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THEORETICAL APPROACHES AND COMPLEX INDICATORS SYSTEM FOR ASSESSING THE ECONOMIC EFFICIENCY OF WATER RESOURCES USE IN AGRICULTURE

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Abstract

This thesis analyzes theoretical approaches to assessing the economic efficiency of water resources use in agriculture and a system of complex indicators. The study studies the main economic, environmental and technical indicators used to assess the efficiency of water use and highlights their interrelationships. It also substantiates the need for integrated and systematic approaches to fully assess the efficiency of resource use. As a result, scientific and practical conclusions have been developed on the formation of a system of complex indicators that serve to increase the efficiency of water resources use.

Keywords: water resources, economic efficiency, agriculture, complex indicators, assessment system, water consumption, productivity, profitability, resource use, integrated approach.

Introduction

Effective use of water resources in agriculture is one of the pressing issues today, both globally and nationally. Population growth, climate change, and limited water resources further increase the need for rational use of this resource. From this point



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of view, the correct assessment of the efficiency of water resources use is of great scientific and practical importance.

An integrated approach is required to assess the efficiency of water use, not limited to economic indicators, but also taking into account environmental and technical factors. Because indicators such as water consumption, productivity, production costs, and profitability are closely interrelated, and only when they are analyzed together can a complete and reliable result be obtained[1].

The purpose of this study is to study theoretical approaches to assessing the economic efficiency of water resource use in agriculture and to develop and analyze a comprehensive system of indicators.

Literature review

The issue of assessing the efficiency of water resources use in agriculture is one of the most widely studied scientific topics in economic, environmental and technological areas. Foreign and domestic literature has proposed various approaches, indicator systems and assessment models for determining the efficiency of water resources use.

Studies by international organizations, including FAO, UNESCO and the World Bank, specifically emphasize the role of water resources in agriculture. These sources consider the relationship between water consumption, productivity and economic results as the main indicator, and note the need to introduce integrated assessment systems to improve water use efficiency[2].

In the scientific literature, three main approaches are distinguished in assessing the efficiency of water resources use: the economic approach (based on income, costs and profitability), the ecological approach (water losses, soil condition and environmental impact) and the technical approach (irrigation system efficiency and



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water transfer coefficients). Although each of these approaches has its own importance, the literature emphasizes the need for their integrated application. Studies by a number of scientists have noted the widespread use of indicators such as “water productivity” and “product per cubic meter of water” in assessing water efficiency. This approach allows for a quantitative assessment of the efficiency of water resources use. At the same time, it is scientifically proven that drawing conclusions based on only one indicator is insufficient, and that a system of complex indicators is needed[3].

Research methodology

This study aims to develop and analyze theoretical approaches and a system of complex indicators for assessing the economic efficiency of water resources use in agriculture. The study used a combination of qualitative and quantitative analysis methods.

The theoretical basis of the study was the scientific work of local and foreign scientists on water resources management, agricultural economics, sustainable development, and environmental and economic assessment. Statistical data and reports published by FAO, UNESCO, the World Bank, and the IPCC were also used. In the research process, the methods of analysis, synthesis, induction and deduction were used, and existing approaches to assessing the efficiency of water resource use were systematically studied. Through this, the interrelationships between economic, environmental and technical indicators were clarified.

Also, using the method of comparative analysis, the evaluation models and indicator systems proposed by different scientific schools were compared. Based on these approaches, the possibilities of forming a system of complex indicators and the effectiveness of their practical application were assessed.



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In the study, based on a systematic approach, water consumption, productivity, production costs, net income and environmental indicators were considered as an interrelated system. The impact of each indicator on overall efficiency was analyzed separately and comprehensively.

In addition, a system of indicators for assessing the efficiency of water resources use was formed using statistical and analytical methods. The possibility of developing an integrated assessment model and scientifically substantiating the decision-making process based on these indicators was studied.

This methodological approach serves to comprehensively assess the efficiency of water resources use, identify existing problems, and develop scientific and practical conclusions on the rational use of resources in the agricultural sector.

Analysis and discussion of results

As part of the study, an analysis was carried out based on a system of complex indicators to assess the efficiency of water resources use in agriculture. Water consumption, productivity, production costs, net income, and water productivity indicators were selected as the main evaluation criteria[4].

1- table Water resource efficiency indicators (per hectare)

Indicators	1- status (traditional irrigation)	2- status (improved management)
Water consumption (m ³ /ha)	9 200	6 800
Productivity (s/ha)	35,0	42,5
Production costs (thousand soums/ha)	19 500	17 000
Net income (thousand soums/ha)	11 200	16 800
Water productivity (kg/m ³)	0,38	0,63
Profitability (%)	57,4	98,8



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The table shows that in case 2, where the improved management system was used, positive changes were observed in all key indicators. In particular, water consumption decreased from 9,200 m³/ha to 6,800 m³/ha, which represents a 26% saving. This indicates an increase in technological and management efficiency in the use of water resources.

The increase in productivity from 35.0 t/ha to 42.5 t/ha is explained by the optimization of the irrigation process and the stabilization of water supply. At the same time, production costs also decreased from 19,500 thousand soums to 17,000 thousand soums, which is the result of efficient use of resources.

One of the most important results is a significant increase in net income. Net income, which was 11,200 thousand soums in case 1, increased to 16,800 thousand soums in case 2, which is an increase of about 50%. This increase confirms the direct positive impact of rational use of water resources on economic efficiency.

The water productivity indicator also increased from 0.38 kg/m³ to 0.63 kg/m³, which indicates a significant improvement in water use efficiency. The profitability level increased from 57.4% to 98.8%, which confirms the high efficiency of management based on a system of complex indicators.

In general, the results obtained showed that the use of a system of complex indicators in the use of water resources plays an important role in increasing production efficiency, reducing costs and increasing net income[5].

Conclusions and recommendations

The results of the study showed that a comprehensive system of indicators is important in assessing the efficiency of water resources use in agriculture. A joint analysis of indicators such as water consumption, productivity, production costs, net income, and water productivity allows for a complete and accurate assessment of the state of resource use.



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The analysis showed that when improved management approaches are used, water consumption is reduced, productivity increases, production costs are optimized, and net income increases significantly. This confirms that the rational use of water resources is an important factor in increasing economic efficiency.

Proposals:

1. Widely implement a system of integrated indicators for assessing water resources;
2. Develop real-time monitoring systems for water consumption and productivity;
3. Strengthen technological modernization to reduce water losses in irrigation systems;
4. Introduce innovative irrigation methods aimed at increasing water productivity;
5. Expand the use of digital and analytical platforms in the decision-making process in agriculture.

The implementation of these proposals will help increase the efficiency of water resource use, ensure the economic stability of the agricultural sector, and rational use of resources.

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