



THE ECONOMIC ROLE OF INNOVATIONS IN REDUCING PRODUCTION COSTS IN RICE CULTIVATION

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Abstract: This article discusses the economic efficiency of rice cultivation and explores new innovative methods to enhance it. It also provides recommendations on improving economic performance in rice production through increasing both the quantity and quality of rice, which plays an essential role in ensuring national food security.

Keywords: food security, innovative agrotechnologies, productivity, costs, economic efficiency, export, import, laser equipment, rice seed production, quality indicators.

Introduction: Ensuring food security is one of the most important global challenges, and rice cultivation—along with other agricultural crops—holds a special significance in addressing this issue. Rice and rice-based products occupy a unique place among essential food sources required for human nutrition. Being one of the oldest food crops in the world, rice has been cultivated in Southeast Asia for more than seven thousand years.

As of 2024, rice is grown in more than 115 countries, covering a total area of 155.5 million hectares worldwide. The average global rice yield is approximately 3.84 tons per hectare. Traditionally, India and China are the leading rice-producing countries, cultivating 44.8 million and 31.7 million hectares of rice fields, respectively. In Uzbekistan, rice is cultivated on about 100–110 thousand hectares, with an average yield of 3.5–3.8 tons per hectare, producing a total output of around 395 thousand tons. This amount barely meets the country's minimum domestic demand for rice, which continues to grow along with population increases. According to official data, to fully meet consumer demand, Uzbekistan imports approximately 55 thousand tons of rice annually.

According to United Nations estimates, the world population, which was 7.6 billion in 2018, is projected to exceed 9.8 billion by 2050, leading to a sharp rise in global food demand. Reports by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) reveal that more than 840 million people around the globe lack access to sufficient nutrition—meaning that roughly one in every eight people suffers from hunger.

In Uzbekistan, various rice cultivation methods have been developed, including traditional, transplanting, and the newly introduced ridge-sowing method, which was first applied in 2024 at the “Akramjon-Ixtiyor” farm in Paxtaobod district of Andijan region. The main rice cultivation methods in Uzbekistan include:

- Traditional direct seeding,
- Mechanized sowing of rice seedlings or seeds, and
- Water-saving transplanting methods.

The latter method—transplanting rice seedlings—has been adopted to conserve water resources. It allows for significant water savings on small plots by cultivating rice seedlings beforehand, which also enables more efficient use of climatic conditions and accelerates

ripening times. Furthermore, the productive use of land through this method can nearly double rice yields per hectare.

Research Methods

In this study, statistical observation and analysis methods were employed to examine the economic indicators of rice-producing farms. The obtained data were evaluated using quantitative analytical approaches to determine the dynamics of changes and their effects on farm activities. Based on these analyses, medium-term forecasts were developed, and corresponding conclusions and recommendations were formulated.

Additionally, during the research process, a combination of economic-statistical, comparative analysis, logical reasoning, and monographic observation methods was utilized to ensure comprehensive and scientifically grounded results.

Research Results

Within the framework of the study on improving the economic efficiency of rice production in Uzbekistan, the state and development prospects of rice cultivation in Andijan region—which accounts for about 1% of the country's land area but is home to nearly 10% of its population—were analyzed in detail.

As of January 1, 2024, the population of Andijan region exceeded 3,422,800 people, with an average population density of 744 people per square kilometer, compared to the national average of 75. The region possesses 201,026 hectares of irrigated farmland, of which 10,892 hectares are dedicated to rice cultivation.

In 2024, agro-clusters and farms across 12 districts of the region produced a total of 45,978 tons of rice, achieving an average yield of 4.31 tons per hectare.

Currently, several rice farms in the region have achieved remarkable success by introducing modern innovations into their production processes. Among them, the “Abdulaziz Rice Fields” farm in Jalakuduk district was studied as a practical case for evaluating the economic efficiency of rice cultivation in 2024.

According to the analysis, the farm obtained an average yield of 8.0 tons per hectare, generating a gross income of:

$8,000 \text{ kg} \times 14,000 \text{ UZS/kg} = 112,000,000 \text{ UZS per hectare.}$

After accounting for production expenses totaling 28,450,000 UZS, the net profit per hectare was 38,750,000 UZS, with a profitability ratio of approximately 73%.

These results demonstrate that the adoption of innovative technologies significantly enhances the economic performance of rice farms. However, it is important to note that various regional factors—including soil quality, water availability, and climatic conditions—play a decisive role in determining the economic efficiency of rice production.

Research findings indicate that the following factors have the greatest influence on the development and economic efficiency of rice cultivation in Uzbekistan:

1. **Precise planning of production costs** for each agrotechnological process, with a well-defined and strictly implemented cost estimate (budget).
2. **Efficient use of laser land-leveling technologies** to prepare rice fields for sowing.

3. **Strengthening the rice seed production system** to ensure varietal purity and higher crop quality.

4. **Wider adoption of efficient irrigation technologies** for optimal water management.

Discussion

Accurate cost planning across all agrotechnological stages is a key factor for increasing efficiency. A properly developed business plan enables rice growers to determine, in advance, the required expenditures for each period and compare them with actual costs incurred. This allows producers to monitor economic performance throughout the production cycle and make data-driven management decisions.

The introduction of laser land-leveling technology is another crucial innovation. Under a Presidential Decree of Uzbekistan, the implementation of such technology has become a national priority. Laser leveling ensures that irrigation water is distributed evenly across the fields (maintaining a uniform depth of 5–7 cm). As a result, optimal plant density is maintained, seedlings receive adequate and balanced water and nutrients, and both yield quantity and quality improve substantially—leading to higher economic returns.

Enhancing seed production systems is equally important. A reliable seed industry prevents the mixing of different rice varieties (commonly referred to as “varietal contamination”), which directly improves the quality of harvested rice and its market value. Producing high-quality seeds also allows farmers to reuse their own seed stock in subsequent years, reducing input costs and improving profitability.

Application of Advanced Irrigation Technologies in Rice Cultivation

The adoption of efficient irrigation technologies is of paramount importance, especially given the growing scarcity of irrigation water in Uzbekistan. Expanding the use of modern agrotechnological irrigation systems not only helps increase the quantity and quality of rice production but also enhances its overall economic efficiency.

Water availability is a direct determinant of productivity in rice cultivation, as rice is an aquatic crop that thrives under flooded conditions. Traditionally, irrigation water in rice fields is distributed through a single water inlet, which causes uneven water temperatures and distribution across different parts of the field.

For example, in a standard rice field with compartments (marzas) of approximately 0.15–0.20 hectares, the sections near the water inlet (about 0.05–0.07 ha) tend to have colder water, slowing down plant growth and delaying ripening. Conversely, areas farther from the inlet receive warmer water due to solar heating, leading to uneven maturation within the same field—up to 7–10 days difference.

To eliminate this inefficiency, introducing a rotational irrigation system—which periodically changes water entry points—ensures that all parts of the rice field receive water of similar temperature and timing. As a result, the crop ripens uniformly, and harvesting becomes more efficient.

If implemented effectively, this innovation could increase the yield by 200 kilograms of paddy rice per hectare, which corresponds to approximately 130 kilograms of milled rice. At the current market rate of 14,000 UZS per kilogram, this equates to an additional 1,820,000 UZS in profit per hectare. Thus, applying this irrigation technique can significantly boost the economic returns from rice farming.



Conclusion

Based on the analysis of the economic efficiency of rice cultivation, the following conclusions and recommendations were formulated:

1. Comprehensive cost planning for each agrotechnological process should be implemented. Clearly defined cost estimates and adherence to planned budgets enhance profitability and are the foundation for sustainable rice production and economic efficiency.
2. The use of laser land-leveling equipment should be expanded. This technology ensures uniform water distribution, optimal seedling density, and balanced nutrient uptake—factors that contribute to higher yields and improved economic performance.
3. Strengthening the rice seed production system helps maintain varietal purity, prevents genetic mixing, and improves the consumer quality of rice. Higher product quality leads to better market prices, thereby increasing farmers' income.
4. Rotational irrigation systems should be widely adopted to ensure uniform ripening and optimal use of irrigation resources. This practice can generate an additional 1.5–1.8 million UZS per hectare, significantly improving overall profitability.

In summary, the introduction and effective use of innovative agrotechnologies—including laser leveling, advanced irrigation methods, and improved seed systems—are crucial for enhancing the economic efficiency of rice production in Uzbekistan. These innovations not only reduce production costs but also contribute to sustainable agricultural development and national food security.

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