

**KAPITEL 3 / CHAPTER 3³****DIGITALISATION OF THE AGRICULTURAL SECTOR AS A PROMISING MODEL FOR THE SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT OF UKRAINE'S AGRICULTURAL SECTOR****DOI: 10.30890/2709-2313.2023-20-02-011****Introduction**

In today's environment, digitalisation and informatisation have a significant impact on the economic policy of certain business entities and states. In Ukraine, the process of digitalisation of the economy and its sectors has already begun. The goal of this process is to create a single information space with up-to-date databases on numerous issues related to information and telecommunications networks and connections. The inefficient existing information environment in the agro-industrial complex leads to an increase in transaction costs of production, which affects the level of value of the products produced and has a negative trend towards the competitiveness of Ukrainian agricultural products compared to similar foreign products.

Agriculture and IT are two of the most promising (at least in the public mind today) sectors of the domestic economy. They are business opposites that are at different poles of technological progress: the existing online industry and the most down-to-earth, location- and time-bound work.

Over the past few years, Ukraine has seen exceptional growth in agriculture, which has attracted serious investor interest.

It should be noted that the rather large volume of relatively cheap imported food and the uncompetitiveness of domestic products in recent years are the main reason for the decline in domestic production, posing a serious threat to the food security of the country as a whole.

We believe that it is the digitalisation of agriculture that will give an impetus to the innovative development of the sector and contribute to reducing our country's dependence on food imports. [4; 5] (*Altukhov, Dudin, Anishchenko, 2019; Dudin, 2018*).

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3.1. Special features of the development of the digital economy

A specific feature of the digital economy is conducting business activities with data storage in electronic form and continuous processing of large volumes of information. This makes it possible to obtain accurate and objective analytical summaries, which form the basis for optimizing business processes. The Internet of Things, blockchain and artificial intelligence have become components of a digitally enabled economy [7].

Ways of informatisation of the agricultural industry can be as follows:

- spontaneous self-organisation, characterised by a change in the social component to adapt the population to modern business conditions;
- centralized management - all the stages of digitalization are regulated by legal acts, the execution of the norms approved at the legislative level is controlled by government agencies;
- guided digitalization.

A well-developed information and communication infrastructure is essential for the development of digital technologies. In order to meet the challenges of the digital economy, appropriate knowledge bases, information resources and interactive communities, a wide network of integration business platforms, a digital environment and human resources that can work in the new environment are needed. This integrated approach will create a digital ecosystem in which each participant has the dual role of client and data server. This will form the basis for subject-oriented clusters within which agrarian digital ecosystems function. [1]

The application of digital technologies has a positive impact on the rate of productivity growth and profitability in agribusiness. A striking example is Israel, which has only 20% of its land resources suitable for agricultural activities, yet has a food supply of 95%. In this case, the lack of favourable natural and climatic conditions is compensated by the possibilities of innovative technologies.

Another example of the effectiveness of digital technology in agriculture is the creation of smart farms. This technology makes it possible to increase milk yields by an average of 30-40%, the use of modern methods of transport control makes it possible to reduce fuel costs by 20%. The experience of using digital technologies in agricultural enterprises of Kyiv region has shown that the vector of automation and digitalization can help reduce costs even in the short term - when implementing the system of operational production management at the meat processing plant in the first month,



labor costs decreased by 30%, and general production costs decreased by 10%. [2]

The agricultural sector of today is developing under pressure due to a number of negative factors:

- food markets in developed countries are characterised by overproduction;
- there is a constant shortage of food in developing countries;
- environmentally friendly agricultural production is combined with mass cultivation of products using GMO technologies;
- growth in the number of healthy eating habits, which increases the demand for organic products;
- the focus of large retail chains on maximising the benefits of all transactions, which leads to the concealment of the composition and origin of the food sold;
- uneven transition to information management of agricultural development in different countries causes unfair competition in global markets and discrimination of small producers. [2]

Factors that have a significant impact on the digitalization of agriculture are as follows:

- characteristics of rural entities (size of the territory, population size and structure, economic potential, production capabilities of the region, state of engineering infrastructure, level of social development);
- labour organisation;
- management technologies used;
- degree of automation of the management system;
- professional personal qualities of agricultural workers;
- the level of personnel's interest in the results of the farm's activity. [3]

Ukraine at the present stage is characterized by "insular" informatization, i.e. digital technologies are not applied everywhere, but only by individual economic entities. This is explained by the fact that software developers do not have complete databases for the needs of agriculture, required for the creation and operation of specific technologies. The strategy of public policy and private investment in innovative agriculture should focus on the development of precision farming, remote sensing, the introduction of integration databases and cloud services, the popularisation of mobile solutions and control and metering sensors.

As of 2019, Ukraine has launched the Digital Agriculture project, overseen by the Ministry of Agriculture. The programme consists of several areas of agricultural intensification:



1. "Effective hectare". This is a unified database of land with characteristics of the current state of the plot and the nature of its exploitation.

2. "Smart contracts". A network of personal offices on electronic resources, where business entities will be able to apply for state subsidies, is envisaged, the project is aimed at automating the process of subsidising the agro-industrial complex.

3. "From field to port". The programme is designed to build efficient export models of domestic products, based on yield forecasts and planned load of transport and transport interchanges.

4. "Agro Solutions for Business". This direction is created to enhance the process of implementation of innovative developments in the agro-industrial complex.

5. "Land of Knowledge". The project stipulates creation of the common base with of educational materials and building of the training system for highly specialized agro-specialists in accordance to the actual requests of the agroindustrial complex. [5]

The efficiency of digitalization of the agricultural industry can be improved by creating an electronic platform for the sale of agricultural commodities, where transactions will be concluded not only with intermediaries, but also with the end buyers. This will reduce the margins of intermediaries and will give incentives to producers.

Elements of the digital economy can be used to monitor land, crops, optimise settlements between producer and buyer, rationalise the investment and credit system, and social insurance.

Digitalization provides for the active use of marketing techniques, opposition to monopoly, creation of conditions for electronic interaction between all participants in the economy. [7]

AIC digital platforms. Technological digital platforms are elements of the innovation infrastructure. Their purpose is to ensure prompt and effective communication, stimulate direct interaction of farmers with other stakeholders (scientific and educational institutions, public structures, authorities). [6] The following platforms have great potential:

1. Food and processing technology in agriculture.
2. Eurasian agricultural technology platform.

The effectiveness of the digitalisation policy is impossible without the use of space and geo-information products, environmental development technologies, and the development of computer technology platforms. Platforms allow virtual analysis and combination of innovative projects, implementation of the latest developments, such



platforms increase the coordination of activities and create conditions for productivity growth. [1]

A digital marketplace is a marketplace in which transactions for the buying and selling of goods are conducted using computer networks and specialized software. The functioning of such a marketplace is ensured by a digital platform, i.e. a set of software and technical products, a set of rules for the operation of the market infrastructure. Well-known examples of Uber and Airbnb are well-known examples of digital platforms in operation.

For agribusiness, it is advisable to create a separate platform for each area of activity with the introduction of a network of sub-platforms. For example, for crop production, one of the sub-platforms could be grain production, and the grain sub-platform could be divided into several more platforms - wheat, barley, maize, etc. The participants of the sub-platforms are agricultural producers, i.e. sellers, and buyers - processors, livestock farms, feed mills. [6] A similar approach can be successfully applied to the livestock industry, consulting, education and research, robotics, engineering, and trade.

Thus, digitalisation in the agro-industrial sector is at an early stage.

Legislatively approved programmes for the informatisation of the sector and the economy as a whole are currently insufficiently developed and are largely aimed at automating already established processes, but do not offer measures for a radical transformation of the economy. Digitalisation of agriculture contributes to significant reductions in production costs, increases the affordability of food, and ensures the sustainable use of natural resources. Creating an optimal digital ecosystem, i.e. marketplace, is impossible without developing a large-scale network of digital platforms and sub-platforms across all areas of the agricultural sector.

The trend of Industry 4.0 is transforming the production capabilities of all industries, including agriculture. As the analysis of many years of foreign practice shows, a knowledge-intensive market for innovative products and the widespread use of innovation play an enormous role in improving the competitiveness and performance of agricultural production.

The domestic agro-industrial complex is a cross-section of scientific and technological and socio-economic processes that cover all sectors of the Russian economy.

The agro-industrial complex combines technologies invented in different years. The gap between the dates of inventions reaches hundreds of years. Transnational



holdings modernised with the latest technology coexist with farms, of which there are quite a few in the country. The human resource hunger and decades-long backlog of competence profiles is being filled by related fields and sectors of knowledge. As a rule, low-value-added products are exported. The costs of operating and logistics costs are also quite high.

It is the agricultural sector that has all the prospects of becoming the main demonstration ground for the results of the technological revolution. Through the use of 'Agriculture 4.0' robotic technology, all agricultural machinery can be switched to autonomous mode without human intervention. "The Internet of Everything and the Internet of Things are helping to integrate the entire production chain into one integrated ecosystem - from the creation of from creating new fertilizers and new plant and animal species to producing functional products that dramatically improve human properties.

The implementation of the smart city concept contributes to increasing opportunities for vertical urbanised farms. At the same time, new research in biotechnology and cosmology allows us to speak confidently about space exploration [5].

Some strengths and weaknesses of agriculture, as well as opportunities and threats to the further development of the industry are presented in table 1.

Reform of production relations in the food sphere, technical and technological re-equipment of public production, application of modern resource-saving technologies in production activities are hampered by limited use of scientific and technological progress, slow pace of research work, low level of solvency.

In 2015, the UN 2030 Agenda for Sustainable Development and the international community pledged to overcome hunger. Global demand for food will increase by 70% by 2050, with agriculture's share of global GDP declining to 3%. Four major factors - demographics, natural resource scarcity, climate change and food waste - contribute to hunger and food insecurity and at the same time increasing pressure on the outdated agricultural model of meeting human needs.

These global technologies will enable farms to be more profitable, efficient, safe and environmentally friendly and aim to:

- improve management and implementation of agricultural processes along the entire value chain, reducing risks and limiting vulnerability due to various influences (breakdown of machinery, drought, disease, etc.);



Table 1 - Strengths and weaknesses of agriculture, as well as opportunities and threats to further development

Strengths	Weaknesses
Unique natural resources; sufficiently large area of agricultural land; research potential that can agriculture to a new level of development	Low competitiveness of agricultural products; deterioration and lack of equipment; lack of funding; underdevelopment of certain agricultural sub-sectors, e.g. the cattle sub-sector
Opportunities	Threats
Reduction of the industry's import dependence; development and widespread introduction of biotechnology in agriculture; Intensification of production through mechanisation of manual labour and use of modern machinery	Reduced import duties and import quotas caused by our country's accession to the WTO; natural and man-made disasters; volatility of the global environment, in particular prices for agricultural products (grain crops)

- Building agricultural ecosystems that include integrated networks that integrate digital data, obtained in real time from both internal sources (farmer sensors' readings) and external ones (provided by other participants in the ecosystem), in order to make efficient management decisions, and integrate ecosystem actors in order to ensure the effectiveness of the value chain;

- Digitalisation of agricultural machinery using modern technical tools - sensors, sensing devices, which are the largest generators of data.

Experts and scientists predict that the next stage in the evolution of 'Agriculture 5.0' will be based on the comprehensive robotisation of agri-food production using various forms of artificial intelligence.

Digitalisation will change every part of the agrifood chain.

Resource management throughout the system could become highly optimised, individualised, intelligent and proactive. Value chains will become traceable and coordinated at the most detailed level, while different fields, crops and animals can be precisely managed according to their own optimal recipes. Digital agriculture is a more



highly productive, predictable and adaptable system (e.g. caused by climate change). This, in turn, can lead to increased food security, profitability and sustainability. In the context of the Sustainable Development Goals, digital agriculture has potential to generate economic benefits through higher agricultural productivity, cost-efficiency and market opportunities, social and cultural benefits through increased communication and inclusiveness, and environmental benefits through optimization of resource use as well as adaptation to climate change.

Conclusions.

As a result of the analysis, it has been established that modern global agriculture is at stage 4.0 ("Agriculture 4.0") as a result of the evolutionary development of technology and is focused on the use of environmentally friendly natural resources (sun, sea water), advanced innovative technologies for smart, precision agriculture, in particular genetic modification, nanobiotechnology, extra-soil plant cultivation and vertical farming, as well as sophisticated technological systems for satellite navigation, robots, drones/drones, 3D food printing, internet of things, blockchain technology, etc.

The main opportunities for the development of the agricultural sector have also been identified, which include: reducing the dependence of the industry on imports; development and widespread introduction of biotechnology in agriculture; intensification of production through the mechanisation of manual labour and the use of modern technology.

It should be noted that the effective development of the agricultural sector in Ukraine requires changes in the use of its resource base, the introduction of resource-saving innovative high-performance technologies in agricultural production to ensure production of high quality and competitive in domestic and foreign markets agricultural products and food.

The potential benefits of digitalization of the agrifood sector are compelling, but it will require a major transformation of agricultural systems, rural economies, communities and natural resource management. This will be a complex task and will require a systematic and holistic approach to achieve all the potential benefits.