THE NEED TO DEVELOP DIGITALIZATION OF AGRICULTURE IN TERMS OF PANDEMY

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Abstract: *This article highlights the main directions of development, implementation and the main problems of digitalization of agriculture in the countries of the world, in particular, agriculture of the Republic of Uzbekistan in the modern conditions of the spread of Coronavirus and self-isolation. In addition, current data and a comparative analysis of digital technologies introduced into the agricultural sector are provided. Some suggestions were made for the development and implementation of digital technologies in the agricultural sector.*

Keywords: *digitalization, agro-industrial complex, agriculture, neural network technologies, artificial intelligence, innovative development, productivity*

Introduction. The global coronavirus pandemic and isolation have weakened traditional supply chains and, in one way or another, raised the acute issue of economic independence, including food security, before all states. In the era of globalization, conditions dictate their requirements to the modern market, according to experts, by 2020 more than 25% of the world economy will start introducing digitalization technologies. This will significantly increase the efficiency of not only business, but also society as a whole. Given the key issues, that digitalization should considered as a recognized mechanism of economic growth due to its ability to have a positive impact on the efficiency, effectiveness, cost and quality of economic, socio-political and personal activities [1]. Digital technology is a platform for increasing the efficiency and competitiveness of a huge market and industry, as well as all other markets and industries. Modernization of high-tech production and the agro-industrial complex with the help of information, communication and digital technologies, the scale and pace of digital transformation should become a priority of our economic development. The digitalization of agriculture is one of the leading in this regard, since the economic stability of the state largely depends on the level of development of the agricultural sector in the country. In the world, agriculture is evolving from traditional technologies to high technologies capable of creating new markets for innovative solutions and developments [2].

Agricultural information and digital technologies already successfully used in the leading countries of the Asia-Pacific region to create e-agriculture systems in the agricultural segment of the national economy, as well as in the leading EU countries and the USA. [4].

Currently, the process of forming an innovation system in the Republic of Uzbekistan, especially in the agro-industrial complex, is taking place in extremely unfavorable conditions: sufficient provision of scientific and technical resources, shortage and loss of highly qualified personnel, high unemployment, rural poverty and low quality of rural life, rational use of potential agricultural sector. All these factors reduce the investment attractiveness of rural areas and hinder their socio-economic development. [3]

Materials and methods. Digital technologies in Uzbekistan are the main way to diversify the national economy, from raw materials to industrial services. The main technologies introduced in Uzbekistan as the first part of the digitization of agriculture are GPS navigation of agricultural machinery, parallel driving, traction automation, electronic field maps and, of course, unmanned aerial vehicles as the most amazing and unusual technologies. In the context of the global digital transformation, local manufacturers will be able to acquire advanced solutions for services requiring knowledge for the agriculture and food industry, including biotechnology, information and communication technology, robotics, aerospace, environmental restoration and ecosystem design. (Figure 1) [5].

The agro-industrial complex of Uzbekistan is an area of increased risk, mainly due to climatic factors. The digitalization of agriculture in Uzbekistan will help reduce the impact of climate change and a gradual transition to specific agriculture.

However, the transition should be gradual: before the introduction of digitization technologies, agricultural enterprises must go through several preparatory stages:

1.Reengineering of business processes, development of a production management system methodology (planning, accounting, control, analysis);

2.Strengthening agro-technical services, conducting agrochemical land surveys, collecting data for each territory (weed map, soil composition, field history, etc.);

3.Provision of the Internet in the field of industrial automation (installation of sensors, controllers and other equipment) and installation of equipment;

4.After the automation of production, you can go directly to the collection and analysis of data;

5.Implementation of agricultural software or the stage of direct digitization involves the implementation of software for automatic data collection. All received data is collected and analyzed, the same links are formed;

6.The final stage will be the transition to specific farming, the purchase of equipment that can use differentiated chemicals. [6]

It should be noted that is expressed the effect of the introduction of financial digitalization technologies, first, in a significant reduction in costs by increasing the efficiency of all business processes. In addition, experts have identified forecasts for increasing crop yields when using the right technological solutions (Figure 2).

In the digital world, the existence and development of most analog systems (industries) is impractical if there is a digital alternative. By default, the presence, development and support of the digital principle implies the digitization of analog systems, which is undoubtedly harmful and ineffective. A digital format is becoming the norm for many

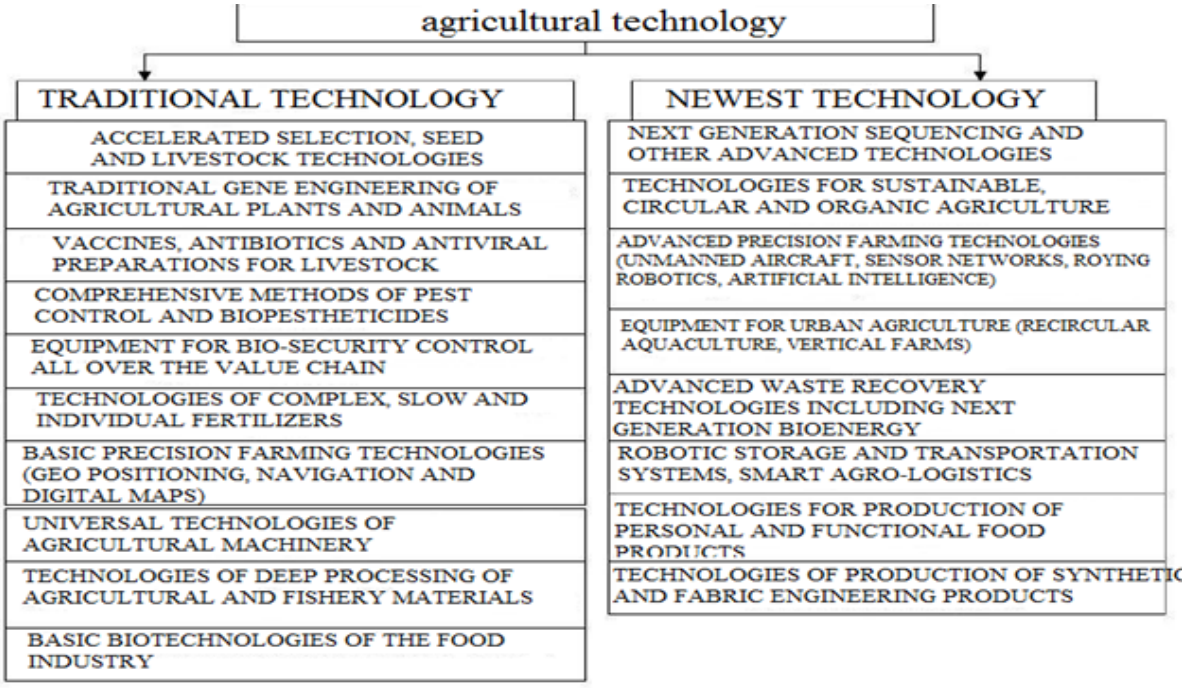

Figure 1. Promising directions of scientific and technological development of agriculture and food sector.

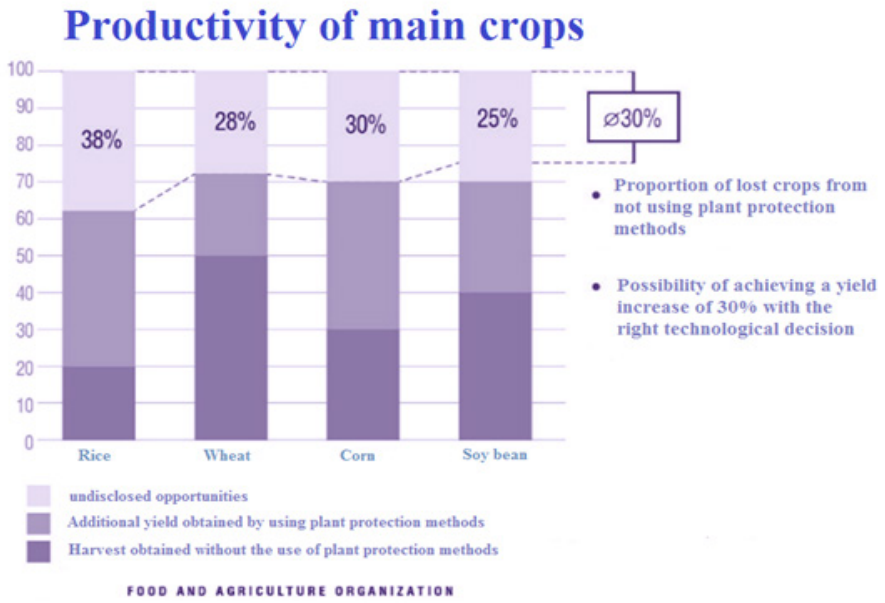

Figure 2. Productivity of main crops.

systems, industries, organizations, sectors and economies. [7]

It should be noted, that agriculture is an ideal environment for the use of digital technologies (DT), which makes it possible to increase the efficiency of agricultural products and have a strong positive impact on its development. Due to the influence of some macro factors and the painstaking work of Russian farmers, the agro-industrial complex can become the leading sector of the national economy. The economies of the leading countries of the world characterized by a high level of development, implementation and use of digital technologies. Many countries of the world make the creation of a new model of the national economy based on digital technologies a priority for their development. The process of building a digital economy in Uzbekistan is a strategic task that will ensure national security, competitiveness and development efficiency at different levels and in different sectors of the economy, including agriculture. [9]

Results and discussion. Currently, the main indicators of the development of the digital economy are the economic growth of the national economy and its individual sectors (including agriculture). According to preliminary data, the total volume of products (services) in agriculture, forestry and fisheries in January-June 2020 amounted to 97.2 trillion. Soums (Figure 3), or 102.8% to the corresponding period of 2019, including in crop and livestock production, hunting and provision of services in these areas - 93.9 trillion. soums (102.7%), forestry - 2.8 trillion. soums

Figure 3. The volume of products in agriculture.

(102.0%), fisheries - 0.5 trillion. sum (116.7%). In the structure of GDP (GVA), the share of agriculture, forestry and fisheries in the period under review was 24.1%. The contribution of this industry to GDP growth as a whole reached 0.6.

In January-June 2020, the growth rates of products (services) in agriculture, forestry and fisheries, compared to the corresponding period of last year, amounted to 102.8% (in January-June 2019, compared to the same period in 2018, - 102, 4%), including in plant growing and animal husbandry, hunting and provision of services in these areas - 102.7% (102.4%), forestry - 102.0% (102.1%), fisheries (Figure 4) - 116, 7% (102.0%).

In our opinion, one of the main factors of low productivity in Uzbekistan is the use of outdated technologies. The volume of innovative agricultural production in 2017, according to the State Statistics

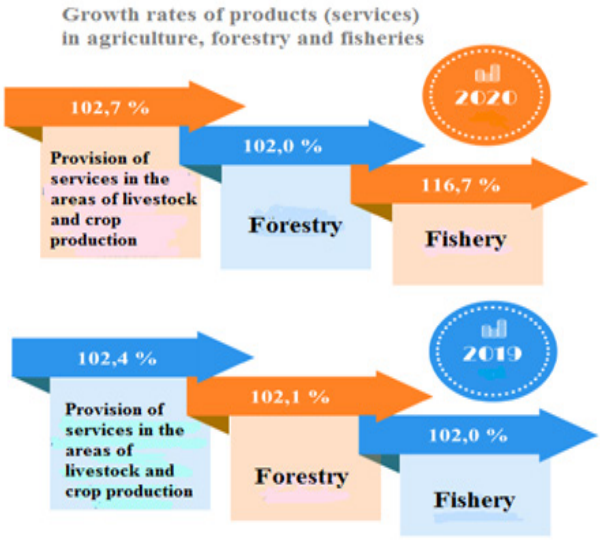

Figure 4. Growth rates of products.

Penetration rate of process innovations in agricultural companies

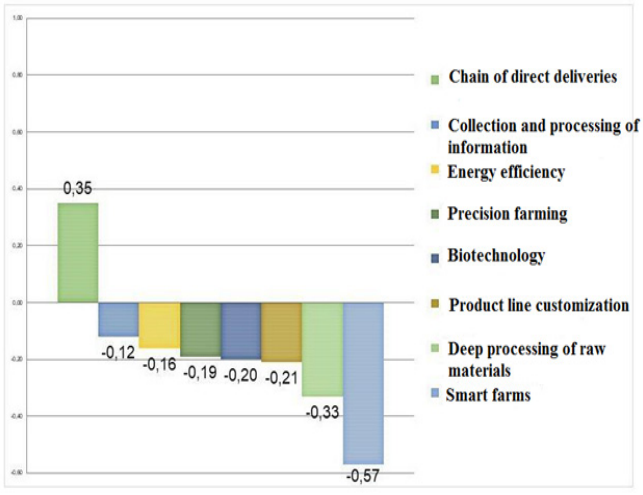

Figure 5. Penetration rate of process innovations in agricultural companies

Committee, is 2%, this is a very small part of all produced innovative products and services. The bulk of agricultural innovation came from livestock and annual crops. At the same time, more than 90% of companies emphasize the need to increase the economic efficiency of business by automating key processes.

In the next two years, the share of such companies may grow to 34 percent. Many local companies have undergone technological upgrades in recent years in the hope of gaining a foothold in global value chains. A key industry indicator (KPI) set out in the May presidential decree, which provides exports of $ 45 billion a year by 2024, will create additional incentives for rapid growth. Intelligent agricultural technologies, including agricultural technologies for growing plants, environmentally friendly agricultural technologies, technologies and equipment for phytosanitary control, biosafety and quality control of raw materials. Also technologies for integrating logistics management into the agro-industrial complex, etc. [6].

Training farmers in advanced agricultural technologies will also enhance agricultural productivity. Some projects include expanding curriculum or collaboration to improve communication. The scale and pace of digital change should become a key characteristic of the development of the agro-industrial complex of Uzbekistan. Thus, with a systematic state approach, digital technologies will significantly contribute to the development of an open information society in the country as one of the important factors in the development of democracy, increasing production efficiency, economic growth and improving the quality of life of the population of Uzbekistan. Persistent trade barriers, relatively low labor costs relative to the cost of agricultural machinery, and low awareness all contribute to the continued mechanization of agribusiness in low-income countries and some middle-income countries. Table 1 shows the possibilities of using information and digital technologies in agriculture. [10]

Modern information and digital technologies allow real-time monitoring of production processes in agriculture, which makes it possible to adapt these technologies to the needs of modern agriculture based on the construction and development of an electronic agriculture system in the agricultural sector of the Russian economy.

The introduction of modern land use systems and information agricultural technologies requires the development and implementation of innovative digital technologies. Such systems include GLONASS, Rapid Eye satellites, CORINE Land Cover.

For example, to ensure a successful harvest, farmers must be able to create ideal conditions for crop health and identify any potential pest or disease threat before they spread. Digital technologies allow faster soil testing before planting, as well as monitor plant nutrition and even recognize plant diseases after growing crops. Autonomous vehicles and drones can be equipped with cameras

Table 1

Possibilities of using digital technologies and neural networks in agriculture

Options	Plant growing	Livestock
Possibilities from application	□ precision farming □ GLONASS; □ satellite technology; □ landscape maps; □ determination of the actual cultivated areas; □ forecasting harvest performance and crop losses; □ computer vision for planting analysis; □ crop health monitoring; □ automatic irrigation systems.	□ machine vision for livestock counting; □ face recognition systems for livestock; □ formation of animal diet; □ veterinary service; □ optimization of the agricultural machinery fleet.
Implementation problems	□ significant need for financial investment; □ requires a lot of research and development; □ the need for highly qualified personnel, scientists; □ limited access of informational data of aerial photography	□ high cost of equipment renewal and modernization; □ the need to import modern technological means of keeping, feeding and caring for animals; □ high level of physical wear and tear of domestic equipment.

and sensors to collect data, which are then loaded into agricultural software. This allows you to quickly present information about the harvest to the user or the farmer to see potential problems quickly.

The introduction of GIS technologies, precision farming allows to reduce the costs of farmers and increase the efficiency of resource use. One of the most promising areas for the use of modern digital technologies is the use of GIS technologies for monitoring the use of agricultural land. Robots and autonomous vehicles can reduce labor costs while increasing efficiency. GPS and drone contour mapping quickly provide farmers with detailed information on water levels and soil fertility - and can even be transferred via the cloud.

It is advisable here to consider the role of space technologies in agriculture, which are satellite navigation systems that allow you to control the territory of Uzbekistan, prevent or minimize losses from the onset of adverse weather events. The use of the achievements of the space industry is one of the main requirements of the modern functioning and development of agricultural production, since the presence of significant territories of the agricultural sector predetermines the need to obtain information on the state of resources and forecast yield.

Note that the scope of application of global navigation satellite and geoinformation systems, as well as methods of remote sensing of the Earth is constantly expanding. GLONASS technologies in the agro-industrial complex can be used in three cases: as a guidance system, as a data analysis system and as a variable rate system. The main function of satellite navigation systems in agriculture is contact mapping of fields by soil fertility (humus content). Another area of application of GPS technology is a precision irrigation system (irrigation) for linear irrigation equipment. This system improves the accuracy and quality of irrigation equipment and the irrigation process.

In the agricultural sector, to make timely and well-grounded decisions, information is needed on the current state of crops, for the collection of which it is possible to use data from RapidEye satellites, which allow collecting data for observing and analyzing the state of the vegetation cover (assessment of the content of chlorophyll, protein and nitrogen) [12].

Precision farming solutions are used only in 3% of agricultural enterprises in Uzbekistan. While in the USA this figure reaches 60%, in the EU countries and even higher - 80%. To assess the state of the environment and monitor land use, it is possible to use CORINE Land Cover landscape maps. The costs of individual elements of the precision farming system pay off in one to two years, even in small agricultural enterprises.

The result of the introduction of innovations is to increase yields, improve the agrochemical properties of the soil, save financial costs due to the optimal use of seed material, fertilizers, plant protection products and fuel. Precision farming technologies have been successfully used for several decades abroad, and in recent years they have found more and more fans among domestic agricultural producers. [11]

The planting observation system has been introduced abroad for several years (AgMRI). To process this data, special labor-intensive models are required, but their spatial structure currently allows the use of modern computer vision technologies, in particular, convolutional neural networks. Thus, in the USA, $ 37 million was invested in the creation of the Plant Phenotyping and Imaging Research Center at the University of Saskatchewan. The tasks of this organization include collecting large datasets of crop data (usually in the form of photographs or 3D images described above) and matching phenotype data with plant genotype; the results of such projects can be used to improve agricultural technologies around the world [].

The introduction of modern technologies in animal

husbandry is characterized by the updating of the technological base of farms with the latest equipment for keeping animals. Thus, China, as part of the modernization of agriculture, is switching to innovative technologies in the management of pig-breeding complexes. Multifunctional artificial intelligence system allows you to effectively manage large farms. With the help of infrared sensors, you can keep track of the pig livestock, as well as track the movement and health of animals. Artificial intelligence makes it possible to eliminate expensive and ineffective RFID tags. This technology allows you to read data from tattoos on pigs. [8].

Artificial intelligence technologies can be useful in shaping the diet of animals. On modern farms, pigs are kept in relatively small groups, in which the most similar animals are selected. The bulk of the cost in pig production is in feed, and optimizing the feeding process is central to modern pig production. Obtaining information on the progress of feeding individual individuals allows you to create individual pig feeding programs and the selection of an individual composition of food additives, which in turn significantly increases the yield. For example, in the UK, they launched a project to use artificial intelligence to detect calf diseases. The project aims to develop a robust approach for early detection of bovine respiratory disease using infrared thermography combined with artificial intelligence.

The main advantage of using neural networks for decision-making in agriculture is the ability to reduce the risks associated with a shortage of qualified personnel, to ensure a high level of management of the usual economic activities of an agricultural enterprise. [11].

For the effective use of neural networks in the Uzbek agro-industrial complex, it is necessary to form a national publicly accessible neural network, focused, among other things, on solving problems related to veterinary medicine. This will make it possible to make a qualitative leap in the development of animal husbandry, as well as significantly reduce the costs of farms for veterinary services. The effect of the introduction of such systems will be especially noticeable in small farms, which under normal conditions cannot afford a full-time veterinarian. Thus, agrarian digital technologies of the agro-industrial complex will be able to support a single chain: information - consultation - decision making - training.

We believe that the above areas can help the agro-industrial sector to diversify the total volume of production and ensure export earnings.

Also, in order to develop agriculture, it is important to introduce digital farming as a fundamentally new management strategy based on the use of digital technologies that affect the development of the agrosphere, as well as management and executive processes that can differentiate the methods of applying fertilizers, chemical ameliorants and plant protection products. [13].

The digitalization of agriculture and agriculture is, among other things, an instrument of a large-scale program for the digitalization of villages, connecting them to digital infrastructure, bridging the "digital" divide and socio-economic revival of rural areas.

Conclusion and suggestions. The agro-industrial complex plays an important role in the development of the economy of Uzbekistan, therefore one of the important tasks of the state is to ensure its effective functioning. The introduction of digitalization in the agricultural sector contributes to ensuring food security, reducing the cost of agricultural production, as well as increasing the country's competitiveness in the global food market. The development of satellite technologies, artificial intelligence, neural networks and their introduction into agriculture marked the beginning of a new era of agriculture - intellectual, to replace manual and mechanized.

Automated irrigation systems, crop health monitoring, face recognition for livestock and many other innovations are prime examples of how digital technology can be applied to the agricultural industry. As a consequence, their use is an increase in the stability and profitability of the agro-industrial complex, the strengthening of agriculture as one of the key sectors of the national economy.

In modern conditions, for effective and cost-effective farming, it is necessary to switch to the latest agricultural management technologies using artificial intelligence, GNSS and GIS technologies. When choosing equipment and machinery, it is worth considering the size of the farm, the types of crops grown, the chosen method of processing the field, etc.

To be successful, an agricultural enterprise must meet four conditions:

— To produce as much production as possible per arable unit of land;

— To predict the risk of crop failure and minimize it;

— To minimize operating costs;

— To sell the crop at the highest possible price.

Predicting optimal planting and harvesting times, smart irrigation and fertilization, and intelligent pest control significantly increase farm productivity. The use of innovative technologies in pilot "smart" farms in Uzbekistan made it possible to obtain 2.5 times more grain harvest and reduce costs by more than 20% (according to the Ministry of Agriculture).

Precision farming requires careful and quick data analysis, therefore, Big Data and artificial intelligence processing technologies will inevitably develop in agriculture. Today farmers face new educational challenges. Being a good agronomist or machine operator is no longer enough for a farmer. Precision farming requires new technological knowledge and skills, continuous professional development. Training of professional personnel for an innovative agro-industrial complex is one of the highest needs for Uzbekistan. Innovation is developing so fast that the staff cannot keep up with it, especially in a traditionally conservative industry.

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