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STATE AND PROBLEMS OF IMPLEMENTATION OF INNOVATIONS IN THE FIELD OF ANIMAL HUSBANDRY

Summary. Ukraine's agriculture is currently facing serious challenges: high price pressures, fierce international competition, global economic constraints and growing demands on food quality and environmental protection. The article analyzes the level of livestock development in Ukraine, which indicates negative trends in livestock development: reduction of livestock, significant decline in productivity, deterioration of the quality of animals. It is noted that there is a difficult situation in the development of the industry, caused by a number of negative phenomena, some of which are long-lasting and systemic, without overcoming the current situation could lead to complete loss of certain segments of livestock and further deteriorate food security. Transforming livestock into a competitive high-tech industry with high productivity and low unproductive costs requires a technological breakthrough, an integral part of which is the introduction of digital technologies. Digital technologies in animal husbandry allow to implement the targeted needs of animals feeding, milking, product quality control, remote control of production processes in real time, provide continuous collection, analysis and use of information to ensure safety and care for the environment. The current level of development of information and communication technologies and means of their implementation in animal husbandry is analyzed and the factors that slow down their development are identified, problems of their implementation are identified, including high equipment prices, acute shortage of IT specialists, legal and ethical issues, compatibility of knowledge and experience of farmers with these technologies, stable Internet and electricity supply.

Key words: animal husbandry, intelligent digital technologies, efficiency, implementation problems

Formulation of the problem. Agriculture in Ukraine is currently facing serious challenges: high price pressure, fierce international competition,



global economic constraints and increasing demands for food quality and environmental protection [1]. The livestock industry is one of the foundations of the country's agriculture, which forms about 30% of its gross output [2]. Livestock is a supplier of raw materials for the meat and dairy industry and fertilizers for crop production; it is able to provide the population with high-quality, high-calorie, dietary and fortified food products [3]. However, there is a difficult state in the development of the industry caused by a number of negative phenomena, some of which are of a long-term and systemic nature without overcoming which the current state can lead to a complete loss of certain segments of animal husbandry and will further worsen the food security of the state. Therefore, without the revival and sustainable development of animal husbandry it is practically difficult to imagine positive changes in the standard of living of the population of Ukraine.

Analysis of recent research. Domestic researchers Yu. A. Yarmolenko [4], V. M. Rudenko [5], D. M. Sherstiuk, A. E. Nezdoyminoga [5], Yu. V. Voloschuk [6,7] and others. Foreign scientists such as A. Helwatkar [8], DS Ochs [9], S. Neethirajan [10], L. Klerkx, E. Jakku [11], A. Baldi [12], Samuel Varas [13] investigated and laid the foundations for the theoretical and practical aspects of studying the phenomenon of the digital economy and studied the possibility of obtaining a positive effect from digitalization.

Despite all the advances in the digital economy, agriculture is lagging behind in digital adoption. The transformation of animal husbandry and, in general, agriculture into a competitive high-tech industry with high labor productivity and low overhead costs requires a technological breakthrough, an integral part of which is the introduction of digital technologies into agro-industrial production. This describes the relevance of this research.

The purpose of this work is to analyze the current level of development of information and communication technologies and the means of their implementation in animal husbandry, to determine the factors that slow down their development, to identify the problems of their implementation.

In the context of a decrease in the livestock population, a very low average annual production growth rate is observed. For 10 years, it dropped to the level of 0.4%. For comparison, the growth rate in crop production is 4.8%. In addition, the rate of capital investment in animal husbandry decreased by 9.8%. Since 2015, the number of cattle in Ukraine has decreased by almost 20%. At the beginning of 2015 the number of cattle was 3.88 million heads, and at the beginning of 2020 it decreased to 3.09 million heads [6,7] (Fig. 1).

Accordingly, there is a decrease in the number of cows over the past five years; the number of farms of all types and forms of ownership has decreased by 21%. So, as of January 1, 2015, the number of cows amounted to 2.26 million heads, and at the beginning of 2020 it was already 1.78

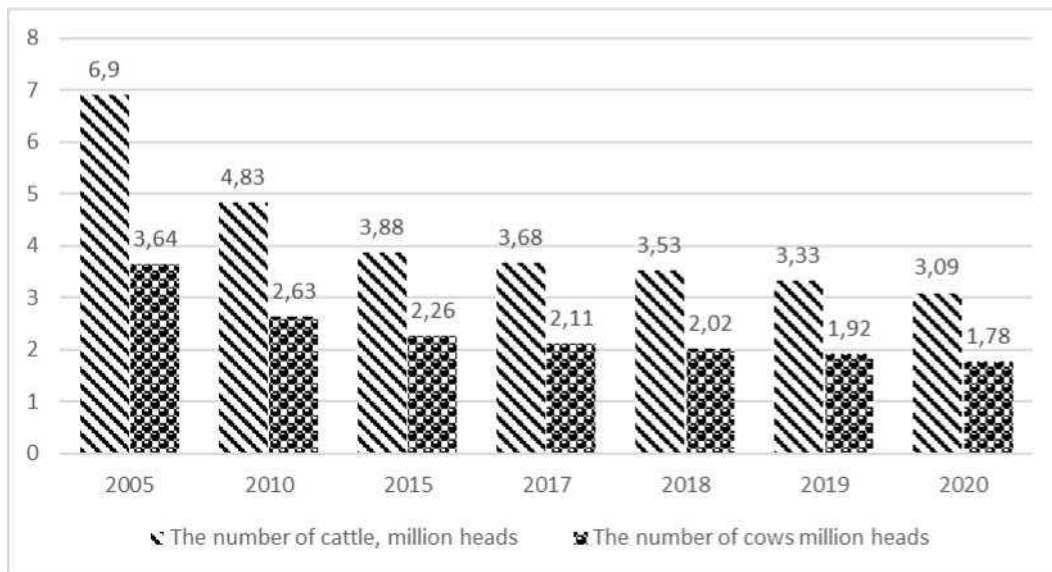


Figure 1. Dynamics of the number of cattle and cows

million heads.

Reducing livestock and falling milk yields, rising feed prices and a liberal import regime created conditions for a decrease in beef and milk production. Since 2015, beef production has decreased by 4% (Fig. 1), and milk production – by 12% (Fig. 2, 3) [6, 7].

The level of milk production also remains low. Recently there has been a tendency for this indicator to grow: over the past year the level of milk yield has increased by 1.5–5%, depending on the form of ownership (agricultural enterprise or household). But this increase is not enough to compensate for the annual decline in livestock. This leads to the fact that less milk is produced and milk prices are constantly growing and in the near future the trend towards price increases will not change.

Assessment of the state of animal husbandry in Ukraine indicates negative trends in the development of animal husbandry: a decrease in livestock, a significant decrease in productivity, deterioration in the qualitative composition of animals. These circumstances led to a deterioration in the quality of products and a decrease in production volumes, and hence a decrease in the consumption of valuable food products [14]. That's why this branch of agricultural production needs revolutionary changes, a technological breakthrough to ensure the country's food independence, an increase in export potential, and transformation into a competitive high-tech industry with high labor productivity and low costs [15, 16].

The most significant are those factors that can provide cardinal shifts in the revival of the livestock industry and the structure of livestock production, accompanied by innovative processes (modern technologies, organic livestock products, qualified personnel, modern farm machinery and

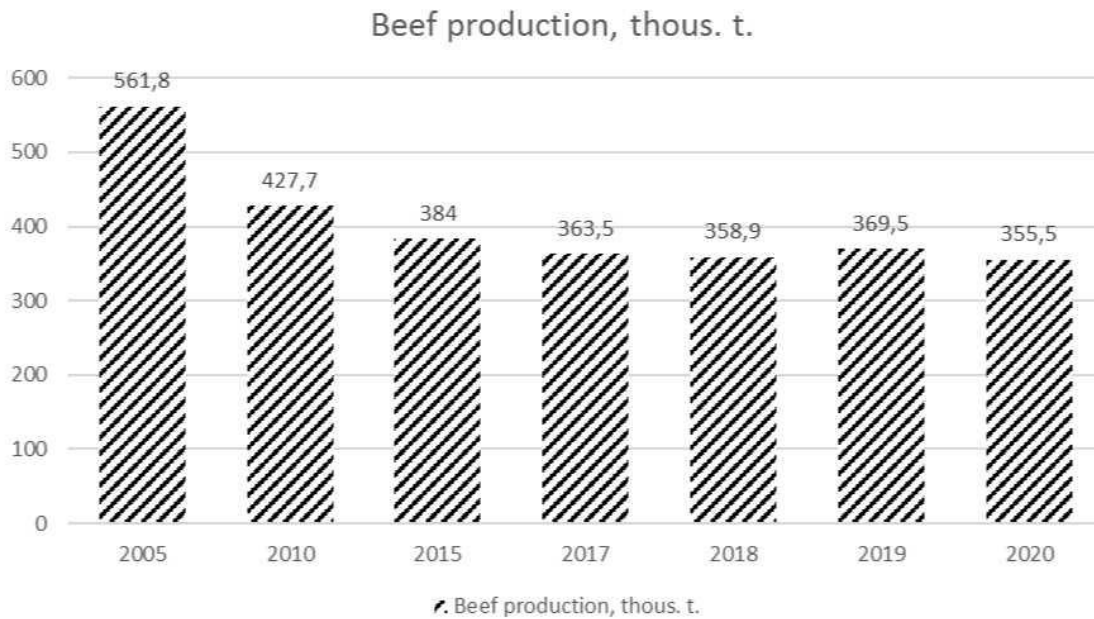


Figure 2. Beef production dynamics

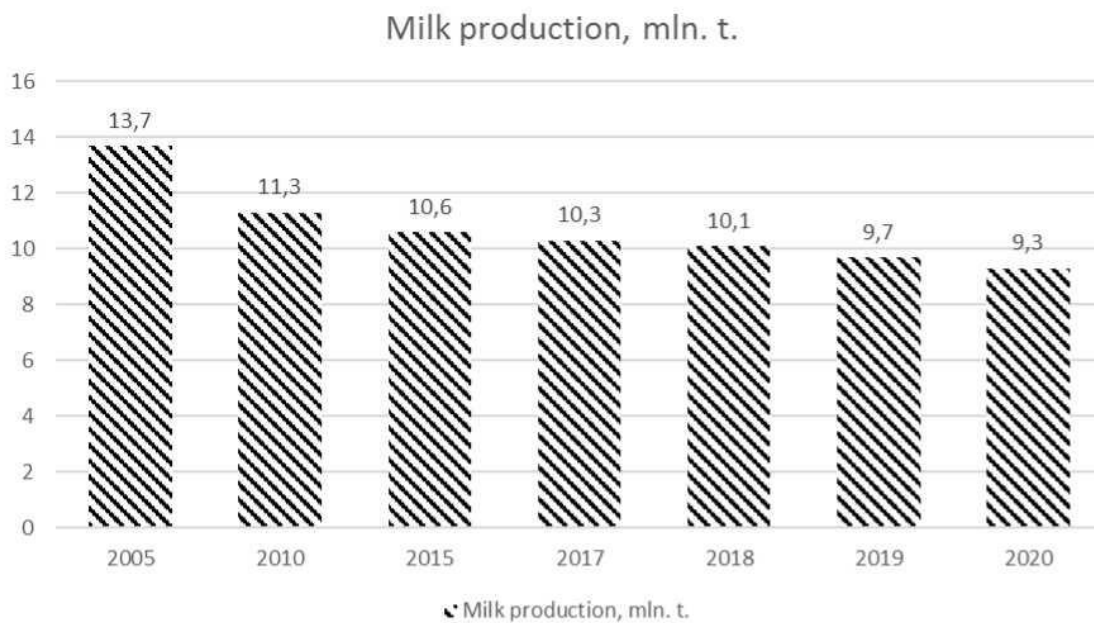


Figure 3. Milk production dynamics

equipment) and end results (reduction of production costs and costs products, improving its quality, increasing labor productivity and profitability) [17].

Formulation of the purpose of the article. The purpose of this work is to analyze the current level of development of information and communication technologies and the means of their implementation in animal husbandry, to determine the factors that slow down their development, and to identify the problems of their implementation.

Main part. A key trend in the global economy over the past decade has

been the widespread adoption of digital technologies. Modernizing their economies foreign developed countries are rapidly developing innovative technologies using artificial intelligence, automation and digital platforms [18].

Agriculture is one of the oldest spheres of human activity, but today it can't remain away from total digitalization. In most developed countries, the agricultural sector is moving away from the conservative approach, “peasant with a plow” and “milkmaid with a bucket”, towards an automated harvester and a robotic milker. In Fig. 4 information and communication (digital) technologies in the agrarian sector are shown [19].

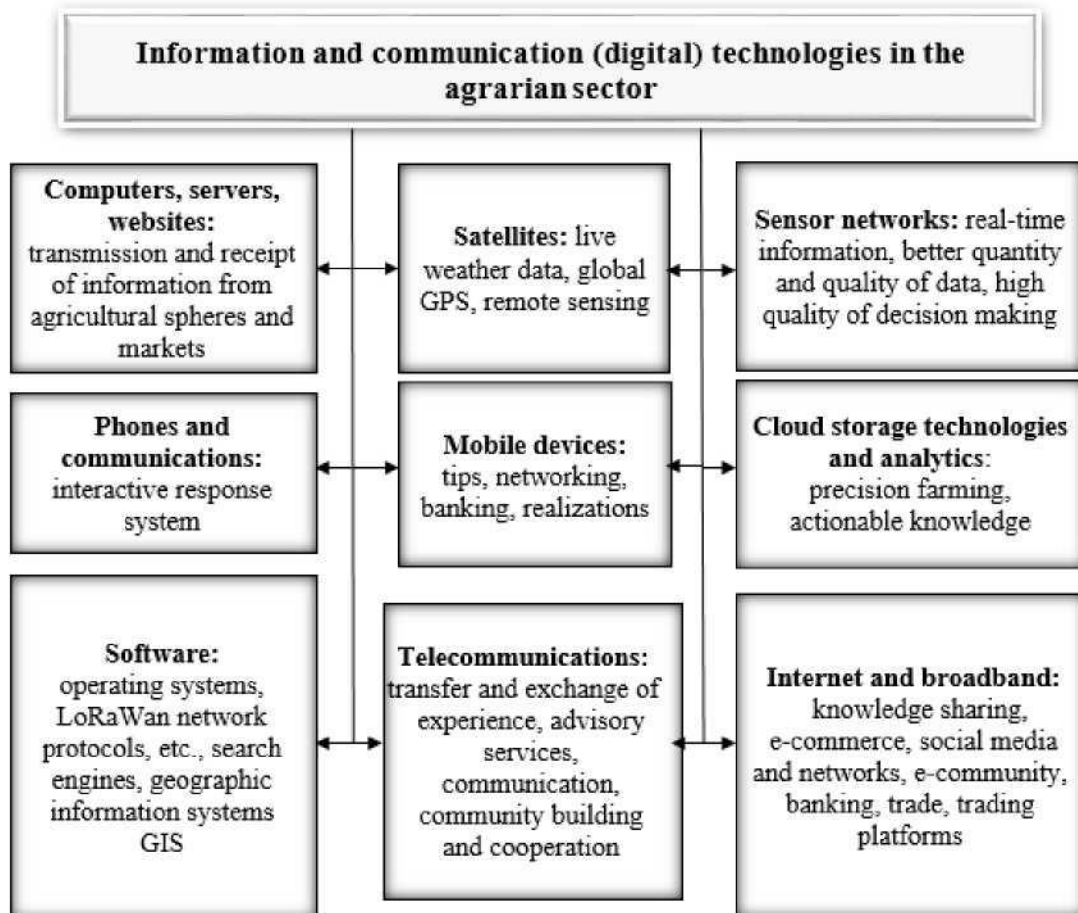


Figure 4. Information and communication (digital) technologies in the agrarian sector

Intense competition in the production of milk, beef, pork and poultry, in meat processing, which has been typical for the industry in recent years, forces all market participants to look for opportunities to reduce costs by automating managerial decision-making, efficient management of purchases, sales, warehouse stocks and optimization of cost production [20–22]. Therefore, digital technologies that help solve all of the listed tasks are in great demand in this sector. Digital technologies in animal husbandry make it possible to implement systems of feeding, milking, product quality



control, remotely control production processes in real time, and ensure the continuous collection, analysis and use of information to comply with safety measures and respect to the environment [23, 24].

An important task in the digitalization process is the adequate calculation and control of the implementation of rations across the entire spectrum of nutrient, mineral and biologically active substances, including vitamins, trace elements and other necessary components of the diet. For highly productive cows, it is extremely necessary to analyze the consumption of dry matter and the concentration of metabolizable energy, protein, fiber in it, as well as the operational management of these indicators through the software of the feed shops of the enterprises. Thus, a new concept “digital livestock breeding” is formed.

In general, digital livestock farming is understood as a set of solutions aimed at increasing production efficiency through the use of special systems, as well as means that ensure the targeted use of resources and accurate control of all processes [25, 26]. In the future, the farms will be autonomous robotic enterprises, where a person is freed from the routine of manual labor. He must be engaged in intellectual work, adjust the control algorithms of production processes, receive information about the state of animals, their location at any time, be aware of emerging malfunctions in the main functional subsystems: milking, feeding, ensuring the microclimate, etc.

The effectiveness of digitalization of animal husbandry lies primarily in the creation of experimental digital enterprises in animal husbandry (smart dairy farm, automatic pig farm, etc.) based on intelligent automated and robotic biomachine complexes of a new generation. The use of these technologies everywhere will lead to a decrease in the level of import dependence of the industry by 35–40%, an increase in the quality and quantity of products produced by 25–30%, an increase in labor productivity in the main subsectors of animal husbandry by 1.5–2 times, and will also contribute to the preservation of health and productive longevity of animals [27, 28]. In particular, centralized and local intelligent systems for managing these biomachine complexes and subsystems in animal husbandry will ensure the harmonization of the interaction of biological, technological and machine objects, effective management, a reduction in production costs by 35–40% and an increase in animal productivity by 15–20%.

Digital innovation in animal husbandry is represented by the following technologies (Fig. 5).

The dairy industry was one of the first among other livestock sectors to use intelligent production management systems, including radio frequency animal identification systems, computer control systems for milking, feeding, climate control, manure removal, milking robots and other solutions. An important step is the introduction of milk meters with the ability to measure blood and conductivity. Monitoring these indicators helps

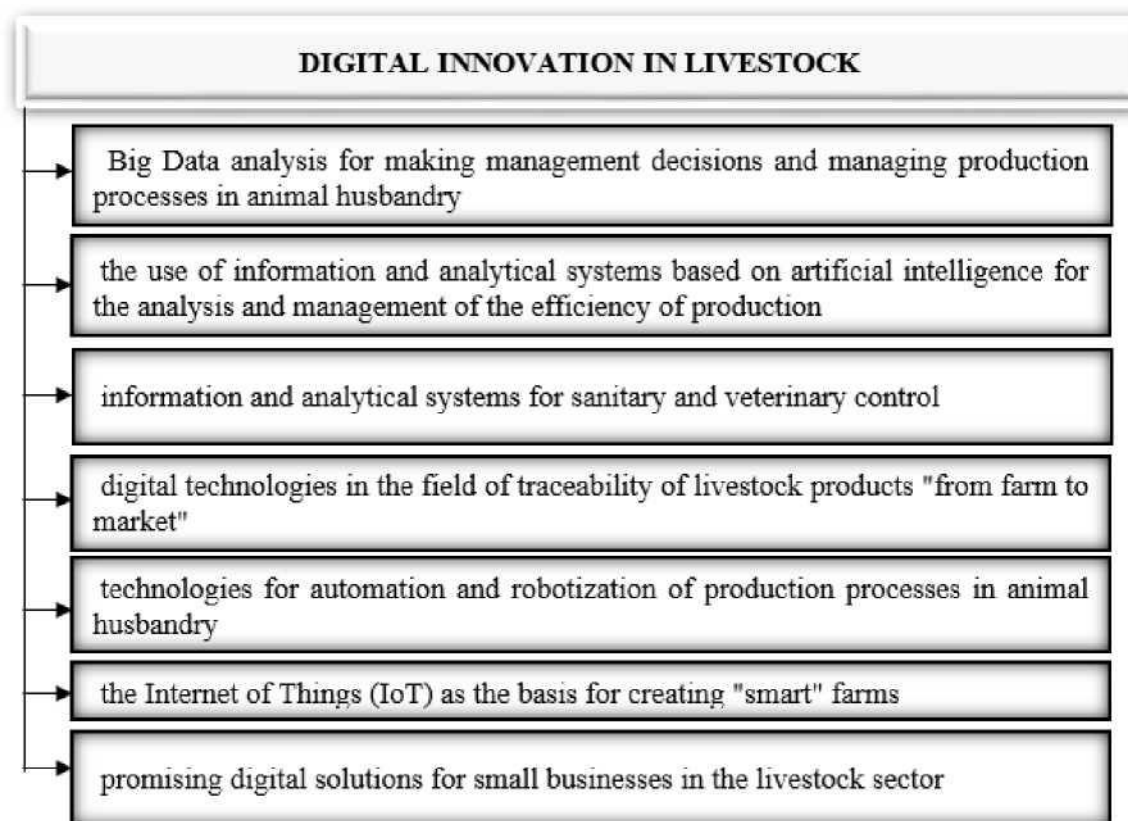


Figure 5. Digital innovation in livestock

to identify animals with mastitis at an early stage, which, in turn, allows you not to lose marketable milk. The automatic body condition determination system is becoming more and more popular in the market. Analyzing the information obtained in this way, it is possible to improve the performance of reproduction and feeding. A sought-after element is a tool that allows you to monitor indicators such as progesterone, LDH, BHB and urea in milk. Of course, the means of processing all this data is the herd management software, which combines data from all sensors and nodes to help make the right decisions with the right animal at the right time

Now the system for monitoring the activity and rumination of cows SCR is actively used. The system is represented by special collars that are assigned to each cow to accumulate individual information. The system monitors two important indicators: rumination (number of chewing repetitions) and activity (number of movements) of animals. A sudden change in rumination usually indicates a disease that is identified at an early stage, which allows the veterinary service to provide timely treatment for the cow and minimize the risks associated with milk loss and animal retirement from the herd. The activity monitoring function is used primarily by the herd reproduction service. It allows you to identify abnormalities in the normal activity of the cow and to identify the cow in heat. In addition, the system will tell you the time at which the insemination will be the most fruitful.



Advanced farms are actively introducing the technology of automatic feeding of calves which is represented by feeding stations for portioned milk feeding. The first 60 days of a calf are critically important in his life. They determine its subsequent development, the age of the first insemination of the animal, as well as all subsequent lactation. The work of the stations is controlled by software which regulates the amount of milk dispensed to a specific individual calf depending on its age. The software records the number of approaches and the amount of milk consumed by the calf and provides a list of those calves that did not drink the amount they were entitled to. This helps to identify the disease early and provide appropriate, timely treatment, which helps to reduce the risk of calves leaving in a group by up to two months and increase weight gain.

The software also regulates the calf weaning scheme and builds the required number of approaches and the amount of milk consumed in accordance with the approved scheme. Correct reduction of the amount of milk to zero stimulates the consumption of roughage and concentrates. This contributes to the normal development of the animal's rumen and has a positive effect on its viability, and subsequently on the reproductive capacity, milk yield and life expectancy of the cow. In addition, the stations are equipped with special scales for monitoring body weight gain in accordance with the required weight gain at a given age.

Despite the obvious advantages of digital technologies, there are certain factors that slow down or even make it impossible to master them. Equipment for digitalization is often imported, and high prices for equipment make the construction and modernization of production facilities too expensive.

But not only the financial side of the issue slows down mass adoption. There is an acute shortage of IT specialists for agriculture, and they will be indispensable for global digitalization at every enterprise. Implementing is not a problem, the problem is to teach how to work in a new system, not all employees, and even the leaders themselves, are psychologically ready to change, as this requires mental and physical costs. To implement a digital transformation strategy, a large number of IT specialists are required: these are experts in machine learning, robotics, big data processing and analysis, etc.

One of the most important questions to be answered is who owns the data, who owns the information? The emergence of programs and gadgets that collect data and provide information has raised the issue of ownership of the use of data. Further use of this data raises legal and ethical issues. With the improvement of new devices and software, the problem of responsibility and control of new technologies has become more acute. The need for accountability is dictated by the risk of errors that can have negative economic or environmental consequences.



Industrialization has led to a 2% reduction in the number of people employed in agriculture. The “digitization” of agriculture could further affect the number of jobs in the industry. Will it motivate talented people to go to agriculture or vice versa? Will the shift of responsibility from farmers to robots and programs increase or decrease? Another challenge is how to combine the knowledge and experience of farmers with these technologies.

And, finally, digitalization requires a stable Internet and electricity supply which not all farms can boast of.

Conclusions. The current level of development of information and communication technologies and means of their implementation in various areas of agricultural production creates the preconditions for the formation of a qualitatively new information environment in the domestic agricultural sector, stimulating the process of accelerated modernization of its industries. Gradually, digital technologies penetrate agriculture, including the livestock sector helping to optimize and simplify many production processes, increase the profitability and profitability of the business.

The future of Ukrainian animal husbandry is seen in the development of intelligent digital production management systems, harmonization of the interaction of all elements and connections in the complex biotechnical system «man – machine – animal».

To ensure the competitiveness of the livestock industry, it is necessary to increase the level of digitalization at an accelerated pace, using new advances in information development.

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СТАН ТА ПРОБЛЕМИ ВПРОВАДЖЕННЯ ІННОВАЦІЙ У ГАЛУЗІ ТВАРИННИЦТВА

Анотація

В даний час сільське господарство України стикається з серйозними проблемами: високим ціновим тиском, жорсткою міжнародною конкуренцією, глобальними економічними обмеженнями та зростаючими вимогами до якості продуктів харчування та захисту навколишнього середовища. У статті проведено аналіз рівня розвитку тваринництва в Україні, що свідчить про негативні тенденції у розвитку скотарства: скорочення поголів'я, значне зниження продуктивності, погіршення якісного складу тварин. Відзначено, що спостерігається складний стан у розвитку галузі, викликаний низкою негативних явищ, деякі з яких мають тривалий і системний характер, без подолання яких нинішній стан може призвести до повної втрати окремих сегментів тваринництва і надалі погіршуватиме продовольчу безпеку держави. Перетворення тваринництва на конкурентоспроможну високотехнологічну галузь із високою продуктивністю праці та низькими непродуктивними витратами вимагає технологічного ривка, невід'ємною частиною якого є впровадження цифрових технологій. Цифрові технології у тваринництві дозволяють впроваджувати орієнтовані потреби тварин системи годівлі, доїння, контролю якості продукції, дистанційно управляти виробничими процесами у режимі реального часу, забезпечують безперервний збір, аналіз та використання інформації для дотримання заходів безпеки та дбайливого ставлення до навколишнього середовища. Проаналізовано сучасний рівень розвитку інформаційно-комунікаційних технологій та засобів їх реалізації у тваринництві та визначено фактори, що уповільнюють їх освоєння, виявлено проблеми їх впровадження, серед яких високі ціни на обладнання, гостра нестача ІТ-фахівців, питання правового та етичного характеру, скорочення кількості працівників, сумісність знань та досвіду фермерів з цими технологіями, стабільний інтернет та електропостачання.

Ключові слова: тваринництво, інтелектуальні цифрові технології, ефективність, проблеми впровадження.