ci2 - Ci1 / C2 - C1} \qquad 3.4$$

where: CI_2, CI_1 - capital investments of comparable investing in innovation projects (for a year or the whole period);

C_1, C_2 - cost of production (works) on the compared projects;

When implementing an innovative project (modernizations, introduction of new technologies, new lines, constructions, reconstructions, etc.), the investment efficiency ratio (Cie) is calculated:

$$\boldsymbol{Cie = C2 - (Cm - Cnp) / Iin - Iim} \qquad 3.5$$

where: $\mathbf{C_2}$ - cost of products to be replaced or upgraded (for a year or other period);

Cm - cost of production after modernization;

Cnp - cost of production after the implementation of a new project (lines, construction, equipment, etc.);

Iin - investment in the implementation of a new project (lines, construction, equipment, etc.);

Iim - investment in project modernization;

If **Cie** ≤ Cne, then the modernization is effective.

If **Cie** > Cne, then the new innovative project is effective.

An important indicator of the effectiveness of the investing - innovation project is the growth of value added. The calculation of value added (VAi) (investing - innovation project) is represented by the formula:

$$\boldsymbol{VAi = \Sigma i(\Sigma Ci + \Sigma Cfe)/Pr} \quad 3.6$$

where: **Σ Ci** - the amount of capital investment (financial expenses) of the innovation project (new or upgraded - equipment, raw materials, materials, construction, etc.);

Σ Cfe - the sum of all current financial expenses (salaries, taxes, depreciation, utilities, rent, social benefits, advertising, etc.);

Pr - profit from sales.

The main structures for development and implementation of innovations in the agro-industrial complex are the network of research institutes (with related research farms) National Academy of Agrarian Sciences of Ukraine and the Ministry of Agrarian Policy of Ukraine. The most common areas of development and implementation of innovations, based on research institutes and farms, are new varieties and hybrids of plants, new and improved animal breeds, strains of microorganisms, chemical preparations and fertilizers, biological preparations (vaccines, antibiotics and veterinary drugs), feed, feed additives, premixes. In addition, new technologies, new brands and modifications of agricultural machinery, new or modified organizational and economic developments (methods, recommendations, etc.) are introducing (Kotsiumbas 2013; Levytskyi 2015; Moravska *et al.* 2020). Conducting and setting up research with the development and implementation of innovations on the basis of research institutes and farms provides an opportunity to research, analyse and develop the effectiveness of implementation and calculate financial plan (Voloshchuk 2011; Yasnolob *et al.* 2019).

On the basis of the research complex of the State Scientific Research Control Institute of Veterinary Medical Products and Fodder Additives of Ministry of Agrarian Policy and Food of Ukraine, innovative developments are developed, researched and implemented (Kotsiumbas 2013). In particular, our laboratory (Control of feed quality and premixes) controls the quality of feed, feed additives and premixes, also investigates the effectiveness of introducing into the diet of animals (experiments are performed on experimental animals) innovative feed additives, feeds and premixes (Levytskyi 2015; Moravska *et al.* 2020). It gives an opportunity makes it possible to investigate the effectiveness of implementation from both biological-environmental and from an economic-financial point of view. As a result, agro-industrial enterprises can obtain a comprehensive description of a certain group of innovations that have been research institutes and research farms researched and developed, which makes it possible to analyse the feasibility of introducing innovations into the production process.

In turn, the effectiveness of entrepreneurial activity depends on the organizational and managerial apparatus, direction of work, training and retraining of personnel for new methods of work in the conditions of market relations of the agricultural sector. Namely, business leaders must taking advanced training courses with the study of new methods of personnel and enterprise management, which are focusing on the modern market economy in compliance with environmental standards and taking into account the innovation direction (Downey *et al.* 2021; Mitter *et al.* 2019; Schut *et al.* 2015).

The management staff must be able to work in the direction of the requirements of a market economy: to study the activities of competitors, monitor market products, pricing policy, develop a thorough business plan and forecast the profitability of innovation (Bondarenko *et al.* 2021; Schut *et al.* 2015**)**. In this direction are working (Bakulina *et al.* 2019; Hutsaliuk *et al.* 2020; Pogodayev 2013; Shvets *et al.* 2013), on the development of new methods, recommendations and methods, staff training and training of managers (taking into account new areas and methods), scientific-methodical and pedagogical activity is carried out on the basis of the Precarpathian Institute named of M. Hrushevsky of Interregional Academy of Personnel Management.

In particular, the results of the study show that one of the innovative and organizational forms of coordination of enterprises in Ukraine is the development of cluster formations (Bakulina *et al.* 2019). Enterprise clusters can be describing as concentrated groups of interconnected enterprises that compete or conduct joint activities. The introduction of the European model of clustering of enterprises of the agro-industrial complex of Ukraine is one of the progressive areas, characterized by a combination of competition and cooperation to benefit from the synergy effect, by combining efforts to increase production. The mechanism of cluster formation includes economic, organizational, social and environmental components, which are aiming at ensuring the effective realization of resource and labour potential, entering new markets, achieving high quality standards and increasing competitiveness (Bakulina *et al.* 2019).

Note, that the American system (antitrust law) of a free enterprise (Guide to Antitrust Laws; Fainmesser and Galeotti 2020) is similarly based on the assertion that competition is the best factor in progress, as it leads to improved product quality and price regulation. According to the American system, victory in competition is possible only by increasing production efficiency due to the introduction of innovative processes. The American business management system also provides a method of merging companies to expand and control the production process, reduce costs and insure against market fluctuations. According to this system, mergers can be horizontal (a combination of companies in one area of production), vertical (mergers of companies representing different stages in one production process) and a conglomerate (a combination of unrelated industries in one financial management structure) (Guide to Antitrust Laws).

In turn, the results of research by other scientists (Bondarenko *et al.* 2021; Kuzmenko *et al.* 2020; Shvets *et al.* 2013), were developed and substantiated the methodology of examination of the investment project, calculated the main financial and environmental indicators of the business plan, which allows to develop of the most optimal management model with risk forecasting and calculation of investment efficiency. These recommendations are aiming at environmentally oriented direction with the possibility of calculating the maximum profit at the lowest cost. We focus on the fact that obtaining a competitive result in compliance with product quality standards is possible only with the use of marketing mechanisms (Pogodayev 2013; Illiashenko 2010).

Notice, that an important aspect is the state stimulation of ecologically oriented direction of agro-industrial complex development in Ukraine (Gorb and Yasnolob 2017; Loizou *et al.* 2019; Herasymenko and Kozlovs'kyy 2017) in the form of development and implementation of relevant of regional's programs, which include specialized issues and methods of stimulation and control of agro-industrial enterprises.

Thus, the innovative mechanism of agro-ecological management should provide a multilevel process of transition of branches of agro-industrial complex of production and processing industry and logistical support based on available potential to new quality, new ecologically oriented technologies and management methods that increase competitiveness of agricultural enterprises of Ukraine. This is allows to reduce costs with increasing profits, control the market and produce products in compliance with environmental standards for the use of natural resources.

Conclusion

Summarizing the above data, we can conclude that in the current conditions of economic development of the agro-industrial complex of Ukraine there is a need to introduce of environmentally friendly innovations projects. This is a complex process - from research and development, experimental verification of scientific results to implementation in production and evaluation of efficiency, based on financial, economic, environmental, and social indicators, based on the development and improvement of management system (agro-environmental systems of management) considering environmental-oriented direction and economically and financially effective result.

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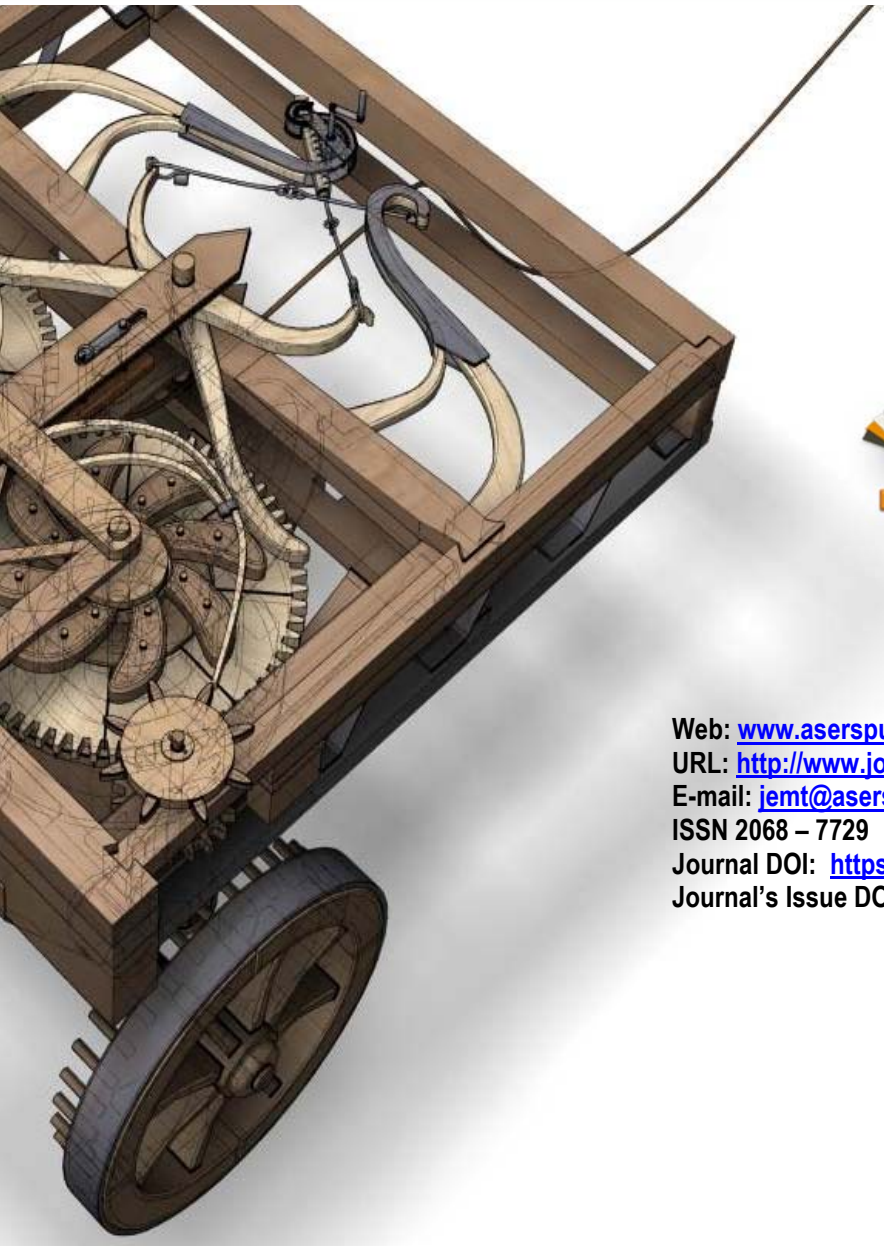

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