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DIGITALIZATION OF THE NATIONAL AGRO-INDUSTRIAL COMPLEX: NEW CHALLENGES, REALITIES AND PROSPECTS

ABSTRACT

The purpose of this scientific article is to diagnose the processes of digital transformation of the national agro-industrial complex in order to substantiate the actualization of digitization of the activities of agro-industrial enterprises for conducting "smart" management" based on the adoption of a set of high-tech solutions in the direction of maximum automation of the industry.

To achieve this purpose, a wide range of research methods was used, the main of which were the methods of generalization and synthesis, scientific abstraction, analytical diagnostics, regulatory and statistical. The application of the regulatory and legal method made it possible to identify the main elements of the legal field for the use of digital technologies in the activities of enterprises of the agro-industrial complex. The dialectical method of cognition of socio-economic processes, the formal-logical method and the method of system analysis were applied in order to better understand the processes of digitalization, to identify the patterns of their course, as well as the level of influence on the formation and modern development of the national agro-industrial complex.

It is determined that national agro-industrial production is characterized by a huge potential for future development by increasing the efficiency of land, labor and biological resources, the full use of which requires the improvement of high-production technologies and the formation of an information management system.

A two-factor model of the genesis of innovative information technologies and innovative business ideas in the agroindustry is built, where there is a clearly pronounced dependence on the influence of the human factor, relatively low yields at a relatively high production cost, and flexible price conditions. The global challenges of digitalization of the agroindustry are defined, and the importance of the network revolution is identified in the process of radical changes in the cost structure of agribusiness and the mechanism of profit formation

The importance of the formation of ecosystems of agricultural market participants for making effective digital decisions, cooperation and effective collaboration of entire digital platforms of market participants is substantiated. The key tools and methods of digital development of agro-industrial enterprises and the national agro-industrial complex as a whole are considered.

It is determined that an important indicator of the development of digitalization of the agroindustry is the development of the global landscape of startups and technology companies, and the analysis of the investment volumes in the main digital projects in the agro-industrial complex is conducted. The optimal directions for successful digitalization in the agro-industrial complex have been specified, which should be considered in the form of a three-level development for agricultural holdings and a two-level development for relatively small agricultural producers.

Keywords: agro-industrial complex, AIC, information and communication technologies, digitalization of the agroindustry, business process, digital transformation, digital project, digital platform, ecosystem

JEL Classification: Q13, Q15, G14, L86

INTRODUCTION

The introduction of modern information and communication technologies is currently taking place at a rapid and dynamic pace. Everyday information technologies are increasingly penetrating into all spheres of our lives, causing structural, organizational and transformational changes. The tools and methods of digitalization enable organizations to make optimal decisions for long-term development faster and more efficiently.

The degree of the introduction of information technologies in the agro-industrial complex directly depends on the level of economic development of the industry and the national economy as a whole. In this aspect, in order to expand the scale of informatization and deepen the implementation of effective information and communication tools and methods, along with economic conditions, political, technical, social and innovative components of successful development of the agro-industrial complex on a digital basis are necessary.

At the current stage of development, the level of the economic situation of Ukraine does not meet the modern requirements of rapid information progress for a number of reasons, the key of which are the rapid spread of COVID-19; unfavorable political conditions for the formation of a priority position in the market; low investment volume in the industry; lack of financial resources allocated for the development of the agro-industrial complex; and an increase in inflation.

The digital transformation of the national agro-industrial complex is already underway. Agricultural holdings use digital technologies that enable to manage organizational and economic processes, smart farming systems make it possible to manage farms using a large set of data and high accuracy of all operations, modern unmanned aerial vehicles are effective solutions for field monitoring, crop protection and quality control of all production processes. It should be noted that the introduction of digital technologies will significantly increase the efficiency of agro-industrial production, increase the turnover of the industry. Therefore, to start the process of intensification of information development, the country needs to choose a real resource-saving way of effective use of information capital.

LITERATURE REVIEW

Applied aspects of the impact of modern information and communication technologies on the functioning of agricultural enterprises in the context of digitalization were studied by B. Ozdogan, A. Gacar, H. Aktas [9]; T. Qin, L. Wang, Y. Zhou, L. Guo, G. Jiang, L. Zhang [10]; V. Seminozhenko [11]; O. Shubravska, L. Moldavan, B. Paskhaver [12]; V. Sidorov, V. Babenko [13]; V. Vyshnevskyi, O. Harkushenko, S. Kniaziev, D. Lypnytskyi & V. Chekina [20] and a number of others. Among foreign scientists should be highlighted the works of N. Ashish [1], M. Bacco, P. Barsocchi, E. Ferro, F. Gotta, M. Ruggeri [2]; A. Walter, R. Finger, R. Huber, N. Buchmann [21] and many others.

A. Walter, R. Finger, R. Huber, N. Buchmann in their scientific research indicated that the dynamic development of digital technologies and the impact on the transformational processes in the agro-industrial complex make it necessary to deepen research in a determined direction. In this aspect, the authors proposed a digital platform model, which will allow the combining and processing of received data, identify patterns, to receive information of a new, higher level of quality, for risk minimizing and increasing agricultural production efficiency.

Ozdogan, B., Gacar, A., Aktas, H. assure that there are two main areas in which digitalization is moving, namely productivity and the creation of fully digital enterprises in the future. The use of new technologies in agriculture reduces overall costs, thereby increasing profits. It is through digitization that agricultural enterprises are realizing that they can improve in their field. Thus, less effort is needed, as digitalization helps to overcome barriers and to make it easier to move to a new management level of agricultural enterprise. With the digitization of data, the methods of agricultural production are also undergoing significant changes. At this stage, many agricultural enterprises in Ukraine have the chance to become leaders with minimal costs, only through the digitalization of production, and the rural areas in which they operate to provide socio-economic development. The second direction of digitalization is "digital enterprises". They are indebted for their creation of cloud technologies and exist on the basis of remote work.

According to such authors as Shubravska, O.V., Moldavan, L.V. & Paskhaver, B.Yo., in nowadays modern conditions the most important transformation of activities in the agricultural sector in Ukraine is digitalization. This phenomenon is designed to simplify activities in the agricultural sector in Ukraine, agricultural production and make it more efficient, in order to ensure rural development. It offers an opportunity to transform a huge amount of information into a structured data system and facilitate the activities of agricultural enterprises, which differ in their industry specifics and requirements for the management system. Digitalization in agriculture radically changes the approach to the organization of the collection, processing, storage and use of the data, reducing production costs, increasing productivity, and hence profitability

Recognizing the significant contribution of scientists, it should be noted that the acceleration of the development of digital technologies and their impact on the transformation processes in the national agro-industrial complex determine the urgent issue of in-depth research of new challenges and realities of the information development of the industry for the long term.

To solve this problem, it is proposed to research the key vectors of successful digitalization of the agro-industrial complex, the feasibility of using the instrumental and methodological complex of innovative and digital functioning in order to minimize economic risks and increase the level of economic efficiency of agricultural enterprises and the industry as a whole.

AIMS AND OBJECTIVES

The purpose of this scientific article is to investigate the importance and relevance of digitalization, as well as the effective use of digital platforms for the economic development of agro-industrial enterprises in the future.

METHODS

In the research, a wide range of research methods was used, the main of which were the methods of generalization and synthesis, scientific abstraction, analytical diagnostics, regulatory and statistical. The application of the regulatory and legal method made it possible to identify the main elements of the legal field for the use of digital technologies in the activities of the enterprises of the agro-industrial complex. The dialectical method of cognition of socio-economic processes, the formal-logical method and the method of system analysis were applied in order to better understand the processes of digitalization, to identify the patterns of their course, as well as the level of influence on the formation and modern development of the national agro-industrial complex.

The use of the statistical method based on the use of representative sample observation helped to synthesize a reliable information database for analytical calculations. The method of generalization and synthesis created an opportunity to accumulate the entire range of scientific results obtained into a single concept that reflects the relevance of the topic, to identify the key directions of development, goals, objectives and features of the adaptation of tools and methods of digitalization in the activities of the enterprises of the agro-industrial complex. The method of analytical diagnostics enabled to conduct research on the main indicators and coefficients characterizing the level of coverage and intensity of the use of digital technologies in the national agro-industrial complex.

RESULTS

Increasing the efficiency of innovative development of the agro-industrial complex requires the use of modern information and communication technologies for the organization and management of economic activities, automation and robotization of agro-industrial production. In the context of globalization and deepening intersectoral ties, the agrarian sector has become the basic innovative component that shapes the trends of efficiency growth for related industries, so the digitization of the agrarian sector is of paramount importance for improving the efficiency of production and processing of products.

It should be noted that national agro-industrial production is characterized by a huge potential for long-term development by increasing the efficiency of the use of land, labor and biological resources, the full use of which requires the improvement of high-production technologies and the formation of an information management system. The key feature of such systems is the processing of a large amount of data, the results of processing, systematization and analysis of which will help to achieve high-performance indicators, improve technical and technological solutions and strengthen production capacities [6].

As the practice and experience of developed foreign countries shows, the expansion of the scope of application of information technologies in the agrarian sector can significantly increase the efficiency of the agroindustry. More than 70% of US agriculture has digitized production and sales processes. In our country, the spread of IT technologies is rapid, ranging from crop planning, automation of fertilizing and digital modeling of the yield to the calculation of fodder rations for animals and birds.

With the gradual introduction of information and communication technologies (ICT) as a key direction of economic development, the national agro-industrial complex is able to receive potential benefits from international cooperation with other

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developed countries, developing its own ICT sphere, while increasing the level of competitiveness on a global scale. According to "The Global Information Technology Report-2021" (The Global Information Technology Report) [18], which has been annually published by the World Economic Forum since 2002, the rating of countries in the world by the level of development of information and communication technologies is determined.

One of the most common indicators by which the state and degree of informatization in the countries of the world is assessed is the assessment of the level of development of information and communication technologies (ICT) by the Networked Readiness Index (NRI), which includes sub-indices "Environment for ICT", "Readiness for ICT", "Use of ICT" and "Impact of ICT" [13, 14]. The top ten countries with the most effective use of information technology in 2021 included: the Netherlands, Denmark, Finland, Singapore, Norway, Canada, Australia, Austria, Luxembourg and Ireland [18] (Figure 1).

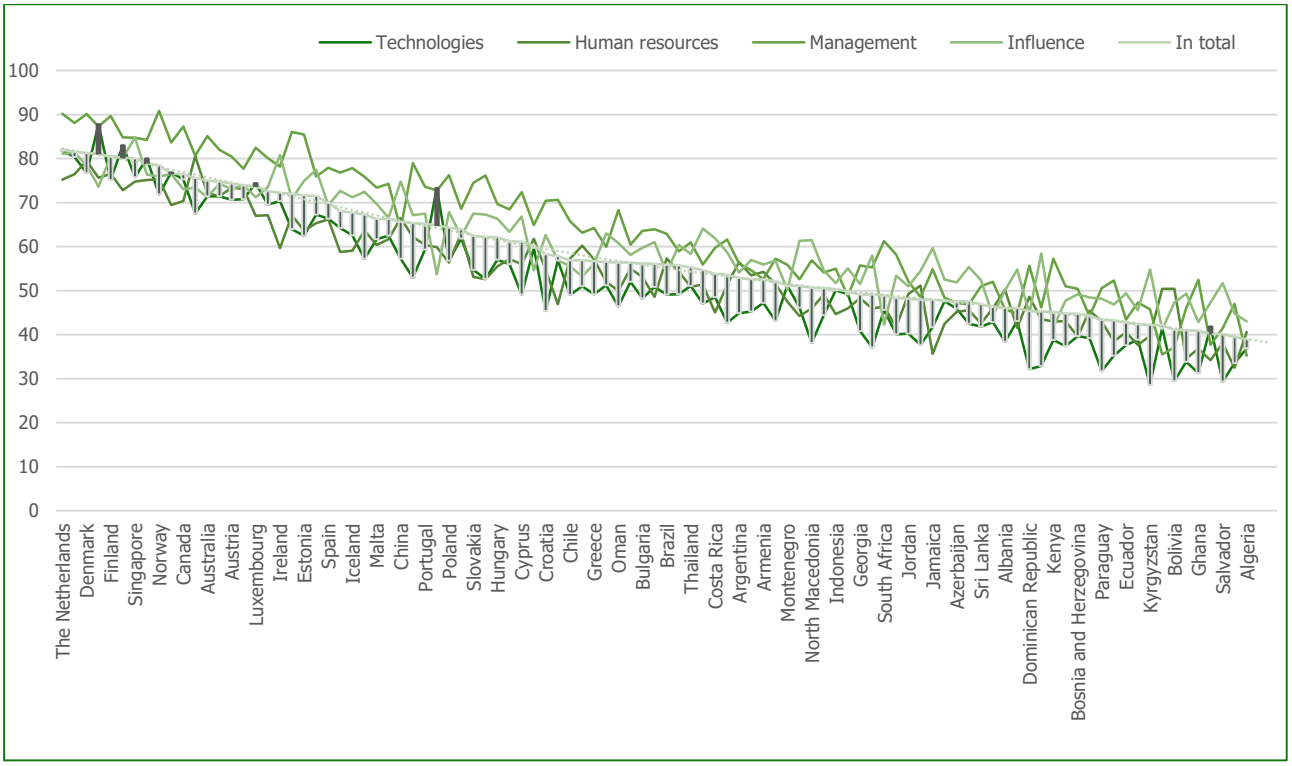

Figure 1. Country ranking of Networked Readiness Index. *(Source: formed by the author based on sources [18])*

The international political situation pushes our country to significant transformations in the agrarian sector. In order to avoid existing and potential threats to national food security, digital transformation of the national agro-industrial complex is necessary. Digitalization should also be considered as one of the key factors for the sustainable development of rural areas.

The genesis of innovative information technologies and innovative business ideas in the agroindustry can be represented as a two-factor development model (see the graph "Evolution of technologies and business models"). The horizontal axis is time, and here we can conditionally distinguish three stages-approaches to doing agricultural business: the traditional way, digital agriculture and ecosystems of market participants. The vertical axis is the complexity of technological development; it is mainly used for selection and seed production as the main drivers of yield growth (Figure 2). In the traditional sense, in the field of agro-industrial production, there is a clearly pronounced dependence on the influence of the following factors, namely: the human factor, relatively low yields at relatively high production costs, flexible price conditions.

Digital agriculture is focused directly on increasing the level of efficiency of each business operation, which depends on the level of digitalization of agricultural machinery, the availability of sensor tools, unmanned aerial vehicles and other digital elements. Modern management of production processes in the agroindustry requires full automation and digitalization, which makes it possible to ensure a high level of yield and labor productivity at a relatively low cost.

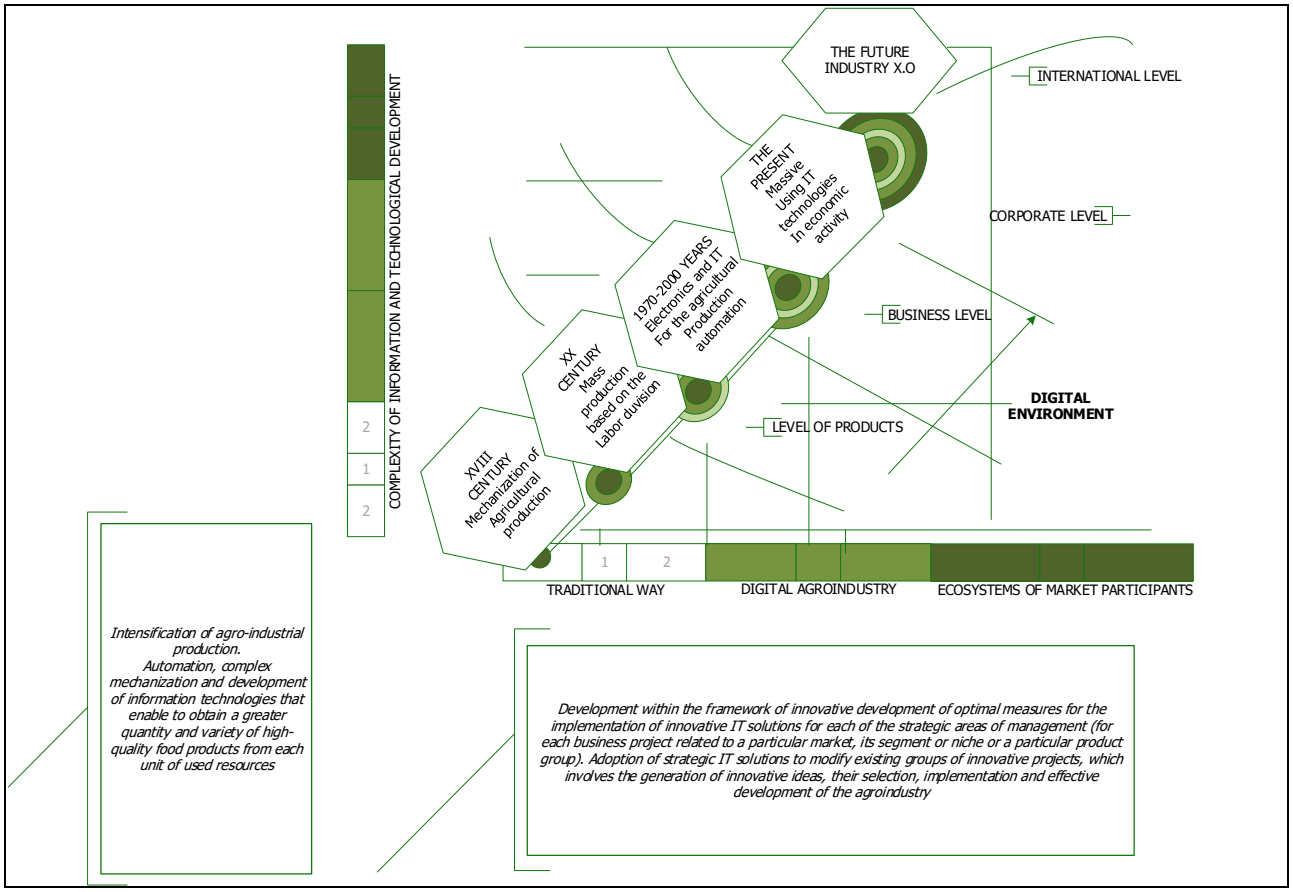

Figure 2. The genesis of digital transformation of the agroindustry. *(Source: formed by the author based on sources [4-9])*

One of the global challenges of the digitalization of the agroindustry is to change all the mechanisms of the system of management and development of an agro-industrial enterprise. The network revolution has radically changed the cost structure of agribusiness and, therefore, the mechanism of profit formation. It should also be noted that the spread of the Internet and the use of digital technologies have led to a significant reduction in transaction costs for searching for information, concluding agreements, selling goods and services. Additionally, it also provided zero marginal transformation costs for agribusiness, since the creation of copies of digital goods, and their distribution on the Internet is practically free [13, p. 12].

The formation of ecosystems of market participants, new businesses and partnerships is an extremely promising approach to the success of the digitization of the agroindustry. The key feature of this approach is that it is expressed not just in the use of certain digital solutions, but in the cooperation and effective collaboration of entire digital platforms of many agricultural market participants. In this case, we are talking not only about the sale of agricultural products, but also services (for example, transport, logistics, sales, etc.), which will be provided in the future not only by classical agricultural holdings but also by IT giants (Kernel, Ukrlandfarming, Myronivsky Hliboproduct, Agroprosperis, Astarta).

Considering the stages of technological development, we can name several main points. Some of them, like hybrid breeding, selection, agrobiology, GMOs are already widely known in the market. But there are also those that are just beginning to be used in the agro-industrial complex. In this aspect, the peculiarity of the CRISPR/Cas9 gene editing method is that the body independently, using the natural mechanisms of the immune system, cuts out the wrong DNA section with the help of geneticists. Such changes in the genome of a natural organism can occur (and do occur) as a result of natural evolution. From the result of gene editing, it is impossible to determine whether it was done as a result of human intervention or natural mutation. The CRISPR/Cas9 technique is more efficient than standard genetic modification techniques and is exactly much more efficient than the archaic methods of "blind" genome modification by selection used in past centuries, as it makes it possible to perform the most accurate DNA editing. Thanks to CRISPR/Cas9, there is no need to select for hundreds of generations to get the desired result – resistance to pests or the desired food parameters [17, p. 128].

DOI: 10.55643/fcaptp.6.47.2022.3929

It is well known that Swedish geneticists have recently managed to substantiate the results of their own research on the official non-recognition of genetically modified organisms as genetically modified if they do not contain foreign DNA in accordance with the requirements of the European Union. Thus, CRISPR/Cas9 experiments and the cultivation of genetically modified plants using this method are currently not prohibited in European countries. Similar measures are being taken in our country, namely in the direction of increasing the level of food security, which prohibits the use of genetically modified plants and animals.

Another new technology is RNA interference (RNAi tech). It is used to systematically disable genes in cells and select useful gene functions. Due to this, this method plays an important role in protecting cells from viruses, parasitic genes (transposons), as well as in regulating the development, differentiation and expression of genes in the body. By analogy with CRISPR/Cas9, RNAi seeds can be recognized as non-genetically modified products [19].

It should be noted that the technologies of fieldwork and the following links of the value chain are perpendicular to selection and seed technologies (mathematical approach). In connection with the above, it should be explored and defined the key aspects of investment policy in the development of agri-food startups to form a full-fledged large-scale vision and identify the main success indicators for the digitization of the agro-industrial complex with the aim of effective IT development in the present and future. In this aspect, consider the dynamics of financing agri-food startups from 2012 to 2021, Figure 3.

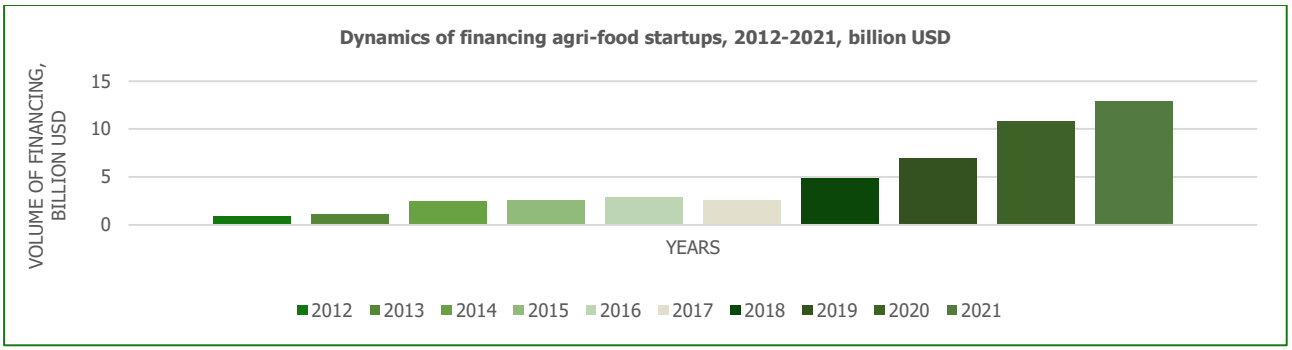

Figure 3. New challenges of digitalization in the context of business process management. *(Source: formed by the author on sources [16])*

The analysis of the dynamics of financial investments in national agri-food startups indicates the dynamic increase in funding and demonstrates galloping growth. The main focus of investors is online sales channels, as well as biotechnology.

In 2019, the largest amount of investment was attracted in the development of e-commerce and marketplaces, where total investments amounted to USD 6.95 billion, which demonstrates the transition of the national agro-industrial complex from offline to online. The volume of investments in e-commerce shows a positive trend and confirms the importance of solving the issues of efficient production of products and its fast and high-quality delivery to potential consumers.

The giants in investing in agri-food startups in 2021 were the United States (online food trading, satellite imagery, bacteria production), China (online food trading, Meicai marketplace) and India (online food trading, restaurant marketplace): USD 8.9 billion, USD 5.5 billion and USD 3.4 billion respectively. Europe lags far behind, which is explained by the advantage of these three countries in investment activity and the overall development of the information programming and forecasting market [16; 20].

An important indicator of the development of agro-digitalization is the development of the global landscape of startups and technology companies, which, in turn, should be divided into eight main directions of activity, namely [21]:

- FMS (Farm Management System);
- data collection and aggregation (for precision farming);
- forecasting;
- marketplace;
- robotic equipment and UAVs (drones);
- sensors;
- smart irrigation;
- animal husbandry;

- next-generation farms (mainly vertical greenhouses).

The innovative solutions of American agri-startups declare the use of new and very effective technologies like artificial intelligence, computer vision and automatic machine learning. Some national companies are also trying to use these technologies, especially on an industrial scale, to analyze NDVI images (photosynthetically active biomass indicator map) of tens of thousands of hectares of arable land, to count the number of apples in thousands of hectares of orchards. This makes it possible to timely and accurately solve the problems of poor germination, to determine the causes of insufficiency of green mass, to identify foci of the spread of viral diseases and causes of pests, as well as to predict the volume of yield with a fairly high degree of accuracy and, as a result, to plan production, harvesting, transport, storage capacities and works more accurately and efficiently [8].

A large number of international technology companies that have grown from startups satisfy the main demand of agricultural producers – data collection, aggregation and analysis. The main ones are presented in Figure 4.

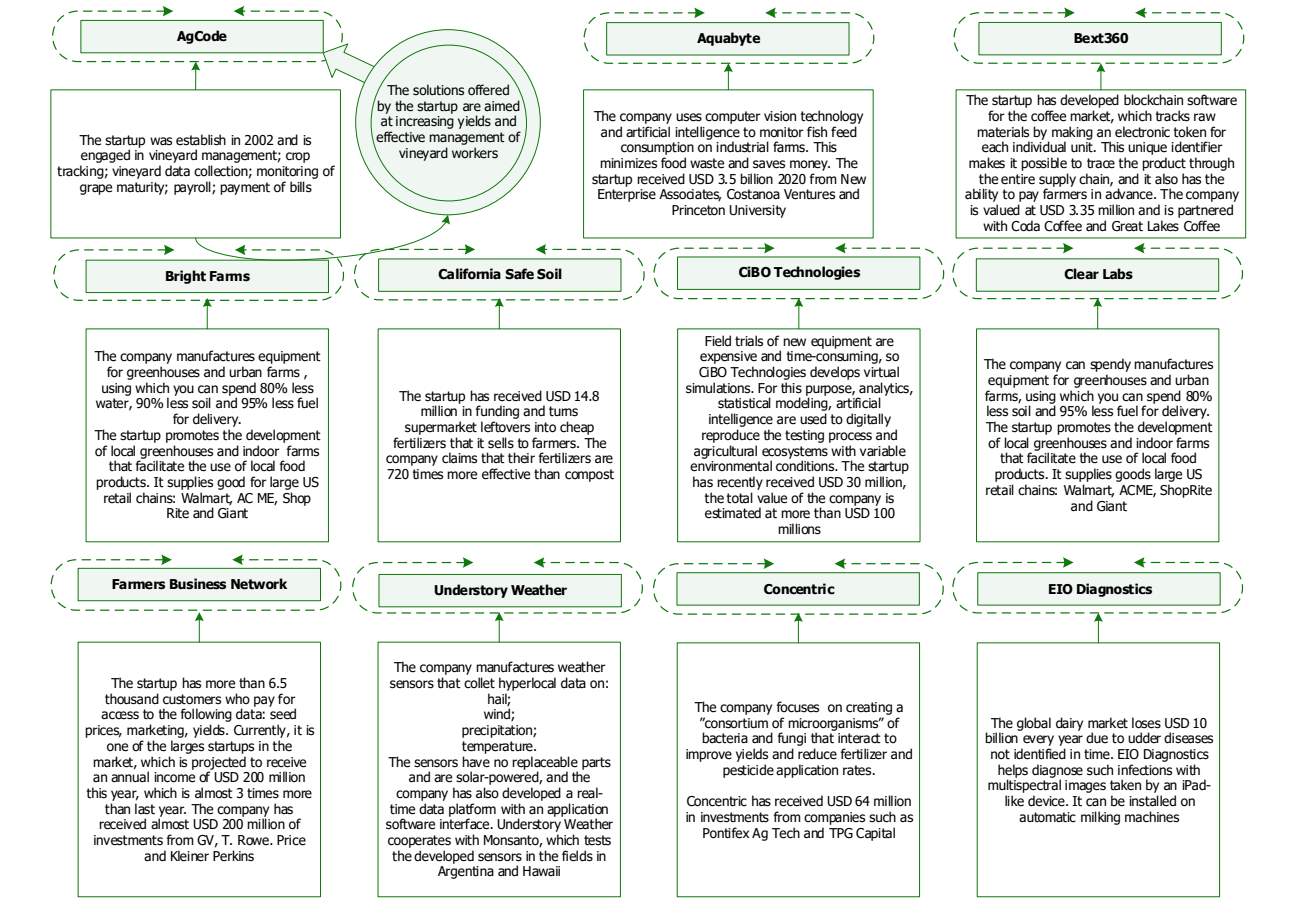

Figure 4. Main international agri-startups, 2021. *(Source: compiled by the author based on [16])*

Agri-startups in the field of animal husbandry are based on the analysis of sensor and detector data. However, these are probably the least "useful" of the startups: they often work only with a certain set of data, while it is common practice at dairy complexes to use system integrators that cover all areas of digitalization, working with the entire set of data generated by the farm.

In the United States, urban vertical greenhouses are actively being developed that enable to produce a synergistic effect for developers and agricultural producers, to meet the demands of the western urban population regarding an increase in the level of greening. This trend (but as objects, not startups that operate/manage objects) is starting to come to Ukraine: in 2019, Limited Liability Company (LLC) "Scientific-Production Enterprise "Agrobiostandard" launched a farm for growing greens and berries. In 2018, Tovmach Agro LLC equipped an agricultural laboratory, where a pilot vertical greenhouse was located on an area of 75 m². Soon, new-generation farm startups will include not only vertical production but also new methods of growing live ingredients (aquaculture, insects, algae, microbes) [9].

DOI: 10.55643/fcaptp.6.47.2022.3929

It should be noted that irrigation is an effective way to increase yields. Smart irrigation provides double the effectiveness of the results, the greatest demand for which is observed in areas with arid climates.

Agromarketplaces are still underdeveloped on a global scale, except perhaps for one case of Indigo: a biotechnology company that has organized an agricultural marketplace in the United States, through which deals worth hundreds of millions of dollars are concluded. The situation is that agro marketplaces are created not by agricultural producers themselves, but by other market players. Many countries, including African ones, such as Kenya, have fairly large electronic platforms for trading agricultural products. In India, an online platform (eNAM) for food trade was launched by the Ministry of Agriculture. At the same time, this is a new trend, as agricultural products, unlike industrial and consumer goods, mostly have fewer clear specifications and pricing methods [24] (Figure 5). On the other hand, marketplaces have other positive effects. For shareholders and top management, this is primarily a potential opportunity to ensure transparency and efficiency in obtaining data on the structure, volume, selling prices, optimization of document flow, and convenience for customers. At the moment, none of the largest national agricultural producers has a full-fledged marketplace, although most of them purchase through their own electronic platforms [17].

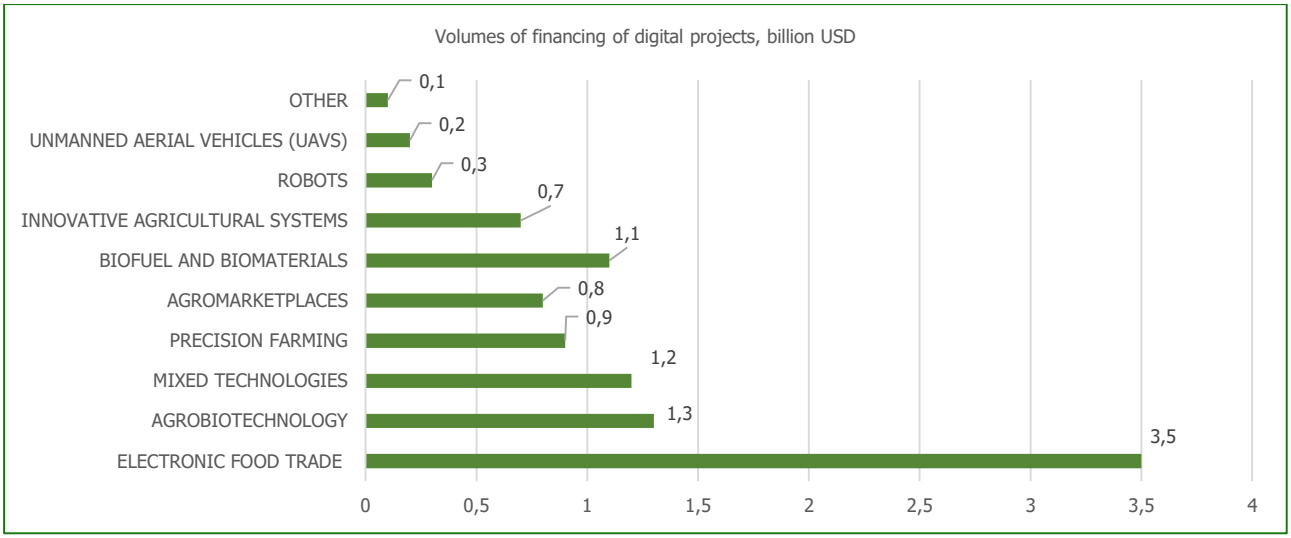

Figure 5. Volumes of financing of digital projects in the agro-industrial complex, 2021. *(Source: compiled by the author based on the source [17-19])*

Thus, the direction or vector of successful digitalization in the agro-industrial complex should be considered as a three-level development direction for agricultural holdings and a two-level one for relatively small agricultural producers. The first division represents enterprises with efficient business processes, where internal accounting systems must be implemented and fully integrated, as well as a single digital back office. Also, the dashboard should be fully used, which displays the values of the most important business indicators in real time, and, ultimately, the accumulation of a database of production performance indicators.

The second level of development is a fully formed digital technology company that uses innovative technologies such as precision farming, artificial intelligence (AI), computer vision (CV), machine learning (ML) and others [22].

The third (high) level of development is the ecosystem of the agricultural holding. A whole infrastructure of innovations has already been built here. Market participants are integrated into a single system based on the digital platform of the agricultural holding, while the sale of optimal digital solutions/services in the agro-industrial complex is positioned as a separate business.

Therefore, given the above, in order to achieve an increase in the level of profitability of the enterprises of agribusiness, in terms of participation in digital transformation processes, it is necessary to fully master the second level of information development. To achieve leadership positions in the industry in 7-10 years, one should strive to move to the third level.

It should be noted that today most national agricultural companies face the important tasks of the first two levels of development. At the same time, it should be taken into account the fact that not all representatives of the industry are confident in the positive economic effect of the introduction of digitalization tools and methods, without providing thorough and convincing calculations of the inexpediency of using the instrumental and methodological complex of innovative and digital functioning [23].

In this way, the key goals of digitalization of agribusiness are not only to directly increase profits but also to provide the entire database of necessary, logically and optimally structured information to the main participants in the agro-industrial process ranging from agronomists to business owners.

DISCUSSION

Ukraine has mastered almost the entire range of elements of precision agriculture, as well as satellite positioning technologies, geographical innovation systems (GIS-systems) and systems for monitoring and control of equipment, as well as the quality of work performed. Also, the market of enterprise resource planning systems (ERP-systems) for agriculture, control and accounting systems in various branches of agricultural production, the market of specialized databases and programs for their storage, processing, systematization in order to make optimal and timely decisions is rapidly developing.

The change in demand is an extremely important and at the same time complex issue, as domestic farmers are forced to master new technologies in leaps and bounds, rather than gradually, which does not always make it possible to competently adapt new digital solutions, applied aspects of managing the activities of agro-industrial enterprises and determine their practical benefits. The introduction of precision farming, for example, enables minimization of the impact of uncertainty factors, primarily in the direction of development strategies, planning of production processes, operational utility management, optimization of resource use, as well as to increase productivity and quality of work.

The use of digitalization tools and methods is one of the key activities of national agricultural holdings. Despite the fact that so far the digital penetration rate among agricultural enterprises (except for large agricultural holdings) is relatively small, the number of farmers using digital solutions will inevitably grow in the coming years, as systems that enable to aggregate, process and analyze a significant amount of data are becoming more and more in demand. Agricultural producers who use several digital solutions, such as telematics systems on equipment and digital agroscouting, as well as own weather stations, have the opportunity to significantly improve the quality of sowing, significantly reduce various losses (for example, reduce cases of theft and misuse of material resources) and prevent risk situations. Also, the introduction of digital products makes it possible to streamline processes in large companies, increase business transparency and ensure efficiency, expediency and timeliness of making strategic management decisions for the long-term period of operation and development.

CONCLUSIONS

Today almost all large agricultural holdings in Ukraine are actively investing and implementing digital solutions in their own activities. At all levels of national agro-industrial production, there are leaders with extensive experience in implementing digital technologies, where there is a clear upward trend. The process of introducing and applying digital technologies is interdependent and interconnected. On the one hand, innovative solutions in various sectors of the agro-industrial complex appear regularly and on an ongoing basis, and on the other hand, agricultural enterprises are gradually coming to conclusions about the feasibility of introducing digital technologies and guaranteeing economic efficiency in the direction of sustainable development for the long term. It is quite realistic that in the future (in the next 10 years), other things being equal, more than 80% of domestic agro-industrial enterprises will implement effective digital solutions in their activities.

Therefore, the processes of digitalization of the national agro-industrial complex are now rapidly spreading to all sectors. The legislatively approved programs for the informatization of the industry and the economy as a whole are under consideration of legislation on the digitalization of socio-economic processes in Ukraine in order to radically transform the agro-industrial complex and the national economy as a whole.

The digitalization of the agroindustry contributes to a significant reduction in production and transaction costs and a significant increase in the level of financial affordability of food, ensuring the rational use of the potential of natural resources and efficient nature management. The introduction of digital technologies in the agricultural sector is possible only through the application of a program-target approach, as well as by improving the efficiency of industry management at the state level.

The results of the conducted research in the direction of diagnostics of the processes of digital transformation of the national agro-industrial complex in order to substantiate the actualization of the digitization of agro-industrial enterprises lead to the conclusion that the use of digital technologies is a key tool for improving the efficiency of national agro-industrial production, as well as a key success factor for achieving a high level of competitive advantage both in domestic and foreign markets. The core idea of the digital transformation of the production and economic activities of agro-industrial

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enterprises is the creation of smart agroindustry, which should be based on the automation of the vast majority of business processes and the management of large databases based on developed digital platforms.

The research results demonstrate the positive digital changes and transformations in the national agro-industrial complex, and, at the same time, the absolute values of the considered indicators are at a low level, which requires more active use of tools and methods to stimulate the intensification of the use of digital technologies in the agroindustry, which in turn can be ensured by the implementation of the following priority tasks:

- development of digital software platforms, scientific and methodological and innovative support of production and sales processes at all levels of management of the business entity;
- development of a methodology for forecasting the volumes of production and sales of products and, on the basis of this, forecasting the level of food security at the state level;
- optimal location of production, taking into account the requirements of rational nature management;
- predictive analytics and monitoring based on large databases with instrumental and methodological complex of a distributed registry, artificial intelligence;
- program-target sectoral planning;
- professional development and provision of digital competencies for specialists in the agroindustry.

Thus, the successful implementation of processes and mechanisms of digitalization is possible due to the joint integration of all systems and business processes, ensuring automation and transparency of their implementation at all levels of management of the enterprises of the agro-industrial complex in order to conduct smart management based on the adoption of a set of high-tech solutions in the direction of maximum automation of the industry for the long-term development period.

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ЦИФРОВІЗАЦІЯ НАЦІОНАЛЬНОГО АГРОПРОМИСЛОВОГО КОМПЛЕКСУ: НОВІ ВИКЛИКИ, РЕАЛІЇ ТА ПЕРСПЕКТИВИ

Метою цієї наукової статті є діагностика процесів цифрової трансформації національного АПК з метою обґрунтування актуалізації оцифровування діяльності агропромислових підприємств для ведення «розумного» господарювання» на основі ухвалення комплексу високотехнологічних рішень у напрямі максимальної автоматизації галузі.

Для досягнення цієї мети, було використано широкий спектр методів дослідження, основними з яких стали методи узагальнення та синтезу, наукової абстракції, аналітичної діагностики, нормативно-правовий та статистичний. Застосування нормативно-правового методу дозволило виявити основні елементи правового поля використання цифрових технологій у діяльності підприємств агропромислового комплексу. Застосовано діалектичний метод пізнання соціально-економічних процесів, формально-логічний метод та метод системного аналізу з метою глибшого розуміння процесів цифровізації, виявлення закономірностей перебігу їх, а також рівень упливу на становлення та сучасний розвиток національного агропромислового комплексу.

Визначено, що національне агропромислове виробництво характеризується величезним потенціалом перспективного розвитку шляхом підвищення ефективності використання земельних, трудових та біологічних ресурсів, повноцінне використання яких потребує вдосконалення високих технологій виробництва та формування інформаційної системи управління.

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Побудована двофакторна модель генезису інноваційно-інформаційних технологій та новаторських бізнес-ідей в агропромисловості, де спостерігається чітко виражена залежність від упливу людського фактору, відносно низького рівня врожайності при відносно високій собівартості продукції, гнучкої цінової кон'юнктури. Ідентифіковано глобальні виклики цифровізації агропромисловості, а також визначено значення мережевої революції в процесі радикальної зміни структури витрат агробізнесу та механізму формування прибутку.

Обґрунтовано значення формування екосистем учасників аграрного ринку для ухвалення ефективних digital-рішень, кооперації та ефективного співробітництва цілих цифрових платформ учасників ринку. Розглянуто ключові інструменти та методи цифрового розвитку агропромислових підприємств та національного агропромислового комплексу в цілому.

Визначено, що важливим індикатором розвитку агроцифровізації є розвиток світового ландшафту стартапів та технологічних компаній, здійснено аналіз обсягів інвестування основних цифрових проєктів в АПК. Визначено оптимальні напрями успішної цифровізації в АПК, які варто розглядати у вигляді трирівневого розвитку для агрохолдингів і дворівневого – для відносно невеликих сільгоспвиробників.

Ключові слова: агропромисловий комплекс, АПК, інформаційно-комунікаційні технології, диджиталізація агроіндустрії, бізнес-процеси, цифрова трансформація, диджитал проєкт, цифрова платформа, екосистема

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