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BARRIERS IN DIGITAL TRANSFORMATION IN AGRICULTURE

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Abstract. *The digital transformation of agriculture presents significant opportunities for improving productivity, sustainability, and global competitiveness. However, its implementation faces multiple obstacles that limit the pace and effectiveness of digital adoption. This article examines key technological barriers, including insufficient internet and communication infrastructure in rural areas, limited access to advanced technologies such as IoT, artificial intelligence, and big data, and the lack of interoperability between digital platforms and farm management systems. These barriers create risks of uneven digitalization, favoring large agroholdings while excluding small and medium-sized producers. The study emphasizes the importance of addressing these challenges through targeted investments, policy support, and the development of standardized, user-friendly solutions. Overcoming such obstacles is essential for enabling the agricultural sector to fully benefit from digital transformation and contribute to sustainable economic development.*

Keywords: *digital transformation, agriculture, technological barriers, IoT, big data, digital infrastructure*

Introduction.

The agricultural sector is undergoing a profound transformation driven by the rapid development of digital technologies. Tools such as precision farming, big data analytics, artificial intelligence, e-commerce platforms, and digital marketing are reshaping how agricultural enterprises produce, manage, and sell their products. Digital transformation holds the potential to increase productivity, reduce costs, optimize resource use, and strengthen the competitiveness of agribusiness in both local and global markets. For countries with a strong agricultural base, such as Ukraine, the adoption of digital solutions is not only a matter of efficiency but also a strategic factor in ensuring food security and sustainable development [1-3].

Main text. Despite these opportunities, the implementation of digital technologies in agriculture is far from straightforward. Farmers and agribusinesses face multiple barriers that slow down or even prevent the effective use of digital tools. These obstacles include technological limitations, financial constraints, lack of digital literacy, organizational challenges, and regulatory uncertainties. Without addressing these barriers, the benefits of digitalization remain unevenly distributed, favoring large agroholdings while leaving small and medium-sized producers behind.

Therefore, the study of barriers to digital transformation in agriculture is of critical importance. Identifying and analyzing these challenges allows policymakers, businesses, and educational institutions to develop targeted strategies aimed at overcoming limitations and accelerating the digitalization process. By addressing these obstacles systematically, the agricultural sector can unlock the full potential of digital transformation, contributing to sustainable growth and long-term competitiveness.

One of the most significant obstacles to digital transformation in agriculture is the uneven distribution of internet coverage between urban and rural regions. Since most agricultural activities are concentrated in rural areas, poor connectivity severely limits farmers' ability to adopt digital tools such as online marketplaces, cloud-based farm management systems, or precision farming technologies. Weak or unstable internet infrastructure hinders real-time communication, delays decision-making, and prevents the integration of smart devices into agricultural processes. Without reliable digital infrastructure, the full potential of digital agriculture remains unattainable [2].

Modern agriculture increasingly relies on advanced technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics. These tools enable precision farming, predictive crop management, and more efficient use of resources. However, access to such technologies remains limited due to high costs, lack of technical expertise, and insufficient availability of localized solutions tailored to small and medium-sized farms. As a result, digital transformation often remains concentrated within large agroholdings that can afford to invest in innovation, while smaller producers face exclusion from these advancements [4].

Another technological barrier is the lack of interoperability between digital platforms and existing farm management systems. Agricultural enterprises frequently adopt different software solutions for logistics, accounting, customer management, and production processes. When these systems cannot exchange data effectively, it leads to fragmentation, duplication of efforts, and inefficiencies in decision-making. The absence of standardized protocols also complicates the integration of IoT devices and data analytics tools, reducing the overall effectiveness of digital transformation initiatives. Creating interoperable and user-friendly ecosystems is therefore essential for ensuring that digital tools bring measurable benefits to agricultural enterprises of all sizes.

The digital transformation of agriculture has the potential to revolutionize production, management, and marketing processes, providing significant advantages in efficiency, sustainability, and competitiveness. However, the analysis reveals that technological barriers remain among the most critical obstacles slowing down the adoption of digital innovations in the agrarian sector. Insufficient internet coverage in rural areas, limited access to advanced technologies such as IoT, AI, and big data, as well as the lack of interoperability between digital platforms, create serious constraints for farmers and agribusinesses. These challenges highlight the risk of uneven digitalization, where large agroholdings are able to integrate modern technologies while small and medium-sized producers remain technologically marginalized. Overcoming these barriers requires coordinated efforts from governments, private companies, and research institutions. Investments in rural digital infrastructure, development of affordable and user-friendly technologies, and the introduction of interoperability standards are key prerequisites for sustainable digital transformation.

Summary and conclusions.

In conclusion, addressing technological barriers is not only a technical necessity but also a strategic priority for the future of agriculture. By removing these obstacles, the agrarian sector will be able to fully unlock the benefits of digitalization, strengthen food security, and enhance its role in the global digital economy [5].

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