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INFORMATION TECHNOLOGIES IN THE COMPETITIVE STRATEGIES OF COUNTRIES IN AGRICULTURAL MARKETS

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ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ В КОНКУРЕНТНИХ СТРАТЕГІЯХ КРАЇН НА РИНКАХ СІЛЬСЬКОГОСПОДАРСЬКОЇ ПРОДУКЦІЇ

The article analyses the peculiarities of the use of information technologies in international agricultural markets. It is noted, that nformation technologies such as remote sensing, spectral analysis and blockchain help to analyze and initiate actions to conserve and rationally use landscapes and resources such as forests. It is established that information technologies are currently affecting international agricultural markets, which, as a result of their market opening, are undergoing a process of a rapid systemic change. The creation of a digitally connected farms powered by Internet of Things sensor network, machines and processing enterprises achieves a high level of systemic optimisation on the supply (food production) and demand (food consumption) sides. It is noted that the increasing number agricultural producers are using information technologies that simplify their access to capital and insurance, allow them to buy and sell equipment and agricultural products online, create agricultural producers' organisations and interact with them. All of this enables agricultural producers to access to international agricultural markets, to international capital markets, and organize social protection systems. It has been established that information technologies affect agri-food systems at both the macro and micro levels. At the macro level, they primarily help to better understand the human impact on the environment (e.g., climate, oceans, landscape), and at the micro level, their role is mainly to optimise and harmonise food value chains. The information technologies employed by domestic agricultural enterprises, particularly modern electronic cartographic solutions, which are of crucial importance in this area, are examined in the article.

As a result of the study, the hypothesis that the use of information technologies in agriculture has a positive effect on the international markets of agricultural products was confirmed. Considering the important place. which occupies agriculture in the system of vital activities of the world society, it is necessary to further study the directions of its improvement, the key of which is the introduction of information technologies.

В статті проаналізовано особливості використання інформаційних технологій на міжнародних ринках сільськогосподарської продукції. Встановлено, що інформаційні технології сьогодні впливають на міжнародні сільськогосподарські ринки, які внаслідок їх проникнення переживають процес швидких системних змін. Зростаюча наукомісткість агропродовольчих систем впливає на збільшення значення інформаційних

технології у процесі сільськогосподарського виробництва, що вже сьогодні дозволяє дозволяє аграріям підвищити загальну продуктивність, знижуючи при цьому негативний вплив на навколишнє середовище. Використання інформаційних технологій у сільському господарстві передбачає автоматизацію та обмін даними у виробничих технологіях і включає кіберфізичні системи, інтернет речей, гіперзв'язок і хмарні обчислення для перетворення виробничих одиниць на «розумні підприємства». Завдяки створенню мережі пов'язаних аграрних господарств, машин і переробних підприємств досягається високий рівень системної оптимізації на стороні пропозиції (виробництво харчових продуктів) і попиту (споживання харчових продуктів). Зазначено, що все більше сільськогосподарських виробників використовують інформаційі технології, які спрощують їм доступ до капіталу і страхування, дозволяють купувати і продавати обладнання і сільськогосподарську продукцію через Інтернет, створювати групи сільгоспвиробників і взаємодіяти з ними. Це все дозволяє розширити доступ до міжнародних ринків сільськогосподарської продукції, забезпечити доступність капіталу та організувати системи соціального захисту. Встановлено, що інформаційні технології впливають на агропродовольчі системи як на макро-, так і на мікрорівні. На макрорівні вони насамперед допомагають краще зрозуміти антропогенний вплив на навколишнє середовище (наприклад, на клімат, океани, ландшафт), а на мікрорівні їхня роль головним чином полягає в оптимізації та гармонізації продовольчих виробничо-збутових ланцюгів. Розглянуто інформаційні технології, які використовуються вітчизняними агропідприємствами, зокрема сучасні електронні картографічні рішення, які мають ключове значення в цій сфері.

Keywords: *information technologies, competitive strategies, international markets, blockchain, internet of things, big data.*

Ключові слова: *інформаційні технології, конкурентні стратегії, міжнародні ринки, блокчейн, інтернет речей, великі дані.*

Target setting. At the current stage of development, global changes are taking place in the world, which have affected all the main spheres of society's life - economy, management, science, security, connected with the deep penetration of

information technologies. Scientific and technical progress, the development of new technologies, rapid changes in the needs of business and society, the emergence of new forms of economic interaction and the diffusion of knowledge are all integral components of modern economic reality. Information technologies are the driving force of socio-economic development of any country in the world and determine the basis of sustainable development in the future.

Information technologies have the potential to eliminate inequality by removing or mitigating barriers to cooperation, collaboration and mutual benefit. They have the potential to become an effective link that brings together multiple stakeholders on a common platform through which developed countries can provide assistance to countries with the highest rates of poverty and hunger through innovation, attracting investment, developing entrepreneurship and ensuring inclusive development at the sub-regional, regional and global levels.

Information technologies are also affecting international agricultural markets, which, as a result of their penetration, are undergoing a process of rapid systemic change. The growing knowledge-intensiveness of agri-food systems affects the increasing importance of information technologies in the process of agricultural production, which already today allows farmers to increase overall productivity, while reducing the negative impact on the environment. In order to make the most effective use of technological advances in the agricultural sector, it is important to understand how technologies evolve, function and become widespread in real life in tandem with other factors, including infrastructure, policy and legislation. This will make it possible to detect, prevent or mitigate the risks and problems that may arise related to the use of these technologies.

Analysis of research and publications. The problems of the formation and development of information technologies of the economy have recently attracted increasing attention of domestic and foreign scientists, in particular, O. M. Vinnyk studied the problems of complex legal support of the information economy, B. V. Khakhula considered modern innovative technologies in the activities of agricultural enterprises. I. Kovach and I. Husti studied the role of digitization in

agriculture.

The purpose of the article is to study the peculiarities of the use of information technologies in the international markets of agricultural products. The tasks of the research are: determine the features of digitization of the economy and information technologies that can be used in the agricultural sector; analyze the impact of information technologies on agro-food systems.

Hypothesis: the use of information technologies in the process of agricultural production has a positive effect on international agricultural markets.

Research methods. During the writing of the article, the following methods were used: methods of scientific abstraction, induction, deduction, system analysis, historical and logical unity were laid as the basis for revealing the essence of the structure and features of the information economy. The methods of comparative studies and the structural-functional approach were applied in the process of analyzing empirical data related to the use of information technologies in agriculture. Monographs, specialized scientific periodicals, and publications served as the research information base. The work uses regulatory, reference, informational and analytical materials, reports of international organizations, materials of official websites and other materials of the Internet.

Presentation of the main research material. In the process of the development of the information society, a new economic system of the information type is simultaneously being formed - the information economy, the main feature of which is the use of information technologies and the Internet in all spheres of economic activity. At the same time, the concept of the "information economy" was a logical continuation of the scientific developments of the 1960s, namely: the theory of post-industrial economy by D. Bell, the concept of the informational way of development and the "network society" or "network economy" by M. Castells, the knowledge economy[6].

The information economy is an integral part of the country's economy, which is dominated by the knowledge of the subjects of economic activity and intangible production - the main indicators of the definition of the information

society. The new economic model makes it possible to implement more competitive products with high added value, create new jobs, and provide effective solutions to current social, cultural, and environmental problems [1, p. 174].

The following two main approaches to the interpretation of the information economy can be distinguished:

- the information economy is defined as a new type of economy that will lead to the transformation of all spheres of the economy and economic activity itself due to the use of information technologies for the processing, transmission, storage and use of information;
- information economy is defined as a combination of several general-purpose technologies and a range of economic and social activities carried out by people through the Internet.

In the first case, the information economy is considered as a new way of doing business, and in the second case, as a tool for ensuring economic growth in the country.

Agriculture 4.0 can be considered the equivalent of the Fourth Industrial Revolution, which involves automation and data exchange in production technologies and includes cyber-physical systems, the Internet of Things, hyper-communication and cloud computing to transform production units into "smart enterprises". At the heart of Agriculture 4.0 are artificial intelligence, hyper-connectivity, intellectual property and automation. Thanks to the creation of a network of connected farms, machines and factories, a high level of system optimization is achieved on the supply (food production) and demand (food consumption) side [4, p. 39].

Information technologies can be an important means of creating sustainable food supply chains, acting as a link between the public good and business interests. They can promote mutually beneficial cooperation between the private and public sectors, creating new business opportunities for agricultural producers. Production and sales chains in the field of agricultural products include all participants in coordinated production activities and the creation of added value, which are

necessary for the production of food products. A sustainable production and marketing chain in the field of agricultural products is such a chain that is profitable at all its stages (economic sustainability), benefits the general population (social sustainability) and has a positive or no impact on the environment (ecological sustainability).

Let's consider examples of information technologies that can be used in agriculture.

Mobile telephony. According to forecasts, by 2025 developing countries will have 80% of the population. Owning a smartphone plays a very important role in socio-economic transformations, especially in developing countries, as the smartphone is practically the only (and in most cases the first) information device that gives people access to the information world. The growing penetration of mobile phones makes them a potential tool to overcome social development barriers such as technology, literacy and gender factors that lead to inequality and the "information divide".

Mobile telephony has disrupted the traditional system of agricultural knowledge dissemination, connecting farmers directly with researchers and other providers of critical information services. Thanks to this, a new order of interaction with remote agricultural consultants has been formed: they are distinguished from ordinary knowledge extension agents by the level of qualifications and the work processes used. Mobile phones are also changing the way institutions such as banks, insurance companies and agricultural markets operate: farmers can now receive money in their e-wallets, purchase crop insurance online and sell their products over the Internet on e-marketplaces, leaving many former participants in the system unnecessary According to estimates, by 2030, thanks to mobile communication technologies, the production volume of agricultural products may increase by 500 million tons [8].

5G technologies. Many operators are already looking to expand the scope of their traditional business in the field of telecommunications and master new channels for receiving revenues from services in 5G networks. However, according

to the degree of implementation of 5G technology, the situation in different countries differs. If the prevalence of 5G is high in developed markets such as Australia, Japan and the Republic of Korea, then for many developing countries 4G is still a novelty.

The Internet of Things is an environment where sensors and machines, using built-in artificial intelligence and data analysis capabilities, can perform measurements, and in the future will have the ability to self-optimize and initiate certain actions independently, without human intervention. The Internet of Things has many applications in agriculture, from in situ sensors that enable real-time monitoring of soil conditions, plant and animal health, to mechanisms for tracking details of product origin, environmental impact and conditions storage in all links of the supply chain [3, p. 95].

Artificial intelligence, machine learning and cognitive computing. The main areas of application of artificial intelligence, machine learning and cognitive computing in agriculture are automation and intelligent machines, remote monitoring and diagnostics, predictive analytics and supply chain optimization.

"Big data" and its analytics, thanks to the possibilities of predictive modeling, help to improve the decision-making process. The most important area of application of "big data" in agri-food systems is agricultural insurance. Research shows that, in addition to providing social protection, farmers' use of insurance products can have a positive impact on investment, efficiency, nutrition and income.

Blockchain. The use of blockchain technology in agri-food systems can be quite diverse. This is the issue of the origin of agricultural goods, and the traceability of food products, and the reduction of transaction costs, and the security of electronic payments, and even the tracking of land ownership and land use rights.

Although the roots of many information technologies lie in advanced industrial economies, today these technologies are increasingly being used by small landowners, farmers who manage infertile lands around the world.

Information technologies such as blockchain have already proven effective in bringing smallholder farmers into the information environment. In Kenya, over 4,000 smallholder farmers use a blockchain-based e-wallet and mobile financial tool for the agricultural sector. With the help of this tool, farmers can open a bank account and use it to store savings and make purchases.

One example is mobile telephony, which is successfully used by farmers. For example, in India, about 70% of small producers and farmers on infertile land used mobile phones for market price alerts, and most of these farmers managed to get a better price for their produce. In Bangladesh and Sri Lanka, mobile agricultural advisory services are helping farmers access information on agriculture, nutrition and health. In India, Microsoft is partnering with the International Research Institute for Study of Crops of Tropical Zones (ICRISAT)) developed an application based on artificial intelligence for the organization of sowing, which enables small-scale subsistence farmers to receive accurate recommendations based on weather and other parameters. In 2017, during the summer agricultural cycle (rainy season), this service was provided to 3,000 farmers for a range of crops, including groundnut, dagussa, maize, rice and cotton. For various crops, yield growth ranged from 0 to 30% [7].

Technologies such as machine-to-machine interaction and the Internet of Things are helping to conserve natural resources: for example, farmers in India are using mobile phones to remotely control irrigation pumps, reducing water loss.

In addition, today farmers are increasingly using social networks. For example, one of the largest agricultural themed Facebook groups in Kenya is a group called Information Farmers Kenya with 336,000 members. Farmers also share experiences and learn new technologies by watching YouTube videos; a YouTube search for the keywords "agricultural extension" yields over 10,000 results. This shows that the lack of literacy and the cost of information technologies are not obstacles for farmers, and if they understand the benefits, they will find ways and means to learn how to use them. This trend is seen worldwide in both developing and underdeveloped countries, and will only increase over time,

with information technology becoming one of the main drivers and influencers in both small and large farming systems [7].

Information technologies affect agri-food systems at both the macro and micro levels. At the macro level, they primarily help to better understand the anthropogenic impact on the environment (for example, on the climate, oceans, landscape), and at the micro level, their role is mainly to optimize and harmonize food production and marketing chains.

Monitoring and analyzing the impact of human activities on the climate is critical to mitigating the effects of climate change. Sensor technologies, big data analytics and blockchain technologies are increasingly being used to monitor and analyze climate conditions and initiate mitigation measures.

The Landsat and MethaneSAT programs help monitor a range of climate-related parameters, including methane emissions, from almost anywhere on the planet, and identify trends and aspects of climate change that are critical for political and strategic planning. character The FAO GeoNetwork produces a large number of geographic information system data sets for monitoring, assessment and analysis of the environmental and socio-economic factors that are the causes of poverty and food insecurity. FAO's information systems, such as Open Foris and SHARP, help researchers, policy-makers and farmers assess the impacts of climate change and make relevant decisions [10].

Information technologies help not only in monitoring and analyzing climate change, but also in organizing preventive measures to mitigate its consequences. As an example of such an approach, the Climate Ledger initiative can be cited, which serves as an aid for intensifying actions to mitigate the consequences of climate change based on blockchain technology. Specialized private blockchain-based cryptocurrency exchanges help companies offset their carbon emissions and create demand for their zero-carbon products and services through their own platforms.

Biogeochemical pollution of the oceans and excessive use of fresh water are just some of the consequences of human activity that affects the state of the oceans.

Information technologies such as sensors and remote sensing, as well as "big data" analytics, can help monitor and conserve Earth's water resources. For example, the ARGO system is a global array of 3,800 free-floating profiler buoys that continuously monitor surface ocean temperature, salinity, and current velocity, and the GEBCO database contains bathymetric data across all oceans (the depth of the ocean floor, as a measure sea level rise or fall). Together, these information tools enable researchers to collect real-time data on surface water temperature, salinity, currents, and more recently, increasingly, biochemical parameters.

Water accounting systems such as AQUASTAT/AQUAMAP, WAPOR and AQUEDUCT are examples of how information technologies help to collect, analyze and disseminate data and information on water resources, water use and agricultural water use in different countries (FAO website).

In order to ensure the sustainability of landscapes, it is necessary to include the issue of conservation and sustainable use of biodiversity in the policies, strategies and practices of the main public and private actors that have one or another impact on biodiversity or use it.

The United Nations Cooperation Program for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries uses Planet Labs satellite images to track forest degradation, predict deforestation, and alert businesses to the need for preventive measures [5].

FAO's Global Food and Agriculture Information and Early Warning System monitors water availability and vegetation conditions during the growing season to assess the Agricultural Stress Index, an indicator of dry periods or, in extreme cases, drought.

Innovative web search engines support climate change efforts by donating a portion of their profits to fund tree planting; more than 73 million trees have already been planted as part of this process. So, in Myanmar, drones are used to plant trees and restore 100,000 hectares of mangrove forests.

Today, advanced domestic agricultural enterprises actively use the achievements of scientific and technological progress in their activities. For

example, during land cultivation, cultivation of agricultural crops and harvesting, modern electronic mapping solutions are used, which are of key importance in this field and help to solve many problems of agricultural companies.

Such a map shows the topography of land plots. The information is useful because low-lying areas of land are usually prone to flooding, while upland areas can suffer from drought. Accordingly, it is possible to effectively adjust the irrigation system, as well as to sow moisture-loving or moisture-resistant plants in the optimal places for this. Accompanying electronic documentation is usually attached to such online maps - object passports, protocols, photos [2, p. 46].

Thanks to cartographic solutions of Ukrainian developers, the following become possible: visualization of soil analysis dynamics; analysis of satellite images; creation of crop yield maps; determination of the most productive and productive areas; tracking the dynamics of crop development; control of the state of the fields; yield forecast, etc.

Using spectral sensors, the farmer receives information in different spectral ranges to calculate vegetation indices or draw up soil distribution maps. All data are provided with exact coordinates with the possibility of detailed study and laboratory analysis. The developers offer quite a variety of services: site monitoring by drones, field measurements, creation of nitrogen and herbicide application maps, plant protection products, creation of visual and NDVI maps of fields, etc.

The geo-information system is actively used for the automated accounting of the land bank in order to preserve the fertility of the land and optimize production costs; conducting an audit of the land bank and developing uniform standards for all enterprises. The implementation of such information systems allows to reduce the burden on employees of land departments and to use information about the land bank in other programs or applications.

Current contours of fields and mapping of crops are used by agricultural enterprises to increase the accuracy of technological works on growing plants. Thanks to them, agronomists got the opportunity to control the state of crops, the

productivity of one or another plot much more effectively, as well as to use fertilizers and plant protection agents in a dosed and effective manner [2, p. 46].

Actively developing systems of precision agriculture - STRIP-TILL and NO-TILL, which, in turn, not only provide the opportunity to save resources (seed material, fertilizers, energy carriers) from 20%, but also additionally preserve the properties of the soil and moisture in it. The use of drones for visual monitoring and accumulation of a database on the state of crops allows to reduce the costs of energy carriers, fertilizers, plant protection products, and seed material.

Conclusion. The use of information technologies in agriculture involves automation and data exchange in production technologies and includes cyber-physical systems, the Internet of Things, hyper-communication and cloud computing to transform production units into "smart enterprises". Thanks to the creation of a network of connected farms, machines and factories, a high level of system optimization is achieved on the supply (food production) and demand (food consumption) sides.

Today, an increasing number of agricultural producers are using information technologies that simplify their access to capital and insurance, allow them to buy and sell equipment and agricultural products over the Internet, and create and interact with groups of agricultural producers. All this makes it possible to expand access to international markets of agricultural products, ensure the availability of capital and organize social protection systems.

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