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## **RESOURCE AND TECHNOLOGICAL DIRECTIONS FOR INCREASING ECONOMIC EFFICIENCY AND COMPETITIVENESS OF AGRICULTURAL ENTERPRISES**

**Abstract.** The article examines resource and technological measures to increase the economic efficiency and competitiveness of agricultural enterprises, which play a key role in ensuring the state's food security and in integrating the national agricultural sector into the global economy. It is emphasized that the efficiency of farming enterprises depends directly on the level of use of production resources, the introduction of modern technologies, and the ability to adapt to the conditions of high competition in domestic and foreign markets. The main factors influencing the competitiveness of agricultural enterprises are identified as resource productivity, the innovativeness of production processes, product quality, logistics, and marketing. Attention is paid to technological aspects, including precision agriculture, digital farm management systems, automated production processes, biotechnology, and renewable energy sources. It is shown that the use of such technologies contributes to reducing costs, rationalizing the use of natural resources, increasing productivity and product quality, and forming sustainable competitive advantages in the agricultural market. The importance of integrating resource and technological innovations into the strategic management of the enterprise is emphasized, which allows ensuring its adaptability to changes in the external environment, minimizing risks, and increasing investment attractiveness. At the same time, some problems were identified, including limited financial resources, low digital literacy among employees, insufficient state support, and a weak infrastructure for the agricultural market. It is concluded that increasing the economic efficiency of farming enterprises is possible only through a comprehensive approach that simultaneously modernizes the material and technical base, introduces resource-saving technologies, and develops effective management strategies. Further research should focus on analysing the economic returns from the introduction of digital technologies, creating models of public-private partnerships in agricultural innovation, and developing environmentally oriented strategies for managing productive capital.

**Keywords:** efficiency, resources, technology, competitiveness.

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## **РЕСУРСНО-ТЕХНОЛОГІЧНІ НАПРЯМИ ПІДВИЩЕННЯ ЕКОНОМІЧНОЇ ЕФЕКТИВНОСТІ ТА КОНКУРЕНТОСПРОМОЖНОСТІ АГРАРНИХ ПІДПРИЄМСТВ**

**Анотація.** У статті розглядаються ресурсно-технологічні напрями підвищення економічної ефективності та конкурентоспроможності аграрних підприємств, які відіграють ключову роль у забезпеченні продовольчої безпеки держави та інтеграції національного аграрного сектору у глобальну економіку. Наголошується, що ефективність діяльності аграрних підприємств безпосередньо залежить від рівня використання виробничих ресурсів, впровадження сучасних технологій та здатності адаптуватися до умов високої конкуренції на внутрішньому та зовнішньому ринках. Визначено основні чинники, що впливають на формування конкурентоспроможності аграрних підприємств: продуктивність ресурсів, інноваційність виробничих процесів, якість продукції, логістика та маркетинг. Особливу увагу приділено технологічним аспектам – застосуванню точного землеробства, цифрових систем управління господарством, автоматизації виробничих процесів, біотехнологіям та відновлюваним джерелам енергії. Показано, що використання таких технологій сприяє зниженню витрат, раціоналізації використання природних ресурсів, підвищенню врожайності та якості продукції, а також формуванню стійких конкурентних переваг на аграрному ринку. Підкреслено значення інтеграції ресурсно-технологічних інновацій у стратегічне управління підприємством, що дозволяє забезпечити його адаптивність до змін зовнішнього середовища, мінімізувати ризики та підвищити інвестиційну привабливість. Водночас виявлено низку проблем, серед яких: обмеженість фінансових ресурсів, низький рівень цифрової грамотності працівників, недостатня підтримка з боку держави та слабка інфраструктура аграрного ринку. Зроблено висновок, що підвищення економічної ефективності аграрних підприємств можливе лише за умови комплексного підходу, який передбачає одночасну модернізацію матеріально-технічної бази, впровадження ресурсозберігаючих технологій та розробку ефективних управлінських стратегій. Подальші дослідження доцільно спрямувати на аналіз економічної віддачі від впровадження цифрових технологій, розвиток моделей державно-приватного партнерства у сфері аграрних інновацій та формування екологічно орієнтованих стратегій управління виробничим капіталом.

**Ключові слова:** ефективність, ресурси, технологія, конкурентоспроможність.

Economic efficiency and competitiveness of agricultural enterprises in the modern world depend not only on the traditional use of natural resources, but also on the introduction of advanced technologies. In the context of growing global competition and climate change, agribusiness must be transformed through innovative, resource-saving approaches to ensure sustainable development.

**Analysis of recent studies and publications.** The problems of improving the efficiency of enterprise resource management were studied by such scientists as O. V. Arefieva, S. O. Gutkevych, B. Paskhaver, I. O. Blank, V. M. Kolot, I. O. Chorna, A. O. Poznanska, N. S. Krasnokutska, T. O. Mokrousova, V. E. Novitsky, I. M. Pisarevsky and others. Their scientific achievements have made a significant contribution to the development of theoretical and applied approaches to the formation, use, and assessment of enterprise resource potential, the identification of factors

affecting its efficiency, and the development of management mechanisms in modern economic conditions.

The need for further research stems from dynamic changes in the external environment, Ukraine's integration into the global agricultural market, and the growing role of innovative technologies in shaping competitive advantage. Modern challenges related to climate change, instability of sales markets, shortage of quality resources, and energy crisis underscore the need for scientific research to identify optimal ways to increase productivity, rationalize costs, and diversify agribusiness.

**The purpose of the article is to** study the resource and technological directions of increasing the economic efficiency and competitiveness of agricultural enterprises in the context of globalization and digitalization of the economy.

**Summary of the primary material of the study.** The Ukrainian agricultural sector is operating amid unprecedented challenges that require a fundamental transformation of traditional management methods. The key factors driving change are climatic fluctuations, scarcity of natural resources, rising production costs, and logistical constraints. Ensuring the sustainability and profitability of enterprises [2].

However, the efficiency and stability of agricultural production depend on both the availability and the condition of the resource base. An important role is played by the degree of its involvement in production processes and the dynamics of its renewal. Resource potential serves as a fundamental material basis that determines both the qualitative and cost parameters of the products and the level of socio-economic development of rural areas [6].

In the structure of the resource potential of the agro-industrial complex, several key points are distinguished. These include the qualitative and quantitative characteristics of agricultural land resources, the level of development and modernization of the material and technical base, and the availability of qualified human resources employed in the industry.

Table 1 presents the main directions for the rational use of the resource potential of agricultural enterprises. Proper management of land, labor, financial, and innovation

resources allows enterprises to achieve economic efficiency and ensure sustainable competitiveness.

Table 1 – Use of the resource potential of agricultural enterprises

Resource	Areas of improvement	Expected effect
Land resources	Introduction of a precision farming system; soil monitoring using GIS technologies	Increasing yields, optimizing fertilization, and reducing costs
Workforce	Training of personnel in modern agricultural technologies; Use of outsourcing at peak stages	Increase in labor productivity, reduction of seasonal risks
Financial resources	Attraction of investments, state subsidies, and grants; Cost optimization	Strengthening financial stability, increasing investment attractiveness
Innovative resources	Use of startups in the field of AgTech, integration of biotechnologies	Formation of long-term competitive advantages

Source: built based on [6,8].

The analysis shows that resource and technological areas, such as digital transformation, precision agriculture, biotechnology, and the transition to alternative production systems, have proven economic efficiency. The introduction of precision farming, for example, can increase yields by up to 30 % and reduce the cost of material and technical resources by 15–30 %, with a payback period of 2–3 years [9]. Ukraine's leading agricultural holdings are demonstrating that innovations can be commercialized and turned into new business models, further strengthening their market position.

Resource and technological strategies are key to increasing economic efficiency and strengthening the market positions of agricultural enterprises. They provide not only the rational and most efficient use of available resources, but also the active introduction of modern technologies that ensure sustainable growth and long-term profitability [1]. The "cornerstone" of improving economic efficiency is the careful management and optimization of all available resources. This includes not only land and labor, but also financial capital, water, energy, and resources such as fertilizers and seeds.

Land resources are a key factor of production in the agricultural sector, with the properties of indispensability and limited reproducibility. Statistical data indicate stagnation in agrarian land areas, primarily due to the complex interdependence of

agricultural production on concurrent conditions. These include specialized equipment, processing infrastructure, and qualified labor. Effective implementation of production processes in the industry is possible only with a balanced combination of all these components; this is a necessary condition for the sustainable growth of the agro-industrial complex. Land management – going beyond traditional farming and implementing precision farming methods. Soil mapping and analysis can detect variations in nutrient levels and soil types throughout the field, allowing variable fertilizer and seed rates to be applied, ensuring that each zone gets precisely what it needs, thereby reducing waste and increasing yields. Crop rotation and diversification are also vital not only for soil health, but also for reducing the risks associated with fluctuations in market prices for individual commodities.

Automation and mechanization play a significant role, as investing in modern agricultural machinery, such as autonomous tractors or robotic harvesters, can reduce the need for manual labor, increase work speed, and improve accuracy. In addition, practical training and workforce management are essential. Implementing digital platforms for task management and communication can streamline operations and ensure the workforce is distributed where it is most needed. Businesses using a digital system to track planting schedules and weather forecasts can better allocate labor for timely operations, preventing delays that can affect yields.

Financial resource management goes beyond strategic financial planning. Access to credit and investment capital is crucial for introducing new technologies and expanding activities. Additionally, risk management tools such as crop insurance and futures contracts can help protect against unforeseen losses from weather events or market volatility. Farmers can use futures contracts to lock in the price of their crop months in advance, providing financial certainty.

In an era of growing environmental concerns and rising utility prices, efficient use of water and energy is essential. Drip irrigation systems can deliver water directly to plant roots, significantly reducing water consumption compared to traditional flood irrigation. Intelligent energy management systems can optimize electricity use for irrigation pumps, lighting, and climate control in greenhouses. Exploring renewable

energy sources, such as solar panels, for agricultural work can further reduce operating costs and environmental impact. Installing solar panels can offset electricity bills for pumping water and powering agrarian buildings.

Precision fertilizer and pesticide application technologies, guided by soil and plant health monitoring, ensure that these resources are applied only where and when needed, minimizing runoff into the environment and costs. Choosing high-yielding and disease-resistant seed varieties adapted to local conditions can also significantly increase productivity. Integrated pest management (IBS) strategies, which combine biological, cultural, and chemical controls, are more sustainable and cost-effective in the long term than relying solely on chemical pesticides.

The introduction of advanced technologies is no longer a luxury, but a necessity for agricultural enterprises seeking to remain competitive in the global market [8].

Precision farming and digital farming encompass a set of technologies that enable data-driven decision-making. GPS-controlled technology ensures precise sowing, spraying, and harvesting. Sensors that monitor soil moisture, temperature, and nutrient levels provide real-time data for accurate application. Drones equipped with multispectral cameras can assess crop conditions, identify stress zones, and map field conditions with extreme accuracy. Farm management software integrates all this data, providing a comprehensive overview of operations, enabling better planning, and facilitating performance analysis [9].

In the context of the comprehensive transformation of the agro-industrial sector, the technological renewal of production assets faces several significant constraints. Financial barriers include: the capital intensity of acquiring modern technical means, and the long payback period of investments in technological re-equipment. The park's technical condition also complicates the renovation process. A critical level of physical wear and tear on equipment, along with high operating costs to maintain operability, leads to a decrease in productivity and efficiency of use.

The basis of the competitiveness of agricultural organizations in modern conditions is the active implementation of innovative solutions that contribute to the effective and continuous renewal of production, based on the achievements of science

and technology, as well as on the best practices of both domestic and foreign colleagues. At the same time, more than a third of the indicators of agricultural economic efficiency depend on the level of mastery of innovative technologies [12].

Among the key technological areas driving the development of agricultural enterprises today, it is worth highlighting digitalization of production processes, automation, and the use of "smart" technologies. The integration of modern innovations, such as precision farming systems, satellite monitoring, drone-based crop and soil condition monitoring, and big data and analytics, opens new opportunities for effective resource management. The use of such solutions allows not only to optimize costs and increase productivity, but also to ensure stable product quality, which is especially important for entering international markets.

The introduction of innovative technologies into the production process creates competitive advantages, enhances the economic efficiency of agricultural enterprises, and, at the same time, ensures their adaptability to changes in the external environment. Thanks to technological innovations, agribusiness can respond more quickly to the challenges of the globalized market, strengthen its position in the global agricultural sector, and develop sustainable development strategies [3].

Table 2 – Technological innovations in agricultural production

Technology	Scope of application	Effect for the enterprise
Precision Farming Systems (GPS, GIS)	Control of tillage, fertilization, crop monitoring	Increasing yields, saving resources
Drones and satellite monitoring	Observation of the condition of the fields, early detection of pests and diseases	Reduction of crop losses, prompt decision-making
Smart farms and automated systems	Animal Husbandry, Feeding Control, and Animal Health	Increase in productivity and product quality
Biotechnology (GMOs, biologics)	Plant protection, increasing crop resistance	Reducing the cost of chemicals and the environmental friendliness of production

Source: built based on [1-3,9].

Advances in biotechnology offer opportunities to develop crops with improved characteristics, such as increased yields, improved nutrient content, drought tolerance, and resistance to pests and diseases. Genetically modified (GM) crops have shown

significant benefits in reducing crop losses and the need for chemical treatment in many regions. Marker-assisted selection (MAS) in traditional breeding enables faster development of improved crop varieties. Developing drought-tolerant corn varieties can significantly reduce water requirements and maintain yields in arid regions.

Biotechnology plays an increasingly important role in optimizing resource use and increasing the sustainability of agricultural production. The use of biological products derived from living organisms helps improve plant growth and increase their resistance to diseases and pests. This, in turn, reduces the need for chemical fertilizers and plant protection products, with positive economic and environmental effects.

The development and implementation of new, climate-resistant plant varieties are key areas of adaptation to climate change. These varieties are highly drought-resistant, helping minimize the risk of crop loss in unstable weather. At a fundamental level, scientific studies show that optimizing fertilization and tillage systems enables high energy efficiency in technologies.

Automation and robotics, in addition to labor efficiency, increase accuracy and stability. Automated irrigation systems respond to soil moisture data in real time. Robotic weeding can selectively remove weeds, reducing the use of herbicides. Automated sorting and classification systems for harvested products improve quality control and reduce post-harvest losses. The development of autonomous agricultural machinery promises to revolutionize field operations further, enabling round-the-clock operation and reducing human error.

The vast amounts of data generated by precision farming technologies can be analyzed using AI and machine learning algorithms to identify patterns, predict outcomes, and optimize decision-making. AI-based predictive models can predict crop yields, disease outbreaks, and optimal harvest timing. AI can also help in optimizing resource allocation, for example, by determining the most effective fertilization rates based on historical data and current conditions. The AI system can analyze weather conditions, soil data, and historical yield data to recommend the optimal planting date for a particular crop to maximize its potential.

Integrating technology with environmental principles is key to long-term competitiveness. These include vertical farming and controlled environment agriculture (CEA), which enable year-round production with reduced land and water use, often in urban areas. Circular economy principles in agriculture, such as using agricultural waste for biogas production or composting, can reduce environmental impact and create new income opportunities [6].

The combination of resource and technological approaches directly affects the key economic indicators of agricultural enterprises. Rational use of resources, combined with technological innovations, enables efficient growth and long-term competitiveness (Table 3).

Table 3 – Influence of resource and technological directions on economic efficiency

Direction	Impact indicators	Result for the enterprise
Optimize the use of resources	Reducing the cost of production and efficient capacity utilization	Profitability growth
Digital adoption	Increasing labor productivity and the efficiency of managerial decisions	Competitiveness in domestic and foreign markets
Use of alternative energy	Reducing energy costs, reducing the carbon footprint	Environmental sustainability, access to green investments
Innovative agricultural technologies	Higher yields, product quality	Expansion of sales markets, growth of export potential

Source: built based on [4,6,7].

By strategically implementing these resources and technological areas, agricultural enterprises can significantly increase their economic efficiency, improve their resilience to market and environmental challenges, and ultimately strengthen their competitive position in domestic and international markets.

Innovative resource and technological approaches are a decisive factor for increasing the economic efficiency and competitiveness of Ukrainian agricultural enterprises. Precision farming, biotechnology, and alternative production systems have a proven positive impact on yields, costs, and product quality. These technologies not only enable adaptation to challenges such as climate change and resource scarcity but also open new opportunities for product differentiation and entry into premium export markets [7].

At the same time, the full realization of this potential is constrained by systemic barriers, particularly insufficient infrastructure, personnel shortages, and low investment. These problems are interrelated: the shortage of qualified personnel and infrastructure reduces investment attractiveness, while a lack of financing hinders modernization and the training of specialists.

**Conclusions.** The success of agricultural enterprises depends on an integrated approach that combines the latest technologies and strategic resource management. Digitalization, automation, renewable energy use, and diversification are key areas for increasing competitiveness. Such investments not only optimize production processes, reducing costs and increasing productivity, but also ensure compliance with modern environmental standards and global market requirements, as the integration of innovations into enterprises' activities contributes not only to economic stability but also to the development of socially responsible business focused on the long term. As a result, agribusiness is gradually transforming into a modern, highly efficient industry capable of adapting to the challenges of globalization, climate change, and growing competition, creating prerequisites for sustainable development at the national and international levels.

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