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**ENHANCING GOVERNMENT FINANCIAL SUPPORT MECHANISMS FOR
THE ADOPTION OF WATER-SAVING TECHNOLOGIES IN THE REPUBLIC
OF KARAKALPAKSTAN.**

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Abstract: This article comprehensively examines the issues of improving state financial support mechanisms for the implementation of water-saving technologies in the Republic of Karakalpakstan under conditions of sharp water resource limitations, climate change, and environmental problems (including degradation processes in the Aral Sea region). The study provides an in-depth analysis of the economic and institutional foundations for increasing water use efficiency in the agricultural sector, and scientifically substantiates modern approaches to water resource management.

In particular, the economic efficiency of innovative agricultural technologies such as drip and sprinkler irrigation, their water-saving potential, and their impact on yields were evaluated based on statistical and comparative analysis. Research results indicate that by implementing these technologies, it is possible to significantly reduce water consumption and increase the efficiency of agricultural production. These findings are consistent with studies by the Food and Agriculture Organization and the World Bank.

Additionally, a systematic analysis was conducted on the current state of financial support instruments implemented by the state—subsidies, concessional loans, grants, and other incentive mechanisms—assessing their effectiveness and level of coverage. It has been established that while existing mechanisms are yielding positive results, their institutional effectiveness, funding volumes, and utilization capabilities are insufficient.

As a result of the study, scientifically grounded proposals were developed to improve the financial support system aimed at stimulating the widespread introduction of water-saving technologies. In particular, the necessity of optimizing subsidies, expanding long-term preferential lending, developing public-private partnership mechanisms, and implementing digital monitoring systems is substantiated.

The results of this study are of great scientific and practical importance for the sustainable development of the agricultural sector in the Republic of Karakalpakstan, the rational use of water resources, ensuring environmental stability, and strengthening food security.

Keywords: water-saving technologies, financial support, subsidies, concessional loans, agricultural sector, water resources, economic efficiency, Karakalpakstan.

Introduction

Today, global climate change, the depletion of water resources, and the aggravation of environmental problems necessitate the implementation of fundamental reforms in the agricultural sector. Water scarcity is becoming a serious threat to food security and economic stability, directly impacting agricultural production efficiency, especially in arid



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regions. From this perspective, the issue of the rational and efficient use of water resources is considered one of the priority areas of modern agrarian policy.

In the Republic of Karakalpakstan, this problem manifests itself even more acutely. The ecological crisis resulting from the Aral Sea disaster, land salinization, water resource depletion, and climate change are negatively impacting the sustainable development of the region's agricultural sector. As a result, the low efficiency of traditional irrigation methods leads to increased water losses, reduced yields, and increased production costs.

According to the Food and Agriculture Organization, agriculture consumes more than 70% of water resources globally. However, the efficiency of using this water remains low in many developing regions. Therefore, the introduction of water-saving technologies, particularly the expansion of drip and sprinkler irrigation systems, is one of the most important directions for increasing the efficiency of water resource use.

Modern scientific research indicates that through the implementation of water-saving technologies, it is possible not only to reduce water consumption but also to increase yields and improve the economic efficiency of agricultural production. At the same time, the widespread implementation of these technologies often requires high initial investments, which necessitates the improvement of state financial support mechanisms.

The object of this study is the process of water resource use in agriculture in the Republic of Karakalpakstan.

The subject of the research is the mechanisms of financial support for the implementation of water-saving technologies and their effectiveness.

The main objective of the study is to develop scientifically grounded proposals for improving state financial policy that stimulates the widespread implementation of water-saving technologies amidst the environmental crisis.

To achieve this goal, the following tasks have been defined:

- studying the theoretical foundations of the efficiency of water resource use;
- assessment of the economic efficiency of water-saving technologies;
- analysis of existing financial support mechanisms;
- studying international experience and adapting it to national conditions;
- development of scientific and practical proposals for improving the financial support system.

Thus, this study is of scientific and practical importance aimed at modernizing the agricultural sector of the Republic of Karakalpakstan, the efficient use of water resources, and ensuring sustainable development.

Literature review on the topic

The introduction of water-saving technologies has been widely studied in scientific literature as an important factor in increasing efficiency in agriculture.

According to World Bank research, the implementation of modern irrigation technologies reduces water consumption by 30–50% and increases productivity.

According to the International Water Management Institute, water-saving technologies can increase yields by 20–40%.



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In OECD studies, state subsidies and financial incentive mechanisms are evaluated as an important factor in implementing agricultural innovations.

Local studies have highlighted the role of the state in implementing water-saving technologies, particularly the importance of support mechanisms through subsidy and credit policies.

Research methodology

In this study, a multifaceted scientific approach was applied to comprehensively evaluate the implementation of water-saving technologies and their state financial support mechanisms. The research methodology, based on a combination of theoretical and empirical methods, allowed for an in-depth analysis of the interdependence between the agricultural sector and the water resources management system.

1. Systematic analysis

Based on a systems approach, the interdependence between water resources, the irrigation system, and agricultural production was comprehensively studied. Through this method, factors (technological, economic, and institutional) influencing water use efficiency were analyzed as a single system. As a result, the role and significance of the introduction of water-saving technologies in the overall economic system were clarified.

2. Statistical analysis

Using statistical methods, the dynamics of indicators such as water conservation, crop yield growth, technology implementation rate, and investment volume were studied for the period 2020–2024. Based on descriptive statistics, trend analysis, and dynamic series, changes were assessed, and the correlations between them were clarified. Data from the Food and Agriculture Organization, the World Bank, and national statistics were used in this process.

3. Comparative analysis

Based on a comparative approach, the experience of implementing water-saving technologies in developed and developing countries was studied, and their effectiveness was compared with the conditions of Karakalpakstan. Through this method, it was possible to identify the most effective elements of international experience and adapt them to national conditions.

4. Economic valuation methods

Economic analysis methods were applied to determine the effectiveness of technology implementation. Including:

- return on investment (ROI)
- Cost-Benefit Analysis
- resource saving coefficients;

calculated. This substantiates the economic feasibility of water-saving technologies.

5. Empirical and analytical approach

The study conducted an empirical analysis based on available statistical data, reports, and scientific sources. Problems identified through an analytical approach were systematized, and their cause-and-effect relationships were studied. The complex of methods used made it possible to scientifically determine the economic



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efficiency of implementing water-saving technologies, the effectiveness of financial support mechanisms, and the directions for their improvement.

Analysis and results

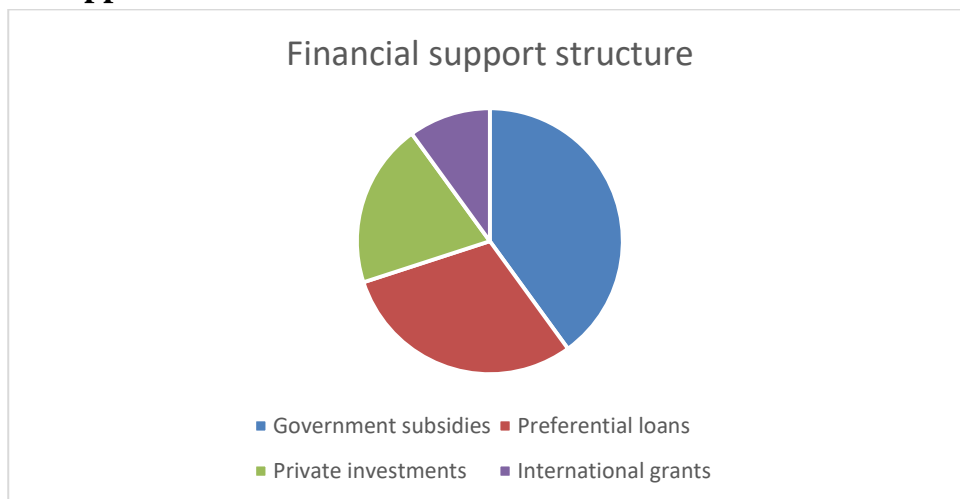
Analysis shows that while the implementation of water-saving technologies in the Republic of Karakalpakstan is showing positive dynamics, their coverage remains limited. According to statistical data: the share of drip irrigation has increased from 8% in 2020 to 22% in 2024; water savings range from 25–40%; and yields have increased to 15–25%. At the same time, the following problems were identified: limited access to financial resources; high investment costs; insufficient infrastructure; and a lack of knowledge and information. In the structure of financial support, state subsidies occupy a leading position (40%), indicating the decisive role of the state.

Efficiency of water-saving technologies

Indicators	Traditional irrigation	Drip irrigation	Traditional irrigation	Drip irrigation	Traditional irrigation	Drip irrigation
	irrigation (%)	Change (%)	irrigation (%)	Change (%)	irrigation (%)	Change (%)
Water consumption (m3/ha)	10 000 – 12 000		6 000 – 7 000		↓ 30–40%	
Yield (t/ha)	2.5 – 3.0		3.5 – 4.0		↑ 20–30%	
Costs (\$/ha)	800 – 1000		1200 – 2000		↑ (boshlang'ich)	
Profitability (%)	100% (bazaviy)		130–150%		↑ 30–50%	

This table shows that while water-saving technologies increase investment costs in the short term, they ensure high profitability and resource efficiency in the long term.

Financial support structure



The presented pie chart reflects the composition of financial resources for the implementation of water-saving technologies and allows for an assessment of their ratio. As seen from the diagram, the largest share is attributed to state subsidies (40%). This situation indicates that the state plays a decisive role in the implementation of technologies in the agricultural sector, especially those requiring high initial investment. According to OECD research, state support forms the bulk of agricultural investment.

Preferential loans (30%) stand out as the second most important source. This means the active participation of the banking and financial system in financing water-saving

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technologies. According to World Bank data, preferential lending mechanisms are a crucial tool for increasing investment activity in the development of the agricultural sector.

The share of private investment (20%) is relatively low, indicating the need to expand private sector participation in this area. The main reasons for this are factors related to a high level of risk and the long-term return on investment.

The smallest share falls on international grants (10%). This means that although donor organizations are present, their contribution to the total funding is limited.

Conclusions and suggestions

The results of the conducted research and statistical analysis show that the introduction of water-saving technologies is one of the important factors in increasing the efficiency of the agricultural sector in the Republic of Karakalpakstan, the rational use of water resources, and ensuring environmental sustainability.

Main scientific conclusions

Firstly, there is a stable positive correlation between water conservation and productivity, and efficient water use has a direct impact on improving agricultural production results. This expands the possibility of obtaining economic benefits by increasing the efficiency of resource use.

Secondly, state financial support mechanisms play a decisive role in the implementation of water-saving technologies. In particular, subsidies, preferential loans, and grants are the main incentives for the introduction of technologies.

Thirdly, although the existing financial support system is yielding positive results, its effectiveness and coverage are insufficient. Access to financial resources remains limited, especially for small farms.

Suggestions

1. Optimization of the subsidy system It is necessary to simplify the mechanism for allocating subsidies, increase their transparency, and ensure their targeted use. This will increase farmers' interest in technology.

2. Expansion of preferential lending

It is necessary to expand opportunities for financing water-saving technologies through the widespread introduction of long-term (5–10 years) and low-interest loans.

3. Development of public-private partnership (PPP) mechanisms

Expanding private sector participation in modernizing irrigation infrastructure and implementing innovative technologies is of great importance.

4. Implementation of digital monitoring systems

The introduction of digital technologies into the processes of accounting, control and management of water resources will significantly increase the efficiency of water use.

5. Increasing financial literacy

It is necessary to develop skills for the effective use of financial instruments by expanding educational programs, trainings, and consulting services for farms.

Final conclusion

Overall, the effectiveness of implementing water-saving technologies largely depends on the state's financial policy, institutional reforms, and innovative approaches.



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Improving these mechanisms based on a comprehensive and systematic approach will serve to ensure the sustainable development of the agricultural sector in the Republic of Karakalpakstan.

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