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IRSTI 68.75.81

<https://doi.org/10.51889/3078-8579.2026.89.3.006>

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ANALYSIS OF DIGITAL INNOVATIONS AND THEIR FINANCIAL IMPACT ON CHINESE AND KAZAKH AGRICULTURAL ENTERPRISES

Abstract

In the context of the rapid development of digital technologies in the economy, the introduction of innovative solutions in the agricultural sector is of particular importance. Digital innovations have a significant impact on the production efficiency and financial results of agricultural enterprises.

The relevance of the study is due to the need to assess the impact of digital technologies on the financial efficiency of agricultural enterprises, as well as insufficient study of the experience of introducing digital innovations in agriculture in China and Kazakhstan.

The purpose of the study is to analyze digital innovations and their impact on agricultural enterprises in the two countries. The paper uses methods of comparative and economic-statistical analysis based on the analysis of statistical data, scientific publications and analytical materials that reflect the level of development of digital technologies in agriculture and their impact on the performance of enterprises. The study showed that the use of precision farming technologies, digital production management platforms, data analysis systems, to increased yields, lower production costs, and increased profitability of agricultural enterprises.

A comparison of the situation in China and Kazakhstan showed that China has achieved a higher level of digitalization in the agricultural sector due to the development of digital infrastructure and active government support. In Kazakhstan, the processes of digitalization are at the stage of active development.

The practical significance of the research lies in the fact that its results can be used to develop strategies for digitalization of the agricultural sector, improve government policy in the field of agriculture and introduce innovative technologies in agricultural enterprises.

Key words: digital innovations, agriculture, digitalization of agriculture, financial efficiency, agribusiness enterprises, China, Kazakhstan.

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АНАЛИЗ ЦИФРОВЫХ ИННОВАЦИЙ И ИХ ФИНАНСОВОГО ВЛИЯНИЯ НА СЕЛЬСКОХОЗЯЙСТВЕННЫЕ ПРЕДПРИЯТИЯ КИТАЯ И КАЗАХСТАНА

Аннотация

В эпоху стремительного развития технологий инновационные решения становятся всё более актуальными в сельскохозяйственном секторе. Их внедрение значительно влияет на финансовую эффективность предприятий.

Актуальность исследования определяется необходимостью оценки воздействия цифровых технологий на финансовые результаты сельскохозяйственных организаций, а также недостаточной изученностью опыта внедрения инноваций в сельском хозяйстве Китая и Казахстана.

Главная цель исследования заключается в оценке уровня применения инновационных технологий на сельскохозяйственных предприятиях Китая и Казахстана и определении их влияния на экономические показатели. Для достижения этой цели были использованы методы сравнительного анализа, экономической оценки, изучения статистических данных и анализа научной литературы. Были рассмотрены материалы, характеризующие уровень цифровизации сельскохозяйственного сектора и её воздействие на эффективность предприятий.

Результаты исследования продемонстрировали, что использование систем точного земледелия, цифровых инструментов управления и технологий анализа данных значительно повышает производительность сельскохозяйственных предприятий, снижает производственные затраты и улучшает их экономические показатели.

Сравнительный анализ Китая и Казахстана показал, что Китай достиг более высоких результатов в области цифровизации сельского хозяйства благодаря развитой инфраструктуре и активной государственной поддержке, а в Казахстане процессы цифровизации находятся на стадии активного развития.

Практическая значимость данного исследования заключается в том, что результаты могут быть использованы при разработке стратегий цифровизации сельскохозяйственного сектора, совершенствовании государственной аграрной политики и внедрении современных технологий на сельскохозяйственных предприятиях.

Ключевые слова: цифровые инновации, сельское хозяйство, цифровизация сельского хозяйства, финансовая эффективность, предприятия агробизнеса, Китай, Казахстан.

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ҚЫТАЙ МЕН ҚАЗАҚСТАНДАҒЫ АУЫЛ ШАРУАШЫЛЫҒЫ КӘСІПОРЫНДАРЫНА ЦИФРЛЫҚ ИННОВАЦИЯЛАР МЕН ОЛАРДЫҢ ҚАРЖЫЛЫҚ ӘСЕРІН ТАЛДАУ

Аңдатпа

Технологиялардың қарқынды дамуы жағдайында инновациялық шешімдердің ауыл шаруашылығы секторындағы маңызы артып келеді. Инновацияларды енгізу кәсіпорындардың қаржылық тиімділігіне елеулі әсерін тигізеді.

Зерттеудің өзектілігі - ауыл шаруашылығы кәсіпорындарының қаржылық тиімділігіне цифрлық технологиялардың әсерін бағалау қажеттілігімен, сондай-ақ Қытай мен Қазақстанның ауыл шаруашылығында инновацияларды енгізу тәжірибесінің жеткіліксіз зерттелуімен айқындалады.

Зерттеудің негізгі мақсаты – Қытай мен Қазақстандағы ауыл шаруашылығы кәсіпорындарында инновациялық технологияларды қолдану деңгейін бағалау және кәсіпорындардың экономикалық нәтижелеріне ықпалын анықтау. Осы мақсатқа жету үшін салыстырмалы талдау, экономикалық бағалау, статистикалық деректерді зерттеу және ғылыми әдебиеттерді саралау әдістері пайдаланылды. Сонымен қатар ауыл шаруашылығы саласының цифрлану деңгейін және кәсіпорындардың тиімділігіне әсерін сипаттайтын ақпараттар қарастырылды.

Зерттеу қорытындылары дәлме-дәл егіншілік жүйелерін, цифрлық басқару құралдарын және деректерге негізделген технологияларды енгізу ауыл шаруашылығы кәсіпорындарының өнімділігін арттыруға, өндірістік шығындарды қысқартуға және жалпы экономикалық тиімділікті жоғарылатуға мүмкіндік беретінін көрсетті.

Қытай мен Қазақстанды салыстыру барысында Қытайдың ауыл шаруашылығын цифрландыру саласында инфрақұрылымның дамуы және мемлекеттік қолдаудың белсенділігі арқасында жоғары нәтижелерге қол жеткізгенін көрсетті, ал Қазақстанда цифрландыру үдерістері белсенді даму кезеңінде екенін айқындады.

Зерттеудің практикалық маңызы ауыл шаруашылығы секторын цифрландыру стратегияларын әзірлеуде, мемлекеттік аграрлық саясатты жетілдіруде және ауыл шаруашылығы кәсіпорындарына заманауи технологияларды енгізуде пайдалануға болатындығымен сипатталды.

Түйін сөздер: цифрлық инновациялар, ауыл шаруашылығы, ауыл шаруашылығын цифрландыру, қаржылық тиімділік, агробизнес кәсіпорындары, Қытай, Қазақстан.

Introduction

In the era of global digital transformation of the economy, the introduction of digital innovations in the agricultural sector is of particular importance.

Modern technologies such as precision farming systems, big data analysis, artificial intelligence, the Internet of Things and digital platforms for agricultural production management are becoming key tools for improving the efficiency of agricultural enterprises.

For countries with developing agricultural economies such as Kazakhstan and China, digitalization of agriculture plays a strategic role in ensuring food security, increasing labor productivity and sustainability of agricultural production.

In China, digital technologies are being actively introduced into agriculture as part of the state strategy for the development of the digital economy and the progressive agricultural sector.. Kazakhstan is also working to integrate digital technologies into the economy, including the development of smart agriculture, digital platforms and systems for agricultural processes. In this regard, an analysis of digital innovations and their impact on the financial performance of agricultural enterprises in two relevant countries is carried out.

The need for research is due to the need to assess the effectiveness of digital technologies in the agricultural sector and their impact on the financial results of agricultural enterprises. Despite the active introduction of digital technologies, the issues of economic benefits from their use have not been sufficiently investigated, especially in comparison with different national economies.

In this article, we will look at how digital technologies affect the work of agricultural enterprises in China and Kazakhstan. To do this, we will analyze how digital innovations are changing the work of these companies and how they affect their financial performance.

To achieve the research goal, we will solve several tasks:

1. Let's look at how digital technologies are developing in agriculture in China and Kazakhstan.
2. Let's determine how digital innovations affect the financial performance of agricultural enterprises.
3. Let's evaluate the economic efficiency of using digital technologies in agriculture.

The study will be unique because we will compare how digital innovations affect the work of agricultural enterprises in China and Kazakhstan. We will also identify which factors influence the effectiveness of digital transformations in agricultural production.

The theoretical significance of the research lies in the fact that it contributes to the development of scientific ideas about the impact of digital innovations on improving the financial stability and effectiveness of agricultural organizations.

Practical application of the research results can be useful for developing recommendations for improving digitalization policy in the agricultural sector. In addition, the data obtained can be used by agricultural enterprises in making managerial decisions about the introduction of digital technologies.

Materials and methods. The study is based on the study of statistical and analytical data that reflect the level of digitalization of agriculture and the financial performance of agricultural enterprises in China.

Data from international and national statistical organizations were used as sources of information, including official reports from government agencies, analytical materials from international organizations, as well as the results of scientific research on digital transformation in the agricultural sector.

Indicators of the use of digital technologies in agriculture, such as precision farming, digital platforms and automation of production processes, were used as the information basis of the study. The financial performance indicators of agricultural enterprises, including productivity, profitability and resource efficiency, were also reviewed.

In the process of applying the comparative analysis method, the level of development of digital innovations and their impact on the financial results of agricultural companies in China and Kazakhstan are compared.

This method allows us to identify possible discrepancies and differences in the processes of digital transformation of the agricultural sector of the two countries, as well as to identify factors affecting the effectiveness of the use of digital technologies.

The method of economic and statistical analysis is used, which includes the processing and interpretation of quantitative data describing the development of digital innovations and the financial results of agricultural companies. This method allows us to determine the relationship between the level of digitalization and the economic efficiency of agricultural production, as well as to track the dynamics of the development of digital technologies in agriculture in traditional countries.

Results and discussion.

A literature review devoted to the analysis of digital innovations and their financial impact on agricultural enterprises in China and Kazakhstan demonstrates that recently scientists have been actively investigating the impact of digitalization on the effectiveness of the agricultural sector, productivity and real performance of agricultural enterprises.

Researchers from China – Xinxin Zhou, Tong Chen and Bangbang Zhang – are studying the prospects for the development of agriculture in their country (Zhou et al., 2023). They analyze how the spatial organization of agriculture is changing in different regions of China, and assess the impact of digital technologies on the environmental and economic efficiency of the agricultural sector.

For their research, scientists use data from Chinese provinces and econometric models. They are trying to understand how digitalization affects agricultural productivity.

The results of the study show that digital technologies really increase the overall productivity of agriculture and the efficiency of resource use. This effect can be compared with the effect of human capital and labor.

Other Chinese scientists, such as Jijie Dong and Jianguo Xu, have made significant contributions to the development of agriculture and helped create a competitive agricultural sector (Dong & Xu, 2025).

In their study, a comprehensive system for assessing the level of digitalization of agriculture was developed. It includes aspects such as digital infrastructure, technological solutions, digital platforms for providing services, and the institutional environment.

The authors conclude that digital transformation contributes to increasing the efficiency and sustainability of agricultural production, as well as contributes to the formation of an innovative agricultural economy.

In Kazakhstan, D. M. Akynov, A. N. Lambekova and A.M. Nurgaliyeva play a key role in the process of digitalization of the agricultural sector (Akynov et al., 2025). In their research, they examine how digitalization and investment affect the sustainable development of agricultural enterprises in Kazakhstan.

The authors emphasize that digital transformation is a necessary condition for increasing productivity, competitiveness and sustainability of the agricultural sector. However, the quality level of digital technologies in agriculture in Kazakhstan is still insufficient.

The work of O. V. Misnik, G. Zh. Yesenova and M. T. Zholamanova examines the key aspects of the development of small and medium-sized enterprises in the field of agriculture in Kazakhstan in the context of digitalization (Misnik et al., 2023).

The study analyzes the main directions of the state program for the introduction of digital technologies in the agricultural sector. Among them are the development of precision agriculture, the creation of “smart farms”, the use of digital platforms and the automation of public services for agricultural producers.

The authors emphasize that the introduction of digital technologies contributes to improving the efficiency of agricultural business and ensures effective interaction between banks, IT companies and agricultural enterprises.

Research of scientific papers shows that digital technologies play a key role in increasing the efficiency of agricultural production, optimizing management and improving the financial performance of agricultural enterprises. There are not enough papers in the scientific literature that would compare the impact of digital innovations on the financial results of agricultural enterprises in different countries, such as China and Kazakhstan.

The analysis of the literature makes it possible to identify traditional scientific approaches, identify the main causes of the digital transformation of agriculture and justify the need for further comparative analysis of the impact of digital technologies on agricultural enterprises in the two

countries. This review forms the theoretical basis of the research and helps to identify the main areas of work.

As a result of the comparative analysis, it was revealed that the level of digital innovation in agriculture in China and Kazakhstan remains at the same level.

The study analyzed aspects such as the degree of digital integration, the level of development of precision farming technologies, the use of digital platforms for agricultural production management, as well as government support and its impact on the financial performance of enterprises.

The results of the comparative analysis show that China has achieved a higher level of digital transformation in the agricultural sector thanks to an active government policy of digitalization, the development of advanced agricultural technologies and significant investments in digital infrastructure.

Digitalization processes are continuing, but the level of information technology is still lower, due to infrastructure constraints, lack of investment and slower spread of digital technologies among agricultural producers. The results of the study are shown in the table 1.

Table 1 – Digital innovations in agriculture in China and Kazakhstan

Indicator	China	Kazakhstan
Digital infrastructure	High level of development of internet technologies, cloud services and agri-digital platforms	Developing, but limited in rural regions
Use of precision agriculture technologies	Wide use of drones, sensors and GPS monitoring	Mainly used by large agricultural holdings
Digital management platforms	Active use of platforms for production and logistics management	Limited use of digital platforms
Government support for digitalization	Large-scale national programs for digital agriculture development	Implementation of initial digitalization programs
Financial performance of enterprises	High growth in productivity and profitability	Positive dynamics but less pronounced
Note: Compiled by the author(s) based on the source (Wang et al., 2025), (Ye, 2025), (Buzaubayeva et al., 2023), (Bekbossinova & Doszhan, 2025), (Gabdualiyeva et al., 2024)		

The comparative study presented in the table reveals substantial disparities in the extent of digital innovation implementation in the agricultural sectors of China and Kazakhstan. China exhibits a more advanced level of digital infrastructure, a broader adoption of precision agriculture technologies, and a more extensive utilization of digital management platforms in agricultural production. These accomplishments are largely facilitated by extensive government programs aimed at fostering digital transformation in the agricultural sector.

In Kazakhstan, although digitalization efforts are being undertaken and the adoption of contemporary technologies is gradually increasing, the overall level of digital adoption remains lower, particularly in rural areas where infrastructure and technological accessibility are still evolving. The examination reveals that a more robust digital infrastructure, a wider adoption of technology, and extensive government backing all contribute to a more successful digital transformation of the agricultural sector and enhanced financial outcomes for agricultural businesses.

The results of the economic and statistical study demonstrated the existence of a strong correlation between the use of digital technologies and the financial performance of agricultural organizations.

Based on the analysis of statistical data and international research, it can be concluded that the use of digital solutions such as precision farming systems, the Internet of Things, agricultural drones,

automated machinery and digital platforms for data analysis contributes to increased productivity, lower production costs and increased profitability of agricultural enterprises.

In China, the level of digitalization of agriculture has reached about 25.4%. This suggests that digital technologies are being actively introduced into the agricultural sector.

Many agricultural machines are equipped with the BeiDou navigation system and digital monitoring systems. The share of such machines is 24.4% of the total.

Agricultural drones are used in approximately 11.2% of the country's total acreage. This indicates the widespread use of digital tools in production (DASF, 2023) .

The introduction of digital technologies into the economy also helps to increase yields and reduce resource costs.

Thus, the use of fully digital technologies in rice cultivation can increase yields by about 14.3%, while reducing production costs and the need for labor.

In systems of precise control over water and nutrient resources, water consumption is reduced by 20-25%, and the use of intelligent plant protection systems helps reduce the use of pesticides by more than 20%. This, in turn, reduces the cost of agricultural products.

In some projects related to the digitalization of agriculture, the introduction of intelligent irrigation and fertilizer control systems has led to an increase in grain yields by about 20% compared to traditional farming methods. At the same time, the use of precision fertilizer application systems increased the efficiency of their assimilation by plants by about 30%. It also allowed to reduce the production costs of agricultural enterprises (Xinhua, 2025) .

The use of unmanned aerial vehicles also demonstrates significant economic benefits. For example, the use of agrodrons to apply fertilizers and monitor the condition of crops has increased the yield of some crops by up to 22%, while reducing the use of fertilizers by about 30% [12] (Msoen, 2025) .

In China in 2024, agricultural drones carried out agricultural work on an area of more than 173 million hectares. This confirms the scale of the introduction of digital technologies in the agricultural sector.

Statistical research also demonstrates that the development of digital technologies in agriculture has a positive impact on overall production efficiency.

The analysis of economic and statistical data shows that the use of digital innovations in agriculture contributes to higher yields, lower resource costs, increased labor productivity and increased profits of agricultural enterprises.

The results of the study confirm that the digitalization of the agricultural sector is a key factor in increasing the financial stability and long-term development of agricultural enterprises, especially in countries that are actively implementing innovative technologies in agriculture.

The results of the economic and statistical analysis demonstrate the gradual development of the digitalization of the economy in Kazakhstan. At the same time, the country adheres to principles similar to those used in China.

According to the Ministry of Agriculture of the Republic of Kazakhstan, precision farming technologies, satellite monitoring systems for agricultural lands and digital platforms for agricultural production management are being introduced as part of the digitalization program for the agro-industrial complex.

According to the data of the Agriculture of the Republic of Kazakhstan, elements of precision farming technology are used on about 20-25% of agricultural land. This allows efficient use of the country's resources and reduces production costs (Ministry of Agriculture of the Republic of Kazakhstan, 2025) .

The introduction of GPS monitoring systems for agricultural machinery and automated production management systems allows agricultural enterprises to reduce fuel costs by about 10-15% and improve the accuracy of agricultural work. Additional research demonstrates that the use of

digital technologies in agricultural enterprises in Kazakhstan contributes to productivity growth and improved financial results.

The analysis of the results demonstrates that the use of digital technologies is becoming an important tool for improving efficiency and financial stability in agriculture.

A comparison of the level of digitalization in the agricultural sector in China and Kazakhstan revealed significant differences. In recent years, China has been actively introducing digital technologies into the economy through targeted government policies, large investments in the development of digital infrastructure and the creation of sustainable agricultural technologies.

Due to digital transformation, productivity growth in agriculture is observed, production costs are reduced and profitability of agricultural enterprises is increased. The results of the study correspond to the conclusions drawn in the course of a number of international scientific papers. They show that the use of precision farming technologies, unmanned aerial vehicles, large-volume data processing systems, and automated production management systems contributes to more efficient use of resources and improved performance in agriculture.

The results of the economic and statistical study also demonstrate that the use of digital technologies directly affects the financial performance of agricultural companies. In particular, the use of precision farming and intelligent management technologies helps to increase yields, reduce costs for water, fertilizers and plant protection products, as well as increase labor productivity. This, in turn, has a positive effect on the profitability of agricultural companies and their competitiveness in the market.

Thus, the digitalization of agricultural production will become a key tool for improving the management efficiency of agricultural companies and ensuring the stable development of agriculture.

In the modern world, the digitalization of agriculture is also gradually developing, but has not yet reached the same level as in China.

The main problems that hinder the development of agriculture are insufficient tension in the regions, lack of investments and qualified specialists in the field of digital technologies.

There are programs that aim to digitalize the agro-industrial complex, introduce precision farming technologies, and use satellite monitoring systems for agricultural land. This creates the basis for the further development of digital innovations in the country's agriculture.

In general, the results of the study demonstrate that the use of digital technologies in agriculture contributes to increased productivity and improved financial results of agricultural companies.

Comparing the experience of China and Kazakhstan shows that successful digital transformation of agriculture requires an integrated approach. It includes the development of human resources, government support for innovation, investments in agricultural technologies and the training of qualified specialists.

The implementation of these measures can accelerate the process of digitalization of agriculture and increase the competitiveness of the agricultural sector in a global digital economy.

Conclusion

The study revealed that digital innovations play a key role in improving the efficiency and financial stability of agricultural enterprises.

A comparative analysis of the experience of China and Kazakhstan has demonstrated that the use of precision farming technologies, digital platforms for agricultural production management and data analysis contributes to increased yields, lower production costs and increased profitability in agriculture.

A higher level of digitalization, well-developed infrastructure and active government support allow agricultural enterprises to adapt faster to market changes and increase their competitiveness.

The study also showed that the active use of digital technologies in agriculture contributes to improving productivity and economic efficiency of agricultural production.

Further study of this topic. The practical value of the research lies in the fact that its results can be applied in the creation of strategies for digitalization of the agricultural sector, improvement of state

policy in the field of agriculture and the introduction of innovative technologies in agricultural enterprises.

The results of the study can also be useful for making managerial decisions at agricultural enterprises when choosing and implementing digital technologies aimed at increasing production efficiency and improving financial performance.

In the modern world, this study helps to expand understanding of the role of digital innovations in the development of agriculture and forms the basis for further study of this topic.

In the future, the research results may become the basis for the creation of more advanced digital technologies in agriculture and the formation of a stable ecosystem in the agricultural region. This is especially true for developing countries such as Kazakhstan, where digitalization of agriculture can become one of the key factors of economic growth, strengthening food security and strengthening positions in the global agricultural market.

Thus, the conducted research has both theoretical and practical significance and can serve as a starting point for further scientific research and practical solutions in the field of the digital economy of agriculture.

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