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Chikov I.*Ph. D. student,**Vinnitsia National Agrarian University, Ukraine;**e-mail: ilya95chikov@gmail.com; ORCID ID: 0000-0002-2128-5506***Radko V.***Doctor of Economics, Associate Professor,**National University of Life and Environmental Science of Ukraine, Kyiv, Ukraine;**e-mail: vitradko@ukr.net; ORCID ID: 0000-0002-6740-9527***Marshalok M.***Ph. D. in Economics, Associate Professor,**National University of Life and Environmental Science of Ukraine, Kyiv, Ukraine;**e-mail: marshalok.m.s@nubip.edu.ua; ORCID ID: 0000-0003-4980-1469***Tepliuk M.***Ph. D. in Economics, Associate Professor,**SHEE «Kyiv National Economic University named after Vadym Hetman», Ukraine;**e-mail: maria_6.11@kneu.edu.ua; ORCID ID: 0000-0001-6823-336X***Petrenko O.***Ph. D. in Economics, Associate Professor,**Odesa State Agrarian University, Ukraine;**e-mail: Leka_m@ukr.net; ORCID ID: 0000-0001-9722-3785***Sharko I.***Ph. D. in Economics, Associate Professor,**State Biotechnological University, Kharkiv, Ukraine;**e-mail: innashark10@gmail.com; ORCID ID: 0000-0003-3875-2323***Sitkovska A.***Ph. D. in Economics, Associate Professor,**Dnipro State Agrarian and Economic University, Ukraine;**e-mail: sitkov@i.ua; ORCID ID: 0000-0003-1892-6314*

ECONOMIC DEVELOPMENT OF AGRICULTURAL FOOD ENTERPRISES ON AN INNOVATIVE BASIS

Abstract. The agri-food sector has been and remains the basis of Ukraine's economy. Today, in the face of industrial decline and the all-encompassing process of deindustrialization of the economy, agri-food enterprises remain stable market players. Despite obstacles to development, agro-holdings have long dominated the agri-food market, accumulating significant land and financial resources. The largest companies are Kernel, UkrLandFarming, MHP, Agroposperis and Astarta-Kyiv, whose land banks exceed 200,000 hectares. These companies employ almost 75,000 workers. Agricultural holdings invest in their own development. One of the priority areas is innovative development. It is innovation that provides stability and a future for companies. The largest innovation fund is owned by Kernel, which spent \$ 2.7 million, MHP — 2.5, AP Group — 2, Astarta-Kyiv, Harveast and IC — 1, Epicentr Agro — \$ 0.42 million. Among these companies, Harveast and IC made the highest investments in innovative development per 1 hectare of agricultural land — 8.1 dollars, MHP — 6.9 \$, Kernel and AP Group — 5 \$, Astarta-Kyiv — 4 \$ and Epicentr Agro — 3.8 \$ per 1 hectare of agricultural land. However, despite these achievements, a mark of \$ 50 / ha is considered acceptable. Due to the implementation of innovative measures Astarta-Kyiv saved about 15 million dollars in 4 years, Agroposperis several times increased the efficiency of decisions made by agronomists, UkrLandFarming increased yields by a quarter. In general, according to experts, 80% of all spending on innovation is spent on computerization and automation of accounting processes, electronic document management, and protection of information from theft. Our study allowed us to analyze the work of company management in terms of areas of innovative development and to derive an indicator of integrated innovative development

by segments and individual companies. This approach can be extrapolated to small and medium-sized agri-food enterprises.

Keywords: innovation, economic development, agri-food enterprises, business process management, sustainable development.

JEL Classification D24, O12, O13, O31

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Чіков І. А.

аспірант,

Вінницький національний аграрний університет, Україна;

e-mail: ilya95chikov@gmail.com; ORCID ID: 0000-0002-2128-5506

Радько В. І.

доктор економічних наук, доцент,

Національний університет біоресурсів і природокористування України, Київ, Україна;

e-mail: vitradko@ukr.net, ORCID ID: 0000-0002-6740-9527

Маршалок М. С.

кандидат економічних наук, доцент,

Національний університет біоресурсів і природокористування України, Київ, Україна;

e-mail: marshalok.m.s@nubip.edu.ua; ORCID ID: 0000-0003-4980-1469

Теплюк М. А.

кандидат економічних наук, доцент,

ДВНЗ «Київський національний економічний університет імені Вадима Гетьмана», Україна;

e-mail: maria_6.11@kneu.edu.ua; ORCID ID: 0000-0001-6823-336X

Петренко О. П.

кандидат економічних наук, доцент,

Одеський державний аграрний університет, Україна;

e-mail: Leka_m@ukr.net; ORCID ID: 0000-0001-9722-3785

Шарко І. О.

кандидат економічних наук, доцент,

Державний біотехнологічний університет, Харків, Україна;

e-mail: innashark10@gmail.com; ORCID ID: 0000-0003-3875-2323

Сітковська А. О.

кандидат економічних наук, доцент,

Дніпровський державний аграрно-економічний університет, Україна;

e-mail: sitkov@i.ua; ORCID ID: 0000-0003-1892-6314

ЕКОНОМІЧНИЙ РОЗВИТОК ПІДПРИЄМСТВ АГРОПРОДОВОЛЬЧОЇ СФЕРИ НА ІННОВАЦІЙНІЙ ОСНОВІ

Анотація. Агропродовольча сфера була й залишається основою економіки України. На сьогодні, в умовах занепаду промисловості та всеохопюваного процесу деіндустріалізації економіки, підприємства агропродовольчої сфери залишаються стабільно функціонуючими суб'єктами ринку. Попри перепони в розвитку, тривалий час на ринку агропродовольства домінують агрохолдинги, які акумулюють значні земельні масиви і фінансові ресурси. Найбільшими компаніями є Kernel, UkrLandFarming, МНР, Agroposperis та Astarta-Київ, земельні банки яких перевищують 200 тис. га. Зазначені компанії працевлаштували майже 75 тисяч працівників. Агрохолдинги інвестують у власний розвиток. Одним із пріоритетних напрямів є інноваційний розвиток. Саме інновації забезпечують стабільність і майбутнє компаніям. Найбільшим інноваційним фондом володіють Kernel, витрати якого становили 2,7 млн дол., МНР — 2,5, АР Group — 2, Astarta-Київ, Harveast та ІМС — 1, Epicentr Agro — 0,42 млн дол. 3-поміж названих компаній на 1 га сільськогосподарських угідь найвищі інвестиції в інноваційний розвиток здійснили Harveast та ІМС — 8,1 дол., МНР — 6,9, Kernel та АР Group — 5, Astarta-Київ — 4 та Epicentr Agro — 3,8 дол. Однак, попри наведені досягнення, прийнятним вважається відмітка у 50 дол./га. За

рахунок реалізації інноваційних заходів Astarta-Kyiv зекономила близько 15 млн дол. за чотири роки, Agroprosperis — зростання ефективності ухвалених рішень агрономами в декілька разів, UkrLandFarming — підвищити урожайність на чверть. У цілому ж, за даними фахівців, 80 % усіх витрат на інновації спрямовуються на комп'ютеризацію та автоматизацію облікових процесів, ведення електронного документообігу, забезпечення захисту інформації від крадіжок. Проведене нами дослідження дало змогу проаналізувати роботу менеджменту компаній у розрізі напрямів інноваційного розвитку і вивести показник комплексного інноваційного розвитку за сегментами та окремими компаніями. Цей підхід може бути екстрапольований на малі та середні підприємства агропродовольчої сфери.

Ключові слова: інновації, економічний розвиток, підприємства агропродовольчої сфери, управління бізнес-процесами, стійкий розвиток.

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Introduction. Agriculture and related food businesses remain one of the main drivers of any country's economic development, especially in the context of a comprehensive process of economic deindustrialization. Today agri-food enterprises provide the population of Ukraine with foodstuffs, labor for the countryside population, and pay taxes to the budget. The increase in the effectiveness of economic activity occurs against the background of an effective mechanism for using available and borrowed financial resources. Despite the lack of state support, companies are implementing the latest advances in science and technology in their daily activities.

Literature review and problem statement. The issue of innovative development of agri-food enterprises includes the disclosure of such aspects as factors of innovative development [1], features of innovation [2], principles of state innovation policy [3], prospects of innovation development [4], socio-economic mechanism of innovation development [5; 6], risks of innovative development [7], strategies of sustainable development [8], etc.

The transformation of agriculture is influenced by the following factors [9; 10]:

- instability of food supply and its shortage in the world;
- the introduction of computerization and automation of production processes frees and relocates a large number of people employed in agriculture;
- improper control of the level of food security;
- negative impact on the environment;
- the functioning of trade intermediaries (traders) in the market reduces the competitiveness and economic efficiency of enterprises, etc.

It is in this area that innovations should be stimulated by the state and introduced in the activities of agri-food enterprises.

At the same time, there is a huge innovation gap between the economic development of small and large agricultural enterprises (agricultural holdings), due to both the scale of operation and financial opportunities in favor of the latter [11].

The spread of innovation in the agri-food sector requires the transformation of wildlife, conservation of biodiversity, ensuring the reduction of environmental pollution and food security with possible discussions and debates in the scientific community.

The purpose of the study. The aim of the article is to study the complex impact of innovations on the economic development of agri-food enterprises.

Methodology research. For the purposes of the research, we used the scientific achievements of well-known domestic and foreign scientists and specialists focusing on a narrow segment of research and those who consider innovation more broadly as one of the elements of economic stability of the enterprise. For the purposes of analysis and synthesis, technical and economic calculations and evaluation of enterprises using official statistics and data from the flagship companies were used.

Research results. The concept of innovative development is quite common in science. We understand it as a system of measures aimed at introducing new products for the agri-food enterprise, technologies, solutions, etc., which were not previously involved in its direct activities.

It is necessary to distinguish this form of innovative development from the common opinion about the diffusion of innovations in the economy or industry, and as a consequence, their automatic transfer to enterprises, the so-called innovations. Therefore, the development or acquisition and realization or implementation of innovations in the enterprise is the first evidence of changes in its technological structure, updating the material and technical base, the use of the latest advances in selection and genetic engineering and so on.

Agro-food enterprises accumulate huge agricultural lands, influencing the social sphere of rural settlements, providing work to village population, improving tillage technology, introducing their own or purchased plant and animal varieties into agricultural activities, building production and logistics infrastructure, etc. (Table 1).

Table 1

**Main indicators of functioning of the largest agricultural holdings in Ukraine
(as of the beginning of 2020)**

Name	Land Bank, thousand hectares	Number of employees, men	Product storage capacity, thousand tons	Revenue, million dollars USA	Net income, million dollars USA	The main activity
Kernel	524	12807	2500	3992	178.5	sunflower oil, cereals, corn
UkrLandFarming	500	20000	2700	n.d.	n.d.	eggs, cereals, livestock
MHP	380	28500	1100	2056	215.3	chicken, meat processing, cereals
Agroprosperis	300	3328	520	476*	18.8*	wheat, corn, sunflower
Astarta-Kyiv	240	10000	550	499.7	1.9	sugar, wheat, corn
Continental Farmers Group	195	2400	387	n.d.	n.d.	potatoes, seeds, cereals
Epicentr Agro	160	2765	1000	1640	130	seeds, cereals, oilseeds
Harveast	132	1800	74	n.d.	n.d.	seeds, milk, compound feeds
IMC	123	2100	554	169.6	7.3	cereals, oilseeds, milk

* Calculated on the basis of: <https://www.agroprosperis.com/reporting.html>.

Source: compiled on the basis of: <https://bakertilly.ua/news/id49433>.

As it can be seen, not all companies provide public financial statements for various stakeholder groups (UkrLandFarming, Continental Farmers Group, Harveast). At the same time, almost 67% of these agricultural holdings submit financial statements of major or their integrated companies. Despite the constant transformations and turbulence of the economic environment, agricultural companies are demonstrating the profitability of doing business. Part of the costs incurred include the costs of innovations, novations, modernization and other business processes.

In [12] the authors propose to use two types of innovations (to increase productivity and minimize production risks) in the areas of selection and breeding and farming practices. However, this approach is somewhat narrow and may not fully cover all issues related to the operation of agricultural enterprises.

Researchers [13] propose the following management decisions for innovative development of agri-food enterprises, namely: focus on small farms, direct communication between seller and buyer, environmental innovation and alternative sources of financing for agriculture. Through the implementation of this system small and medium-sized enterprises that do not belong to agricultural holdings develop, and thus provide farmers with self-employment, food and basic or additional income from the sale of all or residual products.

In the conditions of large-scale agricultural production, the dominance of agricultural holdings is undeniable. This thesis is confirmed by the colossal capital investments in the innovative development of agricultural holdings and their large-scale utilization in various areas of business (Table 2).

Table 2

Innovative directions of development of agricultural holdings in Ukraine

Name	Directions of innovative development											Comprehensive innovation development, %
	Breeding in crop production / animal husbandry	Compound feeds	Irrigation	Logistics, trade and infrastructure	Product processing	Vertical integration and business diversification	Preservation of the environment	Support for local communities	Research and development	Technical and technological changes	Smart technologies and digitalization	
Kernel	+	+		+	+	+	+	+	+	+	+	91
UkrLandFarming	+ / +	+	+	+	+	+	+	+	+	+	+	100
MHP	+	+		+	+	+	+	+	+	+	+	91
Agroprosperis				+		+	+	+	+	+	+	64
Astarta-Kyiv	+	+		+	+	+	+	+	+	+	+	100
Continental Farmers Group	+	+		+	+	+	+		+	+		82
Epicentr Agro	+	+		+		+	+	+	+	+	+	82
Harveast	+	+	+	+	+	+	+	+	+	+	+	100
IMC		+		+	+	+	+	+	+	+	+	82
Comprehensive innovation development, %	78	89	22	100	78	100	100	100	89	100	100	

Source: authors' own research.

The most common areas of innovation are: logistics, trade and infrastructure (100% of companies) provide construction and operation of paved roads, line and port elevators, etc.; vertical integration and diversification of business (100%) helps to expand the scale of doing business, build or purchase processing facilities, etc.; environmental protection (100%) provides an attitude of care towards land, water resources, biodiversity, reducing the amount of applied plant protection agents, toxic chemicals, pesticides, etc.; support of local communities (100%) provides an opportunity to support existing and develop new infrastructure of settlements, social support, culture, sports, medicine, etc.; technical and technological changes (100%) introduce new types of techniques and technologies of tillage, production, keeping animals and poultry, differentiated application of fertilizers and seeds, etc.; smart technologies and digitalization (100%) increase the efficiency of general business processes (Big Data, drones, satellite monitoring technologies, automation of accounting processes, etc.). Many companies (89%) have in their structure a livestock system that requires the cultivation and production of feed, which significantly reduces the cost of production. Selection and livestock breeding processes are used by 78% of these companies, providing not only their own production processes, but also selling their products on the market. Product processing (78%) provides agricultural holdings with additional value, which is used for self-financing of business. Research and development (89%) realize the potential of enterprises in creating new laboratories, patenting inventions and developments, granting or obtaining licenses, franchising and so on.

The most innovative agricultural holdings in Ukraine are considered Kernel, AP Group, MHP, Astarta-Kyiv, IC, Harvest and Epicentr Agro [14] (Fig. 1 and 2).

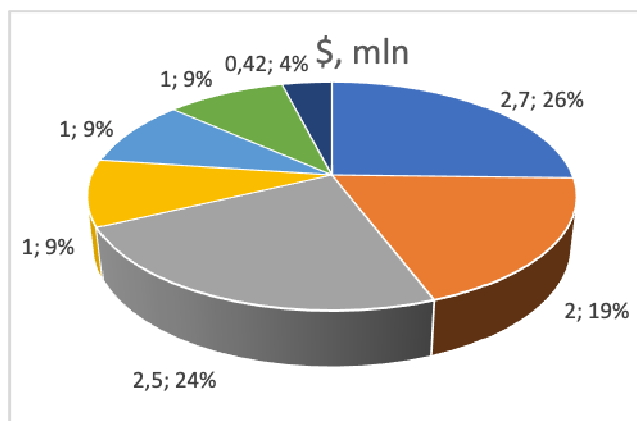


Fig. 1. Expenditure on innovation, \$ million

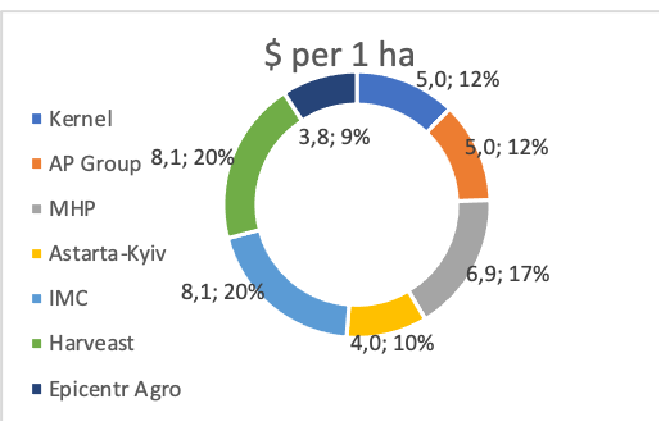


Fig. 2. Cost of innovation, \$ per 1 ha

The efficiency and tangibility of the return on innovation costs is manifested when at least \$ 50 per 1 ha is spent [14]. At the same time, the highest level of investment does not exceed 16.3% of this value.

A similar study was conducted by Delo.ua [15]. The choice was based on the economic component — the annual turnover (over \$ 4.2 million). The companies that improved an existing product or developed a new product, service or technology were next on the list. Important attention was paid to innovations in business process management (production, management, finance, sales and logistics). MHP, Kernel, Nibulon, Astarta-Kyiv and IMC were the winners.

Among these companies, Astarta-Kyiv managed to save about \$ 15 million using a system of GPS surveillance and monitoring of fuel use. This value exceeds the company's annual innovation fund by \$ 3.75 million, which indicates the importance of innovative solutions in the management of the company's business processes. Another agroholding — Agroprosperis — developed its own software AP Agronomist in 2015. Using tablets, agronomists were able to compare past and current usage indicators of mineral fertilizers, plant protection agents, pesticides, fuel consumption and so on. Due to this innovation, the efficiency of these specialists has increased several times. Using the system of precision farming, UkrLandFarming specialists achieved a quarter increase in yield [14]. At the same time, 80% of all investments in innovation in the agricultural sector are directed to accounting, document management and anti-theft solutions [14]. Although the volume of investment is quite significant, the innovative development of domestic agricultural holdings is still far from the world's leading competitors.

The 2030 agenda clearly mentions innovation as the most important means of implementation, recognizing their role in accelerating the achievement of the SDG, which requires [16]:

- strengthening cooperation and knowledge exchange to improve access to technology and innovation;
- emphasizes the urgency of development, transfer and dissemination of environmentally friendly technologies; and
- points to the need to create capacity development mechanisms for the least developed countries.

We are deeply convinced that the innovative development of agri-food enterprises should take place in the following areas:

- organic agriculture and production of safe food [17; 18];
- reduction of the use of mineral fertilizers above the norm, pesticides, toxic chemicals and other plant and animal protection agents;
- introduction of digital technologies, GPS-navigation and production automation processes aimed at increasing productivity, reducing costs and losses of material, technical and financial resources;

- introduction of low-waste and non-waste production technologies, reuse of production waste [19; 20];
- use of zero tillage technology (with a transitional stage — minimal tillage). Today, about 7% of all fields in the world are cultivated using No-till technology. This technology gives a tangible economic effect (costs are reduced by an average of 12%, equipment — 1.5 times, wages — 1.6, fuel — 2.2 times, yields increase 3—5 times), includes agricultural protection measures (reduction of water and wind erosion) [21]. According to Goldman Sachs, the total global market for precision farming technologies is \$ 240 billion [22]. The system of precision agriculture in Ukraine is used by about 30% of large agricultural companies;
- construction of a closed production cycle based on the use of processes of vertical integration, diversification and acquisition and absorption of enterprises of related sectors of the economy, etc.

In particular, agriculture is involved in a number of goals to be achieved by 2030 in a very significant (and safe) way: reduction of pesticides by 50%, reduction of fertilizers by 20%, sales of antimicrobials for livestock by 50% and aquaculture, achieving no less than 25% of agricultural land by organic farming, conversion of at least 10% of agricultural land into areas with high biodiversity and protection of at least 30% of rural and marine areas [23—25].

Conclusions. Despite the general economic situation in Ukraine, the agri-food sector remains one of the dominant industries. Progressive development in the direction of increasing land areas and assets of agricultural companies has led to the phenomenon of agricultural holdings. The latter dominate in agriculture and introduce the latest and most up-to-date management solutions, technologies, equipment, digitalization of business processes in everyday activities.

The study allowed us to divide and disseminate the conclusions of integrated innovation development in two directions: innovative development of the industry and separate development of agricultural holdings. Of course, the author's vision above can be used to analyze the functioning of large agricultural companies and may not coincide with the trends of innovative development of small and medium-sized agri-food enterprises. However, we consider it possible to extrapolate the analysis data to the majority of agri-food market participants.

These facts and analysis have shown the high efficiency of implemented innovative solutions within many agricultural holdings. Creating our own software, implementing GPS navigation, precision farming systems, the latest advances in digitalization have significantly increased productivity, crop yields and animal productivity, reduced costs and losses of material, technical and financial resources, which several times increased business process management.

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