

***ECONOMIC AND LEGAL PRINCIPLES OF
ECONOMIC GROWTH IN THE POST-CRISIS
PERIOD***

Monograph

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5) the method should focus more on cash flows than on balance sheet profit.

Although all of the above methods have certain advantages and disadvantages, analysts often prefer the IRR criterion, as they consider more reasonable decisions made on the basis of analysis of relative rather than absolute indicators. Another advantage of the IRR criterion is that you do not need to know the cost of capital if you use it. On the contrary, the value of the IRR makes it possible to estimate the minimum financing costs at which the project will be profitable.

Given the known cost of financing, the application of the IRR method also yields a corresponding result, as it allows to estimate the "profitability reserve", i.e. how much the profitability of the project exceeds the cost of financing.

The use of different methods of investment valuation often leads to opposite results. An investment project acceptable under one criterion may be non-profit or unprofitable under another criterion. Therefore, to obtain a reasonable and largely reliable assessment of the economic efficiency of the investment project, it is advisable to use a set of the above methods, supplementing them with other formalized and informal criteria.

3.2 Innovation processes in the agricultural sector: the current state and specifics

The most important task of agriculture is the production of competitive products, which is possible only with the use of scientific and technological progress, based on innovative processes that allow constant renewal of agricultural production. Thus, using and implementing innovative developments, the agricultural enterprise reduces costs, increases production, profits, conquers markets, facilitates economic efficiency and development of the national economy. Within the framework of the agro-industrial complex innovations represent the introduction of research and development into economic practice in the form of new varieties of plants, breeds and species of animals and crosses for birds, food, materials, plant technology, animal husbandry and processing industry, fertilizers and plant and animal protection, methods of prevention and treatment of animals and birds, forms of organization, financing and crediting of production, approaches to training, retraining and advanced training of personnel, forms of organization and management of various sectors of the economy, approaches to social services to increase production efficiency.

Recently, terms such as 'innovation' and 'innovative development' are often used in conversation. At the same time, the agro-industrial complex is experiencing a huge innovation crisis, which is due to the insufficient development of scientific and technical direction in the field of agriculture. If we compare the use of Ukraine's innovation potential with the world's leading countries, it is used only 5-6%, while in the US this figure is about 50%. Every year about 40-50% of agricultural scientific and technical achievements and developments remain

unclaimed¹.

Stimulating innovative development will increase domestic and external demand for goods and services produced using green technologies. Accordingly, Ukraine will receive a real opportunity to transform industrial production and export structure, with a greater focus on high value-added goods, using its absolute and relative advantages in the development of "clean" technologies and mastering new niches in world markets².

Changes in the external systems of enterprises lead to the need for inside changes. This leads to the application of innovative solutions in the enterprise. It can be said that innovations exist at the heart of organizations operating in today's fast-paced business world. Although innovation is critical to an organization's success, scientists and entrepreneurs alike agree that the innovation process is complex and difficult to manage. Recent research shows that most innovative firms are not primary innovators who develop innovations themselves, but are secondary innovators who derive value from technologies developed by the primary innovators.

In the agricultural sector, in contrast to other areas of the economy, the development of innovation occurs more slowly, which requires special attention and the search for additional incentives. It is extremely important during the development and implementation of innovation strategies to identify sources of innovation in the agricultural sector, their classification and tools³.

Consideration of the characteristics of the agricultural sector is closely related to the possibility of applying certain innovations. In agriculture, innovation processes have a number of features that follow from the specifics of agricultural production:

- species diversity of agricultural products;
- intertwining of technological processes with processes occurring in the natural environment, participation in the production of living organisms (plants, animals, microorganisms);
- significant differences in agricultural production technologies, their dependence on unpredictable weather and climatic conditions;
- seasonality of production processes of certain types of agricultural products;
- territorial fragmentation of agricultural production;

¹ Altukhov A.I. Innovative way of agriculture development as the foundation to improve its competitiveness/ *Vestnik OrelGAU*. 2008. №6. pp. 4-6. URL: <https://cyberleninka.ru/article/n/innovatsionnyy-put-razvitiya-selskogo-hozyaystva-kak-osnova-povysheniya-ego-konkurentosposobnosti> (accessed: 28.10.2021).

² Honcharuk I., Babyna O. Conceptual principles of improvement of innovation and investment activity for development of energy production from alternative gears. *Colloquium-journal*. 2020. № 17 (69). Vol. 2. pp. 47-55.

³ Larina Ya., Al-Shaban Alaa Tabit Niama. Classification of innovations in the agricultural sector as a precondition of forming marketing strategies of innovative development of agricultural enterprises. *Bioeconomics and Agrarian Business*. 2019. Vol. 10(1). pp.58-67. <http://doi.org/10.31548/bioeconomy2019.01.058>.

- relative isolation of different types of agricultural producers by forms of ownership, specialization, size, integration and cooperation;
- weak relations between agricultural producers and organizations producing scientific and technical products;
- insufficient activity of innovations in agriculture due to the lack of effective demand for scientific, technical and high-tech products;
- potential consumers of innovations in agriculture, as a rule, do not have enough own funds and are characterized by low creditworthiness of attracting credit and investment resources, as a result of which innovation processes in agriculture are impossible without state participation and effective state support;
- low standard of living in the countryside;
- insufficient qualification of agricultural workers in the field of innovation management;
- a variety of scientific and technical developments proposed for use in the agricultural sector, their target areas;
- a long process of developing innovations, primarily in connection with selection and selection work;
- insufficient elaboration of the organizational and economic mechanism for transferring the achievements of scientific and technological progress to farmers;
- innovations are usually improved, rather than radical¹.

The development of the agricultural sector of the economy in modern conditions is influenced by a number of factors, the level of influence of most of which changes according to the change in the type of management system. The strategic vector of development of modern agricultural enterprises is the convergence with the new order of management at the current stage of evolution of the world economy, characterized by the transition to a post-industrial society. The level of effectiveness of traditional principles and methods of management is gradually declining, because until now the management system of the agricultural sector did not provide for the management of such a specific resource as knowledge. All this necessitates the construction of a new paradigm of agricultural enterprise management, based on the active formation, use and management of intellectual resources in order to accumulate intellectual capital and, consequently, achieve the planned results in the form of excess profits, increase value added, expand market segment, increase customer loyalty, etc.

The issues of formation and development of intellectual capital in the agricultural sector are becoming relevant in connection with the objective trends of intellectualization of relations in all sectors of the economy. Effective use of intellectual capital of the agricultural sector is possible provided the creation of an institutional basis for the production, transfer and dissemination of knowledge, which is currently the basis for the formation of sustainable competitive advantages of economic entities. As noted by L. Kurylo, «the strategic prospect of

¹ Bill & Melinda Gates Foundation. URL: <https://www.gatesfoundation.org>. (accessed: 28.10.2021).

a scientific and practical solution to this problem lies in the formation of a resource-saving, environmentally friendly, science-intensive sector of the economy capable for ensuring the competitiveness of products in the domestic and foreign markets, which is impossible without addressing the development of agricultural science, education, and the formation of functional institutions of scientific and innovative activity»¹.

Taking into account the fact that the agricultural sector is currently the locomotive of the domestic economy, the priority is to ensure its sustainable development, which would consider the economic, social and environmental components. The statement about the lack of intellectual capital in the agricultural sector is erroneous. Modern agricultural entrepreneurship is not just the cultivation of land for the purpose of making a profit, but a complex multidimensional concept that reflects economic, environmental, social activities aimed at meeting the needs of consumers in high-quality agricultural products, ensuring optimal working conditions for the expanded reproduction of the human potential of agricultural workers, formation of a high level of food security of the state, development of the newest technical and technological environment for the functioning of agricultural enterprises to ensure sustainable competitive advantages.

The essence of modern agrarian entrepreneurship cannot be limited by the concept of land and classical factors of production. Agricultural production must contain advanced technologies and quality standards that require greater human participation than ever before and, in particular, its knowledge, experience, skills and competencies. Today, the agricultural sector has a relatively low level of domestic scientific research and technical development, but it can be argued that this is one of the most knowledge-intensive sectors of the economy as a whole. Despite the existing obstacles to the automation of agricultural production caused by the specifics of the activity, innovative progress naturally affects agricultural entrepreneurship, forming changes in the understanding of the concepts of both agricultural production and agricultural entrepreneurship in general.

For the domestic economy, the transition from the industrial type to the "knowledge economy" opens up opportunities to change the image from a "raw material appendage to an innovation-oriented economy." It is worth agreeing that the scientific substantiation of concepts and practical implementation of measures to ensure the transition of the agricultural sector to an innovative model is a call of the time, a kind of challenge for workers in the industry and the state, but objectively necessary².

Given the specifics of the industry, the analysis of the factors of formation of intellectual capital of the agricultural sector should begin with an assessment of natural resource potential. Ukraine has a strong natural resource potential due to its

¹ Kurylo L.I. Formaiton of intellectual capital in the agrarian sphere: theoretical aspect. *Ekonomika APK*. 2014. № 8. Pp. 5 -12. URL: http://nbuv.gov.ua/UJRN/E_apk_2014_8_3

² Kaletnik G.M. Educational research and production center as a concept of a mechanism for transfer of agrarian production to innovative model of development. *Ekonomika APK*. 2013. № 9. Pp. 5-11. URL: http://nbuv.gov.ua/UJRN/E_apk_2013_9_3.

favorable geographical location, favorable and diverse climatic conditions, which provide the opportunity to produce high quality agricultural products, ensure food security, positioning the country in the world food market.

The agricultural sector of Ukraine generates more than 10% of gross value added in the country. More than 3 million people, or one-sixth of the total employed population, work in the agricultural sector of the economy. There are more than 75 thousand business entities. The products of the agro-industrial complex and the food industry form more than 40% of exports – more than 22 billion \$ in 2019, and 12.9 billion UAH are crop products (Fig. 1).



Figure 1 – Dynamics of the share of agriculture in the GDP of Ukraine

Source: formed by the authors on the basis^{1,2}

Occupying such an important position in the economic and food security of the state, it is necessary and appropriate to study the factors that will contribute to the development of agriculture not through quantitative indicators, but qualitative. Such a study will facilitate the search for and effective use of the significant economic potential of the agricultural sector on the basis of sustainable development. It is particularly important that agriculture can significantly contribute to economic growth in normal times and serve as the employer of last resort during the crisis.

The need for continuous development of the agricultural sector is confirmed historically. It is known that in the early 1900s, the average farmer in the United

¹ Official site of the State Statistics Service of Ukraine. URL: <http://www.ukrstat.gov.ua> (accessed: 28.10.2021)

² Economic stimulus program to overcome the consequences of COVID-19. Economic recovery. URL: <https://www.kmu.gov.ua/storage/app/sites/1/18%20-%20Department/18%20-%20PDF/07.2020/programa.pdf> (accessed: 28.10.2021)

States produced enough food to feed a family of five. Many modern farmers can feed such family and hundreds of other people. How did this big jump in productivity happen? This is largely due to scientific advances and the development of new power sources. Tractors replaced draft animals and steam engines. Farmers began to use various methods to protect their crops from pests and diseases. They applied grass-based poisons to crops, selected insects from plants, grew resistant varieties of crops, and alternated crops to control insects¹. In other words, the development of agriculture has always begun with a person's search for something new or improvement of existing ones.

Currently, as a result of agrarian transformations in Ukraine, a dual structure of agrarian management has been formed, where the individual sector plays a special role in ensuring the sustainable development of agriculture. In contrast to the corporate sector, agricultural productions here is conditioned by the primary need for self-sufficiency in food for peasant farms. In the corporate sector, the desire to maximize profits has led to disparities in the structure of agricultural production, including crop products (Fig. 2), which in turn contradicts the principles of sustainable development².

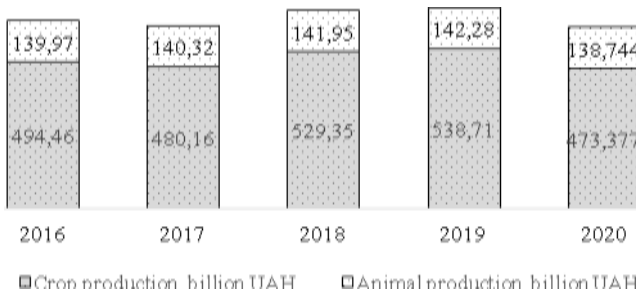


Figure 2 – Dynamics of the volume and structure of agricultural production in Ukraine, billion UAH (at constant prices in 2016)

Source: formed by the authors according to the State Statistics Service of Ukraine³

At the same time, scientists note that the main cause of soil degradation is not the climate and adverse external conditions, but human economic activity. The anthropogenic load on the environment in Ukraine is several times higher than the corresponding indicators of the developed countries of the world, and the state of land resources is rapidly approaching the critical level. The main reason for the decrease in soil fertility is a violation of agricultural laws. The transformation of

¹ Folnovic T. The Development of Agriculture URL: <http://blog.agrivi.com/post/the-development-of-agriculture> (accessed: 28.10.2021)

² Fraier O.V. Tendencies in crop production and sustainable agricultural development in Ukraine – opportunities for harmonization. *Ekonomika APK*. 2018. № 10. Pp. 117-125.

³ Official site of the State Statistics Service of Ukraine. URL: <http://www.ukrstat.gov.ua> (accessed: 28.10.2021).

soils, i.e. increase or deterioration of their fertility, depends on human economic activity the most. Analysis of operational and statistical reporting shows that most land users do not take any measures aimed at preserving soils and increasing their fertility.

The main reasons for the decrease in agronomically important properties of the soil are insufficient application of organic and mineral fertilizers, water and wind erosion, compaction by powerful heavy machinery. On the territory of Ukraine there are 57.5% of agricultural lands that are subject to erosion and these processes continue. The tendency towards to decrease the humus content in soils is observed in 13 oblasts. Nutrient balance is negative. Science-based nutrient ratios are not being followed. The use of nitrogen fertilizers in the total amount of mineral fertilizers applied for agricultural crops reaches almost 70%. This determines the formation of crop yields due to loss of soil fertility¹.

Agricultural yields are relatively low and are particularly variable with respect to wheat and feed grains. These indicators are lower than in Western Europe and are estimated to be at 40% of potential. This situation may be due to lack of technology and knowledge, inefficient use of water resources, soil degradation, as well as insufficient use of fertilizers and plant protection products. Fertilizer application has increased over the last ten years, but remains at a significantly lower level than the EU average. The increase in grain production is driven more by the expansion of arable land and economies of scale than by increased yields.

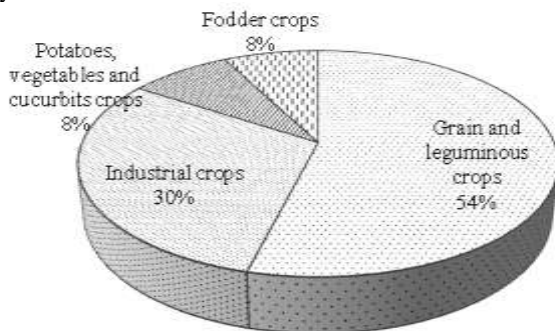


Figure 3 – Sown area under of agricultural crops, Vinnytsia region, 2020

Source: formed by the authors based on ²

The Vinnytsia region has been holding the leading position in the agriculture of the state in terms of the volume of gross agricultural output and the production

¹ Results of scientific research prepared on the basis of materials of the X round (2011–2015) of agrochemical survey of agricultural lands. URL: <http://www.iogu.gov.ua/wp-content/uploads/2013/07/2> (accessed: 28.10.2021)

² Main Department of Statistics in Vinnytsia Region. URL: www.vn.ukrstat.gov.ua (accessed 02.01.2021)

of gross agricultural output per person for a long time. Most of the territory 77.9% of the total area of the region is occupied by agricultural land, of which: agricultural land 2014.2 thousand hectares (76.0% of the total area), including arable land 1725.5 thousand hectares (65.13% of the total area), fallow 1.0 thousand hectares (0.04%), perennial plantations 51.4 thousand hectares (1.94%), hayfields and pastures 263.3 thousand hectares (8.92 %).

The number of enterprises operating in 2020 in the field of agriculture in Vinnytsia region was 2,843 units. More than half of the sown area under agricultural crops is occupied by cereals and legumes (54%), a third – industrial crops (Fig. 3) The share of crop production to the total was 75% in 2018, 69% in 2019 and 63% in 2020.

Demonstrating national trends, the largest share in the structure of value added of the agricultural sector of the region is the cultivation of cereals (except rice), legumes and oilseeds (Table 1).

Table 1 – Value added at production costs of enterprises of Vinnytsia region in 2012-2018, UAH billion

Years	Agriculture, forestry and fisheries, UAH billion	including, %		
		cultivation of cereals (except rice), legumes and oilseeds	growing perennial crops	animal husbandry
2012	74,41	65,72	3,44	18,1
2013	69,67	63,84	4,33	18,31
2014	125,46	75,48	2,81	13,62
2015	183,87	80,97	1,33	10,44
2016	186,93	81,67	1,19	9,4
2017	195,45	76,26	1,99	11,38
2018	201,94	77,55	1,35	10,56

Source: formed by the authors based on¹

Growing perennial crops forms only 1.35% of value added. The livestock industry generates only about 10% of gross value added. Despite the remarkable potential for the development of animal husbandry (favorable climatic conditions, land, labor resources), the industry is in a very difficult situation and needs even more effective state protection.

All large agricultural enterprises of the region in 2019 received a profit totaling UAH 78.8 million. More than 87% of medium and small enterprises received a financial result in the form of profit. The level of profitability of operating activities of enterprises was 10.5%.

The low level of innovative development, technical and technological equipment of Ukrainian industry causes a decrease in production efficiency, extensive economic development, in which GDP growth is achieved mainly due to quantitative increase in factors of production (i.e. resources) with an almost unchanged technological base. It is obvious that ensuring the recovery of the domestic economy is possible precisely by intensifying the reproduction of its innovative potential. However, in Ukraine, large-scale investments in R&D, technical and technological modernization of fixed capital in agriculture are made

only by a limited number of large and highly profitable enterprises. For most domestic agricultural producers, innovative methods and means of management are little known and virtually unavailable. According to the Ukrainian Club of Agrarian Business, agricultural enterprises must spend at least 50 US\$ per 1 ha for innovation. Such costs are still unattainable for Ukrainian business, but some agricultural holdings report increasing the efficiency of their enterprises through the introduction of new technologies, investing in innovations at the rate of \$ 5-7 US\$ per hectare. In addition, 80% of all investments in innovation in the agricultural sector are directed to accounting, document management and anti-theft solutions¹.

Table 2 – Financial results before taxation of enterprises of Vinnytsia region for 2019, thousand UAH

Company size	Financial result (balance)	Profit-making enterprises		Profit-making enterprises	
		Loss-making enterprises	Loss-making enterprises	Loss-making enterprises	Loss-making enterprises
		in % to the total number of enterprises	financial result	in % to the total number of enterprises	financial result
large	78883	100	78883	–	–
medium	1754090,9	87,2	2055692,4	12,8	301601,5
small	1901698,7	87,7	2180594,7	12,3	278896
including microenterprises	777408,9	88,1	901446,1	11,9	124037,2

*Source: formed by the authors based on*²

An example of how innovation affects the efficiency of agricultural activities is the experience of the Netherlands, which for many years has researched and implemented modern methods of farming. Expenditures on research and development of Dutch companies with more than 10 employees increased by almost 11%. As a result, in 2019, the Netherlands was the second largest exporter of agri-food products in the world after the United States. Exports were estimated at 92 billion euros. According to statistics, the most profitable export sectors for the Netherlands are ornamental plants and flowers (5.8 billion euros), dairy products and eggs (4.3 billion euros), meat (4.0 billion euros) and vegetables (3.5 billion euros)³.

The main results of the application of innovations of large domestic enterprises: the group of companies Ukrlandfarming reports an increase in yield by 25% due to the use of precision farming. The Agroprosperis group of companies reports that the efficiency of work has increased several times after they bought

¹ Which Ukrainian agricultural holdings spend the most on smart technologies? URL: <https://agrorereview.com/news/hto-z-ukrayinskyh-ahroholdynhiv-najbilshe-vytrachaye-na-rozumni-tehnolohiyi?page=1> (accessed: 28.10.2021)

² Main Department of Statistics in Vinnytsia Region. URL: www.vn.ukrstat.gov.ua (accessed 02.01.2021)

³ Farming for the future: why the Netherlands is the 2nd largest food exporter in the world. URL: <https://dutchreview.com/news/innovation/second-largest-agriculture-exporter> (accessed: 28.10.2021)

tablets for agronomists with special programs and an interactive database that allows them to make logistics decisions quickly. Kernel Holding Company is implementing a digital platform project for automatic planning of production processes, monitoring of their implementation, as well as the development of mobile applications for work in the field of agronomists and engineers. Astarta agro-industrial holding saved \$ 15 million in 4 years. USA thanks to the system of GPS-surveillance and monitoring of fuel use (more than an annual amount of investment in innovation of the seven largest agricultural holdings in the country). It also plans to launch a mobile platform to monitor the condition of crops, their development and growth phase, the presence of insects and pests, which will select fertilizers, plant protection products, etc.¹.

During 2010-2018, the volume of capital investments in agriculture showed an upward trend: from UAH 11.57 billion in 2010 to UAH 66.1 billion in 2018. However, in 2020 their volume decreased to less than UAH 50.7 billion (Fig. 4).

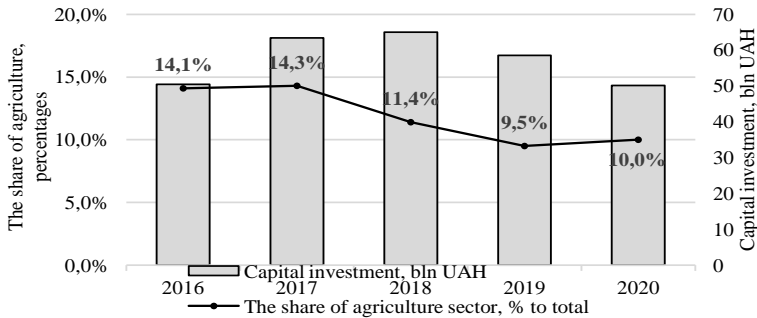


Figure 4 – Dynamics of volume and share of capital investments in agriculture, UAH billion

Source: formed by the authors on the basis of data from the State Statistical Service of Ukraine²

One of the most important reasons for the decline in investment was unfavorable agricultural policy, reduced budget support for producers, narrowing investment opportunities and unacceptable investment risks for potential investors. In the structure of capital investments by type of economic activity, the share of investments in the agricultural sector varied between 6.1-14.3% during 2010-2017, while starting from 2018 the share of such investments began to decrease and at

¹ TOP-7 agricultural companies that spend the most on innovation. URL: <https://landlord.ua/news/top-7-ahrokompanii-i-aki-naibilshhe-vytrachaiut-na-innovatsii> (accessed: 28.10.2021).

² Official site of the State Statistics Service of Ukraine. URL: <http://www.ukrstat.gov.ua> (accessed: 28.10.2021).

the end of 2019 reached 9.5 %. Having considered the sources of financing for capital investments, it becomes clear that the direct owners of the business are most interested in this. More than 90.8% of all investments are own funds of enterprises and organizations, 8.5% are bank loans and borrowings. The state's share is 0.43%¹.

It is important that the current state of technical support of agricultural enterprises has approached a critical limit, since 85-90% of the remaining technical means have worked out their normative resource. Due to deterioration and technical malfunction up to 25% of agricultural machinery is not used. In general, farmers are provided with mechanization by 50-60% of the technological needs. As a result of reducing the number of equipment and reducing the level of its technical readiness led to an increase in the load on technical means by 1.5-2 times, which significantly extends the time of agro-technical work and causes crop losses².

Innovative development of the agricultural sector is impossible without sufficient financial support. Public investment in R&D is an important policy lever to support long-term productivity growth in the sector. In most high-income countries, agriculture provides a higher percentage of public spending on research than the share of agriculture in the economy, both at the national and aggregate levels.

An analysis of the actual structure and dynamics of the movement of the existing main types of equipment in agricultural enterprises of Ukraine indicates a tendency for their reduction in recent years (Table 3) both due to lack of sufficient financial resources for renewal and due to the significant use of funds of outdated models with significant physical and moral deterioration.

Economic research shows that investment in agricultural R&D and the use of industrial resources in agriculture were key factors in the successful transition from resource-dependent to growth in agricultural production in the second half of the 20th century. Public investment in agricultural R&D, along with the spread of technology from other countries and the private sector, are important sources of new technologies that promote agricultural innovation. Farmer education, liberalized trade and changes in the agricultural structure also contribute to increasing the efficiency and productivity of agriculture.

Historically, most research in the field of food and agriculture has been carried out by universities and government agencies. But in 2011, an average of 52.5% of research on crop selection, computer science, fertilizers, pesticides and food technology in many countries is carried out by private firms (in 1980 this figure was 42%). For middle-income countries, the share of private domestic

¹ Kaletnik G. Kolomiets T. Efficiency increasing of agricultural enterprises on the basis of formation and use of intellectual capital. *Economy, finances, management: Topical issues of science and practical activity*. 2020. № 4. pp. 7-19.

² Shlapak M.A. Development of associative forms of use of agricultural machinery: dissertation Cand. Econ. Science: 08.00.04; Zhytomyr National Agroecological University. Zhytomyr, 2019.

spending was 37% in 2011 (compared with 19% in 1980)¹.

Table 3 – Dynamics of the main types of agricultural machinery in agricultural enterprises in 2010-2019, pcs.

	2010	2015	2016	2017	2018	2019	2019 p. to 2010 p., %
Tractors	151287	127852	132686	129272	128727	130529	-13,72
Trucks and trucks	104307	83567	85417	81158	78054	78678	-24,57
Trailers and semi-trailers	86748	66570	67928	65239	63220	64800	-25,30
Plows	49758	47336	49306	49072	49900	51447	3,39
Cultivators	72998	69474	71659	70100	70505	71633	-1,87
Harrows	238160	193950	192029	181386	161132	160004	-32,82
Sowing and planting machines	75888	69322	71290	70343	68950	70536	-7,05
Machines for protection of crops	15107	18739	20227	20727	22220	23487	55,47
Combines and machines, including:							
grain harvesters	32750	26735	27366	26801	26287	26524	-19,01
corn harvesters	2548	1634	1534	1523	1496	1477	-42,03

Source: compiled by the authors on the basis of data from the State Statistical Service of Ukraine²

This situation is due to two reasons. One is the impressive growth in research in genetics, agricultural machinery, agricultural chemicals and the food industry, at least in some middle-income countries. Another reason is the increase in production of offshore multinational companies in middle-income countries (head offices of such companies are located in high-income countries). Today, the influence of corporations on the expansion of research in the agricultural sector is huge. Firms such as Monsanto³, DuPont Pioneer⁴ and Syngenta⁵ are currently mainly focused on the production of machinery and equipment, agricultural chemicals, and crop production.

According to scientists, as soon as countries become richer, people tend to eat more, while they consume more processed and cooked food. Therefore, private sector investment in food research is likely to be higher⁶.

Undoubtedly, the effectiveness of research in the agar field significantly depends on the state of scientific and technical support, which is currently characterized by mostly negative trends. About 2% of equipment for scientific research meet world standards, 85% – generally unsuitable for scientific experiments⁷ to

¹ Philip G. Pardey. Agricultural R&D is on the Move. Nature. 2016. Vol. 537. pp. 301–303.

² Official site of the State Statistics Service of Ukraine. URL: <http://www.ukrstat.gov.ua> (accessed: 28.10.2021).

³ Monsanto Company. Official site. URL: <https://www.monsanto.com> (accessed: 28.10.2021).

⁴ DuPont Pioneer. Official site URL: <https://www.pioneer.com/ua> (accessed: 28.10.2021).

⁵ Syngenta. Official site URL: <https://www.syngenta.com> (accessed: 28.10.2021).

⁶ Philip G. Pardey. Agricultural R&D is on the Move. Nature. 2016. Vol. 537. pp. 301–303.

⁷ Shlapak M.A. Development of associative forms of use of agricultural machinery: dissertation Cand. Econ. Science: 08.00.04; Zhytomyr National Agroecological University. Zhytomyr, 2019. p. 254-255

The number of organizations performing scientific and technical work decreased from 978 in 2015 to 950 in 2019, i.e. by 28 units. The number of employees involved in research has decreased by more than 43 thousand people. The amount of financing the costs of this type of work increased by UAH 6 billion.

Table 4 – Dynamics of the main indicators of the scientific and technical environment of agrarian sector

	2015	2016	2017	2018	2019	Deviation, 2019/2015, +/-
Number of organizations that carried out research	978	972	963	950	950	-28,00
Number of employees involved in the implementation of R&D, persons	122504	97912	94274	88128	79262	-43242,00
R&D costs, UAH million	11003,6	11530,7	13379,3	16773,7	17254,6	6251,00

Source: compiled by the authors on the basis of data from the State Statistics Committee of Ukraine¹

Although the volume of research expenditures shows positive dynamics, Ukraine is at a stage when its economic growth is more in pursuit of more developed countries (catching-up / convergence growth) than innovative development (cutting-edge / frontier growth). Accordingly, research projects that will be productive for the competitiveness of the Ukrainian economy are more likely to include applied work on the implementation and adaptation of already known innovations in the world².

The stable dependence of the technological level of the country's development on the knowledge intensity of GDP has been empirically proved. The indicator is calculated as the ratio of research expenditures to GDP. Thus, with the value of this indicator 0.4-0.5%, science performs a socio-cultural function; 0.6-0.9% – supports the formed technological potential; at a value above 0.9% – ensures the economic development of society. Consider the dynamics of the level of costs for research in some European countries.

As can be seen from Fig. 5, the level of knowledge intensity of Ukraine's GDP is much lower than in European countries. In addition, there is a tendency to reduce the cost of such costs. This is a very significant factor in limiting Ukraine's economic development on an innovative basis.

Nationwide trends resonate in the regions as well. In particular, the number of employees involved in R&D in Vinnytsia region decreased from 627 in 2017 to 481 in 2019. At the same time, the number of support staff remained constant, while the number of researchers decreased. The downward trend is also reflected in the volume of research costs: UAH 44.8 million in 2017 and UAH 39.6 million in 2019.

¹ Official site of the State Statistics Service of Ukraine. URL: <http://www.ukrstat.gov.ua> (accessed: 28.10.2021).

² How much money is spent on science in universities? Analytical note. Centre for Economic Strategy. 2020. URL: <https://ces.org.ua/money-for-science>. (accessed: 28.10.2021).

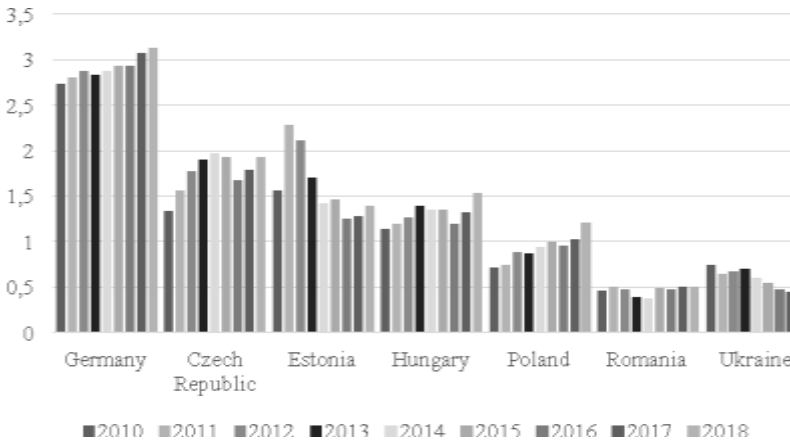


Figure 5 – Dynamics of the share of research expenditures in GDP, %

Source: compiled by the authors on the basis of data from the State Statistical Service of Ukraine ¹

An important issue is the staffing of the scientific sphere as its main driving force. At a time when the dynamics of scientific and scientific-technical work has fluctuated significantly, the number of scientists (employees who are professionally engaged in research and development and directly involved in the creation of new knowledge) tends to decrease significantly.

The originality of the management process of each branch of the economy determines the features of the innovation process in it. In particular, the specifics of innovation processes in the agrarian sector are related to the following factors:

- a wide variety of types of agricultural products, technologies of cultivation and production;
- a significant dependence of the production process on natural and climatic conditions and, as a consequence, the differentiation of individual regions according to the production conditions;
- significant time lags between periods of production and processing of certain categories of products;
- differentiation of the socio-economic level of agricultural workers (especially agriculture);
- diversity and multiplicity of forms and connections of agrarian business entities with innovative formations;
- isolation of the majority of agricultural producers at all levels (lack of diversification of production with a combination of scientific and technical, production and marketing activities);

¹ Official site of the State Statistics Service of Ukraine. URL: <http://www.ukrstat.gov.ua> (accessed: 28.10.2021).

- the lack of a clear scientifically grounded organizational and economic mechanism for the transfer of achievements of agricultural science and a significant lag in the industry in the process of mastering innovation.

3.3 Methodical approach to assessing the effectiveness of livestock production technologies

Food and economic security of the country is determined by the level of development of agricultural production, where cattle breeding occupies a special place in the share of total agricultural production. Increasing production and improving the quality of livestock products, despite the labor intensity of the industry, is a problem that is gaining increasing importance and relevance to meet the needs of the population for high-quality products of animal origin. The crisis situation in the agricultural economy has led to a decrease in the volume and efficiency of production of livestock products. The main reasons for the unsatisfactory provision of the population with dairy and meat products are: a sharp reduction in the number of cows, low livestock productivity, low concentration and mechanization of production, insufficient material incentives, price disparity for agricultural and industrial products; insufficient government support for agricultural producers.

Along with these reasons, it is important that in many regions of Ukraine there is no rational balance in the development of dairy and beef cattle breeding; imperfection of intraregional placement of livestock; economic disadvantages of reproductive and fattening farms. In addition, the high costs associated with the production of livestock products have led to a halt in their activities of enterprises, and most of the operating ones are still in crisis.

Livestock production in Ukraine in 2020 decreased in all categories, and especially significantly decreased the indicators of milk production in households – by 6.2%. Milk production last year amounted to 9.2 million tons, which is 0.4 million tons less than in 2019. Milk production in enterprises amounted to 2.7 million tons, which is 0.8% more than in 2019, and households produced 6.5 million tons, which is 6.2% less than the year before. Sales for slaughter of farm animals (live weight) amounted to 3.4 million tons or 98.9% to 2019. Meat production in enterprises was 2.2 million tons, a decrease of only 0.1%, while households produced only 1.1 million tons, which is 3% less than the year before. Milk production, unlike other livestock industries, provides producers with profits. In 2020, only milk production remained profitable in animal husbandry. Achieving 20.4% return on milk (0.6% less than in 2019) is not enough for expanded reproduction and attraction of investment resources. Milk production is technologically related to the cultivation of young meat, and this type of production traditionally remains unprofitable (-24, 2 in 2020). Therefore, in

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