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MODERN CHALLENGES OF KAZAKHSTAN'S AGRICULTURE: DIGITALIZATION, LOGISTICS, FOREIGN EXPERIENCE

The article explores important aspects of agricultural development in modern conditions, with a particular focus on the implementation of digital technologies and the optimization of logistics processes. It also discusses the key challenges facing the agricultural sector of Kazakhstan, including inefficiency of the logistics system, insufficient use of digital tools and technologies, as well as a high dependence on external factors. The authors paid special attention to government programs and projects aimed at supporting the agro-industrial complex in the Republic of Kazakhstan. The study analyzed the experience of other countries in the use of digital tools and logistics in agriculture and formulated recommendations to improve the situation in Kazakhstan. The main focus is on the need to integrate modern digital solutions and logistics strategies adapted to the specifics of the Kazakh agro-industrial complex in order to increase production efficiency and reduce costs.

In addition, as one of the main problems in the field of digitalization of the agro-industrial complex, the article draws special attention to the importance of education and training in the field of digital technologies and logistics for effective adaptation of the agricultural sector to the constantly changing conditions of the external environment. As a result of the analysis,

certain steps and recommendations are proposed for the development of agriculture in Kazakhstan taking into account digitalization and logistics, which contributes to improving its competitiveness and resilience to change.

Keywords: agriculture, digitalization, logistics, economic transformation, government programs.

Introduction

Many authors in their studies note the key role of agriculture in the economic and social development of Kazakhstan, as it is one of the main sectors of the country's economy in many regions, making a significant contribution to the formation of GDP and employment of the population [1]. Agriculture is also of great social importance, providing the population with affordable food and contributing to improving the living standards of people in rural areas.

Agriculture of the Republic of Kazakhstan is facing a number of serious problems that affect its development and efficiency. One of the main problems is the low productivity of crops due to inefficient use of resources, insufficient use of modern technologies and insufficient financing of the industry. These factors lead to insufficient competitiveness of agricultural products in the domestic and foreign markets.

Another problem is underdeveloped infrastructure and logistics in agriculture. The lack of a developed transportation network of communications, storage facilities and, in general, infrastructure for storage and processing of agricultural products, creates difficulties for agricultural entrepreneurs in the delivery and distribution of products from producers to final and intermediate consumers. All this leads to an increase in the cost of transportation and storage costs, which significantly reduces the competitiveness of domestic agricultural producers and limits their ability to expand production.

Materials and methods

The main objective of this study is defined as the study of the current state and level of digitalization in agriculture in Kazakhstan in order to identify problems and prospects for the development of the main digital logistics tools in the agro-industrial complex.

For the analysis, the theoretical framework and methodological foundations based on research in the field of economic transformation of agriculture and the principles of development of digital logistics tools were used. During the work on the article, methods of statistical, logistic, economic analysis and comparison were used. Normative legal acts regulating the procedure for the introduction of digital technologies in agriculture, statistical and analytical data on the Republic of Kazakhstan, scientific papers and materials of scientific conferences are used

as source and information data. The works of foreign scientists in this field were considered as a methodological basis.

Results and discussion

Economic logistics plays an important role in solving the problems of agriculture in Kazakhstan. The development of logistics will optimize the processes of delivery and storage of agricultural products, reduce transportation costs and improve access to markets. However, this requires major changes in the infrastructure and organization of logistics processes.

The development of economic logistics in the agricultural sector also contributes to the improvement of living standards of the rural population, because as it is known, an increase in production efficiency leads to an increase in the income of society and improved access to food and other goods and services.

One of the important tasks of economic logistics in agriculture is to optimize logistics processes in order to reduce costs and improve the quality of service. Continuous development and dynamic advances in information technology and automation are helping to reduce the time and costs associated with data processing and transmission, significantly improve inventory management, and increase the efficiency of product transportation and warehousing.

In addition, as noted earlier, it is important to develop warehouse complexes taking into account modern requirements for temperature and storage conditions, as well as create conditions for processing agricultural products at production sites, which will reduce transportation costs and improve the quality of the final product. An efficient transport system makes it possible to deliver agricultural products to consumers in a timely manner and reduce the time and financial costs of transporting them. The development of transport infrastructure contributes to an increase in the production and export of agricultural products, which has a positive impact on the country's economy.

Modern achievements in agriculture cannot be considered without digitalization. Digitalization plays a key role in optimizing the processes of economic logistics in agriculture in Kazakhstan. It allows you to improve inventory management, increase the accuracy of demand forecasting, optimize delivery routes and reduce order processing time. The use of digital technologies such as warehouse management systems (WMS), enterprise resource planning systems (ERP) and transport monitoring systems (GPS) allows agricultural enterprises to effectively manage their logistics and improve customer service [2].

One of the examples of effective application of digital technologies in the agro-industrial complex of Kazakhstan is the use of field management system (FMS), which allows you to automate the management of agricultural land, manage

machinery and equipment in the field and collect data on the condition of crops. This helps to increase yields and reduce production costs.

Digitalization also contributes to the development of e-commerce in agriculture, which allows agricultural enterprises to expand their markets and improve access to consumers.

E-commerce in agriculture (e-agriculture) is the use of information and communication technologies to improve the production, processing, storage, transmission and use of information related to agriculture. It includes a wide range of activities, ranging from online trading of agricultural products and services to the application of information and communication technologies in the management of agricultural processes [3].

Ways for the development of electronic commerce in agriculture in Kazakhstan include:

1 Creation of electronic trading platforms: The Government of Kazakhstan supports the creation and development of electronic trading platforms for agricultural goods and services, which helps to increase market access and reduce costs.

2 Development of digital infrastructure: For the successful development of e-commerce, it is important to provide access to high-speed Internet and modern information technologies in rural areas.

3 Training and support for entrepreneurs: Conducting training programs and consultations for agricultural producers on the use of electronic commerce and digital tools.

4 Promotion of the use of the electronic payment system: Support for electronic payment systems and promotion of their use to pay for agricultural products and services.

The implementation of these and other measures will help improve the access of agricultural goods to markets, increase the incomes of agricultural producers and improve the quality and accessibility of products for consumers.

One of the key advantages of digitalization in Kazakhstan's agriculture is improved data management. Digital technologies make it possible to collect, analyze and use large amounts of data on production, market, customers and transport. This helps to make more informed decisions, optimize production processes and predict demand.

Another important aspect of digitalization in agriculture is the improvement of supply chain management. The use of digital technologies allows agricultural producers to: 1) trace the path of products from the manufacturer to the intermediate or final consumer, 2) optimize their logistics operations as much as possible, and 3) reduce time delays (supply disruptions) and associated excess costs. This

contributes to the efficiency of the entire supply chain and improves customer service.

Digitalization helps to improve access to information and learning. Agricultural workers can access training materials, expert support and information about new technologies through digital platforms. This helps to improve the skills of personnel, improve production processes and reduce production risks.

Thus, digital technologies play the most significant role in the progress of economic logistics in the agricultural sector of the country, contributing to improving production efficiency, reducing costs and improving service quality. The introduction of digital technologies allows the country's agricultural enterprises to improve their productivity indicators and become more competitive in the global market.

Changes and transformation of the economy in agriculture of the Republic of Kazakhstan based on the principles of digital logistics face various problems, which hinders its effective implementation. Here are some of the main problems:

1) Insufficient development of digital infrastructure. Insufficient coverage of rural areas with high-speed Internet and lack of access to modern digital technologies limits the possibilities of implementing digital logistics tools. According to the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, in 2022, only 76 % of rural settlements had access to broadband Internet [4]. This creates problems for the introduction of digital technologies in agriculture.

2) **Low level of digital literacy** among agricultural workers and lack of specialists with relevant qualifications in digital technologies may hinder the successful implementation of digital transformation projects. According to the Agency of the Republic of Kazakhstan for Statistics, in 2021, the share of workers with higher education in agriculture was only 5.7 % [5].

3) Financial constraints: The introduction of modern digital logistics tools requires significant investments in updating the technological base, which may not be available for small agricultural enterprises. In accordance with the data of the National Bank of the Republic of Kazakhstan provided in official sources, in 2023, the share of loans for agricultural development was only 6.2 % of the total volume of loans to the economy in the expanded definition [6]. Lack of funding may limit the possibilities of implementing digital tools.

4) Legislation characterized by complexity, internal contradictions and instability, which can significantly slow down the process of economic transformation.

5) Privacy and data security issues: The introduction of digital technologies in agriculture is associated with the risk of leakage of confidential information

and cyber attacks, which requires additional measures to ensure data security. According to the Kazakhstan Cybersecurity Center, the number of cyber attacks on agricultural enterprises increased by 25 % in 2021. In general, the Republic of Kazakhstan ranked 7th in the world in terms of the number of cyber attacks in 2023 [7]. This creates additional risks for the introduction of digital technologies.

Solving these problems will require an integrated approach and cooperation between government, business and educational institutions to develop digital infrastructure, improve digital literacy and provide financial support for the introduction of digital tools in agriculture.

To date, the state is taking active measures in matters of digitalization. The most significant of these measures in the field of state support for the development of agriculture in general, as well as issues of digitalization of the agro-industrial complex industry, is the development and approval:

1) «Concepts for the development of the agro-industrial complex of the Republic of Kazakhstan for 2021–2030»,

2) The State program «Digital Kazakhstan», According to which the country will have to go through a complete digital transformation, carried out with the help of 23 key projects, the purpose of which is to penetrate into various sectors of the economy to stimulate the development of digital business.

3) The National Project «Accessible Internet», for the implementation of which in the period 2023–2027 it is planned to allocate 1499333378 thousand tenge. The result of this project is «providing the population and business entities with high-speed Internet access (≥ 100 Mbit/s)» [8]. and others.

The effectiveness and experience of using digital tools in agriculture and logistics can be considered using the example of countries such as the USA, Germany, the Netherlands and Japan, which are presented in Table 1 [9].

Table 1 – Use of digital tools in agriculture

Country	Digital tools
The United States	uses digital technologies to manage the supply chain in agriculture. Farmers use specialized software solutions for crop accounting, production planning and soil condition monitoring. In addition, digital technologies are actively used for weather monitoring, crop forecasting and optimization of delivery routes.
Germany	uses digital tools to manage production processes and logistics in agriculture. Farmers are using automation systems to manage irrigation, agrochemicals and mechanization, which generally reduces production costs and increases production efficiency.

The Netherlands	Farmers in this country are improving crop yields and the efficient use of natural and other resources through the use of sensors to monitor soil and plants and GPS systems to control farm machinery.
Japan	Japanese farmers, on the other hand, are increasing crop yields and reducing agricultural production costs by using drones to monitor fields and identify problem areas, as well as smart systems for irrigating and fertilizing land.
Russia	uses automated production management systems and Precision Agriculture technologies
Canada	uses digital technologies to manage production, monitor soil and plants, and optimize logistics processes
Australia	uses drones, sensors and GPS systems to improve production efficiency
Brazil	Brazil proposes to use digital tools to manage crops, track yields and monitor farm machinery.

These examples show that developed countries are actively using digital tools in agriculture and logistics, which allows them to increase production efficiency, reduce costs and improve product quality [10]. Studying the experience of these countries can help Kazakhstan identify the most effective approaches to the development of digital agriculture and logistics in a similar climate and level of development.

Conclusions

At the moment, digital technologies in agriculture in Kazakhstan, despite the stated digitization strategy, have not yet reached the proper level of development and are used only by some farms, which indicates the fragmentation of the digitalization process. However, agricultural enterprises are increasingly realizing that the digital transformation of the industry is necessary to increase competitiveness and sustainable environmental development of the agricultural sector. Currently, large agricultural firms are beginning to introduce digital technologies, and there is a tendency to increase their number. It is predicted that by 2025, most agricultural enterprises in Kazakhstan will use information technology and digital solutions in their activities.

Summing up and analyzing the information presented above, let us highlight the main key challenges in logistics and digitalization of agriculture in Kazakhstan, described in Table 2.

Table 2 – Key problems in the field of logistics and digitalization of agro-industrial complex, possible ways to solve them

Problems	Solutions
Digitalization	
<p>- Many agricultural producers are not interested in the results of the digitalization program. The main reasons are: 1) unwillingness to change long-standing, current approaches; 2) high risks associated with the payback of expensive digital technologies, software and their implementation; 3) unwillingness to learn</p> <p>- Agricultural enterprises mostly do not have specialists in digitalization and have insufficient level of staff training. Many employees of peasant (farm) farms have education and experience in agronomy and technology, but do not have even basic skills in information technology. This shortage of qualified specialists seriously hampers the introduction of modern digital technologies in the agro-industrial complex of Kazakhstan.</p> <p>- The program «Digital Kazakhstan» is not sufficiently elaborated at regional levels, taking into account their agricultural specification. It presents only a general vision of digitalization in agriculture, but does not contain detailed plans and proposals for their implementation in the regions of the country.</p> <p>- Important agricultural data necessary for peasant farms to conduct their production are scattered and not systematized.</p>	<p>- In order to stimulate peasant farms to implement digital technologies in agriculture, it can be proposed to use various subsidies from the state, the introduction of “digital” benefits and tax reductions for participants of relevant programs.</p> <p>- It is proposed to create a common database that will contain the information necessary for farmers and, in the future, the entire information space.</p> <p>- It is recommended to conduct detailed studies to assess the effectiveness of digitalization of technological processes in the region at the level of typical (representative) peasant farms, agribusinesses with specific calculations of costs, benefits and results (economic, technological, environmental effects, etc.).</p> <p>- It is necessary to organize cooperation with foreign partners, including companies specifically specializing in digital technologies in the agribusiness sector. To study their experience in the field of digitalization of agriculture, and adapt suitable platforms for the regions of Kazakhstan, as well as to create conditions for the exchange of international practices and technologies in the agricultural sector.</p> <p>- For the effective and high-quality use of digital technologies in agriculture, it is also important to attract specialists from universities, research centers, etc., conduct joint research in order to ensure the necessary testing, analysis, certification and subsequent monitoring and consulting on modern digital technologies in peasant farms.</p>
Logistics	

<ul style="list-style-type: none"> - Insufficient infrastructure: Some regions of the country have poorly developed transport and storage infrastructure, which makes it difficult to efficiently deliver agricultural products to consumers. - Low transportation efficiency: Insufficient use of modern technologies and logistics methods leads to suboptimal use of vehicles and increased shipping costs. - Problems with storage and processing: The limited availability of modern storage facilities and processing plants limits the ability to preserve and improve the quality of agricultural products. - Insufficient coordination between participants in the supply chain: The lack of effective interaction between producers, suppliers, carriers and other participants in the supply chain leads to delays and losses of goods. 	<ul style="list-style-type: none"> - Infrastructure development: Investing in the development of transport and warehouse infrastructure in agricultural production regions to improve storage and transportation conditions for agricultural products. - Introduction of modern logistics technologies: The use of warehouse management systems, transport routing, as well as the use of Internet of Things (IoT) technologies to improve the efficiency of logistics processes. - Stimulating the development of storages and processing enterprises: Providing benefits and subsidies for the development of modern storages and processing enterprises to improve the conditions of storage and processing of agricultural products. - Improved coordination and information exchange: Implementation of e-commerce and data exchange systems between supply chain participants to increase transparency and responsiveness to changes in the logistics chain.
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ҚАЗАҚСТАНДАҒЫ АУЫЛ ШАРУАШЫЛЫҒЫНЫҢ ЗАМАНАУИ МІНДЕТТЕРІ: ЦИФРЛАНДЫРУ, ЛОГИСТИКА, ШЕТЕЛДІК ТӘЖІРИБЕ

Мақалада цифрлық технологияларды енгізуге және логистикалық процестерді оңтайландыруға назар аударатын, қазіргі жағдайда ауыл шаруашылығын дамытудың маңызды аспектілері қарастырылады. Сондай-ақ, логистика жүйесінің тиімсіздігін, цифрлық құралдар мен технологияларды жеткіліксіз пайдалануды, сондай-ақ сыртқы факторларға жоғары тәуелділікті қоса алғанда, Қазақстанның аграрлық секторының алдында тұрған түйінді проблемалар қарастырылады. Авторлар Қазақстанның АӨК қолдау саласындағы мемлекеттік бағдарламалар мен жобаларға ерекше назар аударады, басқа елдердің ауыл шаруашылығын цифрландыру және логистика саласындағы тәжірибесін талдайды және Қазақстандағы жағдайды жақсарту үшін ұсынымдар ұсынады. Өндірістің тиімділігін арттыру, шығындарды азайту мақсатында Қазақстандық агроөнеркәсіптік кешеннің ерекшелігіне бейімделген заманауи цифрлық шешімдер мен логистикалық стратегияларды интеграциялау қажеттілігіне басты назар аударылады. Сонымен қатар, мақала аграрлық секторды заманауи сын-қатерлерге тиімді бейімдеу үшін цифрлық технологиялар мен логистика саласындағы мамандарды оқыту мен оқытудың маңыздылығына назар аударады. Талдау нәтижесінде цифрландыру мен логистиканы ескере отырып, Қазақстанның ауыл шаруашылығын дамыту үшін нақты қадамдар

мен ұсынымдар ұсынылады, бұл оның бәсекеге қабілеттілігін және өзгерістерге төзімділігін арттыруға ықпал етеді.

Кілтті сөздер: ауыл шаруашылығы, цифрландыру, логистика, экономикалық трансформация, Мемлекеттік бағдарламалар.

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СОВРЕМЕННЫЕ ВЫЗОВЫ СЕЛЬСКОГО ХОЗЯЙСТВА КАЗАХСТАНА: ЦИФРОВИЗАЦИЯ, ЛОГИСТИКА, ЗАРУБЕЖНЫЙ ОПЫТ

В статье исследуются важные аспекты развития сельского хозяйства в современных условиях, сосредотачиваясь на внедрении цифровых технологий и оптимизации логистических процессов. А также рассматриваются ключевые проблемы, с которыми сталкивается аграрный сектор Казахстана, включая неэффективность системы логистики, недостаточное использование цифровых инструментов и технологий, а также высокую зависимость от внешних факторов. Авторы особое внимание уделяют государственным программам и проектам в области поддержки АПК Казахстана, анализируют опыт других стран в области цифровизации и логистики сельского хозяйства и предлагают рекомендации для улучшения ситуации в Казахстане. Основной акцент делается на необходимости интеграции современных цифровых решений и логистических стратегий, адаптированных к специфике казахстанского агропромышленного комплекса, с целью

повышения эффективности производства, снижения издержек. Кроме того, статья обращает внимание на важность образования и обучения специалистов в области цифровых технологий и логистики для эффективной адаптации аграрного сектора к современным вызовам. В результате анализа предлагаются конкретные шаги и рекомендации для развития сельского хозяйства Казахстана с учетом цифровизации и логистики, что способствует повышению его конкурентоспособности и устойчивости к переменам.

Ключевые слова: сельское хозяйство, цифровизация, логистика, экономическая трансформация, государственные программы.

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