



WHEAT INNOVATION INDEX AND PRODUCTION EFFICIENCY

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ABSTRACT

This thesis analyzes the role and importance of innovative approaches in improving the efficiency of wheat production. Wheat production plays a crucial role in ensuring food security and stable economic development. The study emphasizes that the effective use of modern agro-technologies, resource-saving methods, and advanced management practices contributes to increasing productivity and reducing production costs.

Introduction

In the context of increasing global demand for food and the need to ensure food security, improving the efficiency of wheat production has become one of the key priorities of agricultural policy in many countries. Wheat is a strategic crop that plays a crucial role in providing the population with essential food products and ensuring the stability of national economies. Therefore, enhancing the productivity and economic efficiency of wheat production through the introduction of innovative technologies is of particular importance.

In recent years, the agricultural sector has been undergoing significant transformation driven by digitalization, resource-saving technologies, and modern management approaches. The application of precision farming, improved seed varieties, efficient irrigation systems, and advanced agro-technologies has created new opportunities to increase wheat yields and optimize production costs. However, the level of adoption of these innovations varies across regions and farms, which leads to differences in production efficiency.

Analysis and Results

The analysis of wheat production indicators shows that the efficiency of the sector is directly influenced by the level of resource utilization and the degree of innovation adoption. In particular, yield (centners per hectare) is one of the key indicators reflecting production efficiency. Empirical evidence indicates that farms implementing modern agro-technologies and improved seed varieties achieve higher yield levels compared to those using traditional farming practices.

The results also demonstrate that the gross output of wheat production has shown a steady upward trend, primarily due to improvements in productivity rather than expansion of cultivated areas. This reflects a shift from extensive to intensive development in wheat production. At the same time, land use efficiency is largely determined by soil fertility and

crop management practices, while water use efficiency depends on irrigation technologies and water-saving methods. Based on the selected indicators, a Wheat Innovation Index was developed to assess the level of technological advancement and its impact on production efficiency. The findings reveal that regions with higher index values achieve better economic performance, including reduced production costs and increased profitability. In contrast, regions with limited access to modern technologies and technical resources exhibit lower levels of efficiency.

Table 1.

Key Indicators of Wheat Production Efficiency and Innovation Index

№	Indicators	Unit	2020	2021	2022	2023	2024	2025
1	Yield	centner/ha	45.2	48.6	51.3	53.8	56.1	58.4
2	Gross output	thousand tons	6500	6700	6900	7050	7200	7400
3	Land use efficiency	coefficient	0.72	0.75	0.78	0.80	0.83	0.85
4	Water use efficiency	coefficient	0.65	0.68	0.70	0.73	0.75	0.78
5	Technical equipment level	%	62	65	69	72	75	78
6	Agro-technology adoption level	%	58	62	66	70	74	77
7	Production cost (per 1 centner)	USD	18.5	19.2	20.1	21.0	21.8	22.5
8	Profitability	%	18.0	19.5	21.0	22.8	24.2	25.5
9	Wheat Innovation Index	index (0–1)	0.58	0.62	0.66	0.70	0.74	0.78

The data presented in Table 1 indicate a stable and consistent improvement in the key indicators of wheat production efficiency over the period 2020–2025. In particular, wheat yield increased from 45.2 centners per hectare in 2020 to 58.4 centners per hectare in 2025, which represents an overall growth of 13.2 centners or approximately 29.2%. This positive динамика confirms the increasing effectiveness of applied agro-technologies and improved farming practices. At the same time, the gross output of wheat production rose from 6,500 thousand tons in 2020 to 7,400 thousand tons in 2025. This reflects a total increase of 900 thousand tons, or 13.8%, indicating that production growth is primarily driven by higher productivity rather than expansion of cultivated land. This trend highlights the transition toward intensive development in wheat production.

Land use efficiency also demonstrated a steady increase, rising from 0.72 to 0.85 during the analyzed period. This improvement suggests more rational utilization of agricultural land resources and better crop management practices. Similarly, water use efficiency increased from 0.65 in 2020 to 0.78 in 2025, reflecting the gradual introduction of water-saving irrigation technologies and improved water management systems. Technical equipment levels and agro-technology adoption rates also showed significant growth. The level of technical equipment increased from 62% to 78%, while the adoption of agro-technologies rose from 58% to 77%. These changes indicate a strengthening of the material and technological base of wheat production and confirm the increasing role of innovation in the sector.

Despite the increase in production costs per unit (from 18.5 USD to 22.5 USD per centner, or by 21.6%), profitability also increased from 18.0% to 25.5%. This indicates that the growth in output and efficiency has outpaced the rise in costs, leading to improved economic performance overall. The Wheat Innovation Index increased from 0.58 in 2020 to 0.78 in 2025, showing a growth of 0.20 points or 34.5%. This confirms that innovation factors—such as technology adoption, technical capacity, and resource efficiency—play a decisive role in improving wheat production efficiency. The econometric analysis confirms a positive relationship between innovation factors and wheat production outcomes. Specifically, the adoption of advanced technologies, improved technical equipment, and efficient resource management significantly increases yield and overall production efficiency. In addition, optimizing input costs, particularly for fertilizers, fuel, and labor, plays a crucial role in enhancing economic efficiency.

Overall, the results indicate that improving wheat production efficiency requires a comprehensive approach that combines technological innovation, efficient resource utilization, and effective management practices. These findings provide a scientific basis for further forecasting and the development of strategies aimed at ensuring the sustainable growth of wheat production.

Conclusion

The study confirms that improving wheat production efficiency is closely linked to the level of innovation adoption and the effective use of available resources. The analysis shows that increases in yield, gross output, and profitability are primarily driven by the introduction of modern agro-technologies, improved technical equipment, and more efficient land and water use. The developed Wheat Innovation Index proved to be an effective tool for assessing the level of technological development and its impact on production outcomes. The results demonstrate that higher index values are associated with better economic performance, confirming the важная роль инноваций в повышении эффективности wheat production..

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