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FEATURES OF THE IMPLEMENTATION OF DIGITAL TECHNOLOGIES IN THE PRODUCTION

In modern concepts of agricultural development, increasing the efficiency and environmental safety of the agrarian sector of the national economy is associated with the digitization of production. After all, the main trends in the development of world agriculture are an increase in the production of agricultural products, an increase in the productivity of fields and farms; increasing labor productivity with lower costs; introduction of high-precision (precision) technologies, an integrated system of plant protection against pests, diseases and weeds; resource conservation; increase in energy saturation and energy supply; increasing the technical level, quality and reliability of equipment; ensuring environmental safety; creation of comfortable and safe working conditions; wide application of agroinformatics, electronics, intelligent, automated and robotic systems; use of alternative energy sources; use of new technologies for maintenance and repair of MTP; increasing the professionalism of personnel. At the same time, in the leading countries of the world, technologies using the automation of machinery with navigation equipment for conducting precision agriculture are rapidly spreading.

Science and practice show that digital technologies have great potential in the future, as they allow electronic monitoring of various indicators of production technology, ensure environmental protection, contribute to sustainable production management, reduce risks, increase production efficiency, improve product quality, etc. Digital technologies are a new method of management based on the use of global positioning systems, geoinformation systems, information technologies, remote and on-board sensors, automatic executive bodies of machines.

The experience of using digital technologies in our country is small, but positive and convincingly shows the great prospects of revealing their potential. This path is relevant, but very difficult. It involves the use of not only a huge amount of knowledge accumulated in the field of agronomy, agrometeorology, agrochemistry, biology and other sciences, but also high technical and informational equipment of all stages of this technology. Moreover, the main condition for the use of digital technologies is an individual and differentiated approach to each specific soil difference, to the focus of a crop disease or to an area affected by pests. It is at the same time that huge resources are saved, and it is thanks to this approach that the thrifty attitude of manufacturers to the environment in the ecological sense is ensured.

An assessment of the state and trends in the development of agricultural production in the country and abroad shows that its effectiveness is largely determined by the level and scope of the use of innovative production technologies and high-performance equipment. Digitalization of agricultural production plays a key role in this process.

Many domestic and foreign scientists, including Bacco M., Barsocchi P., Ferro E., Gotta A., Ruggeri M. [1], Walter A. ., Finger R., Huber R., Buchmann N. [2], Voloshchuk Yu. O. [3], Lobas M. G., Rossokha V. V., Sokolov D. O. [4], Lyashenko V. I., Vyshnevs'kyy O. S. [5], Maznev G.E. [6, 7], Martinez H. [8], Rudenko M. V. [9] and many others. At the same time, the dynamic development of digital technologies and their impact on the efficiency of production of competitive agricultural products necessitates further research into these issues.

To determine the peculiarities of the implementation of digital technologies and to find out their importance for the sustainable development of agricultural production.

Digital technologies are a dynamically developing field of activity. They include methods and means of obtaining, collecting, processing, and using information in appropriate formats, which allows for full, closed automation, digitalization, and intellectualization of any processes.

The digital technologies of crop production are understood as a system of interacting technical means, software, information management systems and networks, and organizational and economic relations. They allow, on the basis of a single digital model of activity, to dramatically increase the efficiency and sustainability of the enterprise's development

The priority directions for the implementation of digital technologies in the production processes of crop production are those directions of development that can in the near future increase the volume of production, improve its quality, reduce production costs, accelerate the return on capital investments, etc.

In crop production, the digital development of agricultural production involves the development of resource-saving technologies and precision agriculture technologies by agricultural enterprises, which are positioned as soil-protecting, innovative and competitive technologies that contribute to the structural and technological restructuring of producers and increase the economic potential of the agricultural sector of the Ukrainian economy.

The technologies of precision agriculture provide for a clear definition of the agrochemical and agrophysical characteristics of the fields, the compilation of electronic maps of the relevant indicators and the introduction of agrochemicals taking into account the different needs of crops in individual sections of the field. A necessary condition for its use is the exact orientation of the units according to the GPS system. Based on the development of this direction, mechanization of soil cultivation, fertilization, sowing, and plant protection is already possible without the participation of

an operator working on a tractor or combine [4].

At the same time, digital technologies of the field of crop production are a system of interacting means of production, including software, information systems and networks, which, subject to the formation of appropriate organizational and economic relations, allows, on the basis of a single digital model, to increase the economic and environmental efficiency of production and ensure the sustainability of development industry.

In modern conditions, the level of development of digital technologies in crop production determines the level of development of organizational and economic relations, which require serious shifts and transformations, because the use of rather expensive digital technology involves both the unification of efforts of various agricultural enterprises and the transformation of state support.

The influence of digital technologies on the production process of crop production is carried out through the possibilities of introducing modern digital tools into separate technological and management processes. The technological process in crop production is a set of agricultural measures that are performed in the optimal sequence in the necessary agrotechnical terms in order to ensure the most favorable conditions for the growth of agricultural crops, the formation of high plant productivity, taking into account economic, technological, natural and ecological requirements.

Modern "intensive" technologies that ensure a high yield of agricultural crops are based on the use of the achievements of agricultural science (breeding and seed production), technology (material and technical means) and a highly efficient agricultural production management system [9].

Digital innovations in crop production can be divided into basic and complementary. The main ones include: remote sensing, monitoring, forming an information base for real-time decision-making; data processing, decision support, automated management systems for determining rational agrotechnological operations; Internet of things and smart machines for direct execution of operations and feedback; 5G systems and networks to support information processes. Complementary innovations, in turn, include: big data for making optimal decisions; blockchain; virtual, augmented reality for personnel training; cloud services.

Main innovations, as a rule, should be applied in a complex. First, on the basis of GIS technologies, remote sensing with the use of UAVs, artificial Earth satellites, an information basis for managing the agrotechnological system with high detail and a complete digital model of agricultural land is formed, and then, using modern ICT, rational decisions are made regarding the implementation of agrotechnological operations with maximum productivity. They are implemented by "smart machines" and unmanned equipment with minimal or no human intervention. At the same time, with the use of Internet of Things technologies, the collection of information, the change of the digital model of the state of the agricultural ecosystem and the adjustment of the impact on it continue.

This process is carried out in semi-automatic or fully automatic mode.

Complementary innovations can be used in auxiliary processes or in the organization of interaction with counterparties.

Some scientists equate the concepts of "digital technologies" and "precision agriculture", while under the category of "precision agriculture" they understand, first of all, a progressive system of agriculture, a set of specific agricultural technologies that involve differentiating the effects on soil and plants. Thus, precision agriculture has mainly an agro-technological meaning, not an organizational and economic one, and its meaningful basis is precisely related to the application of specific agricultural technologies, including GIS technologies, specialized machines, software, etc.

One of the aspects of precision agriculture is differentiated, as precise as possible application of fertilizers and pesticides according to the condition and needs of small areas of the field and groups of plants. A similar situation occurs during the use of plant protection products. Another aspect of precision agriculture is the accuracy and differentiation of influences when planning and implementing agrotechnological techniques. Planned technological operations in traditional farming systems can be performed with errors, the minimization of which will allow to significantly increase the economic efficiency of crop production, reduce the costs of non-renewable natural resources, and reduce environmental damage.

Therefore, precision agriculture is based on the maximum correspondence of agrotechnological influences to the real state of small areas of fields, groups of plants, within which the same properties are observed. It allows you to implement an intensive way of crop production development with a simultaneous reduction of environmental damage due to an accurate analysis of the properties of agricultural lands and a differentiated impact on their small areas [8].

Thus, it is incorrect to identify the categories of precision agriculture and digital plant breeding technologies. Digital technologies involve the use of information and communication technologies and special technical means for the development of the productive forces of agriculture, increasing the flexibility, speed, and efficiency of operational activities. At the same time, precision agriculture is characterized as much by specific technologies as by the requirements for the final result of their application and directions for solving ecological, economic and social contradictions of the sustainable development of crop production.

Therefore, digital technologies of crop production are a concrete system of technological means and methods of solving tasks set in the concept of precision agriculture. That is, precision agriculture and digital plant breeding technologies are far from the same thing, but the latter ensures the implementation of the former. The wide spread of digital technologies directly allowed agricultural enterprises to work according to the requirements of precision agriculture.

At the same time, the digital technologies of precision agriculture should be understood as a system of interacting means of production (including equipment, software, information and control systems and networks), which, under the condition of the formation of the corresponding organizational and economic relations, ensure the implementation of the requirements of precision agriculture by forming and using digital model of agricultural production. The composition of digital technologies that can be used by a crop production enterprise includes not only purely agricultural, but also general economic, general management technologies. Therefore, the concept of "digital technologies of crop production" is somewhat broader than "digital technologies of precision agriculture". In particular, blockchain, virtual and augmented reality are not directly related to precision agriculture, but a crop production enterprise can use them to solve organizational and management tasks, personnel training, etc.

The advantages of digital technologies and precision agriculture include:

- increase in yield, more complete use of the agrobiological potential of plants and agricultural land;

- improvement of indicators of the state and quality of agricultural crops that affect productivity - germination, vegetation index, biomass, etc.;

- economical use of seed material, fertilizers, pesticides, PMM, agricultural machinery, general reduction of the cost of crop production;

- reducing the harmful impact on soils and the environment by reducing the amount of fertilizers and pesticides used and reducing soil compaction during agro-technological operations;

- significant improvement of the economic indicators of the crop production enterprise due to the simultaneous saving of resources and increased productivity.

The advantage of using digital crop production technologies is also the acceleration of the operational cycle of the industry. Although it is mainly determined by the natural processes of plant development and crop ripening, digital technologies make it possible to reduce the time of obtaining agro-technological information and decision-making, which can indirectly contribute to faster results.

Innovative technologies, including digitalization of the agricultural sector, have a significant impact on the sustainable development of the economy and the environment, as their application allows optimizing the use of natural resources, while simultaneously providing food for the growing population and making agriculture more sustainable and profitable, both for the consumer and and for the agricultural producer.

Therefore, the use of digital technologies in agriculture ensures an increase in its productivity and environmental friendliness, which contributes to increasing the sustainability of production and increasing its profitability and quality.

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