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SCIENTIFIC AND PRACTICAL FOUNDATIONS OF THE TRANSITION TO THE GREEN ECONOMY CONCEPT IN WATER RESOURCES UTILIZATION IN UZBEKISTAN

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ABSTRACT: This article analyzes the theoretical foundations, current state, and priority directions of the transition to the green economy concept in water resources utilization in Uzbekistan. Based on the Concept for the Development of the Water Sector for 2020–2030, the Strategy for the Transition to a Green Economy for 2019–2030, and reports published by international organizations, the study evaluates water-saving irrigation technologies, digitalization of the water sector, energy efficiency, and economic incentive mechanisms. The findings indicate that agriculture accounts for the largest share of water consumption and that the risk of water scarcity is increasing under changing climatic conditions. Based on the research findings, recommendations are developed for implementing integrated water resources management, improving tariff and subsidy policies, promoting wastewater reuse, and strengthening human resource capacity in the water sector.

Keywords: green economy, water resources, water-saving technologies, irrigation, water management, sustainable development, integrated management, climate change.

INTRODUCTION

Water resources are a fundamental prerequisite for socioeconomic development, food security, and ecosystem sustainability. Population growth, urbanization, and climate change are intensifying pressure on freshwater resources in many regions of the world. The United Nations 2030 Agenda for Sustainable Development identifies the rational use and sustainable management of water resources as a separate Sustainable Development Goal (Goal 6) [11].

According to the United Nations Environment Programme (UNEP), the concept of a green economy refers to an economy that improves human well-being and social equity while significantly reducing environmental risks and ecological damage. Within this framework, income and employment growth are driven by investments aimed at reducing carbon emissions, improving resource efficiency, and preserving biodiversity [4]. The Organisation for Economic Co-operation and Development (OECD) defines green growth as promoting economic growth while ensuring that natural assets continue to provide the resources and environmental services upon which human well-being depends [5].

This issue is particularly relevant to Uzbekistan. The country's water supply largely depends on the Amu Darya and Syr Darya river basins, while a substantial proportion of its water resources originates in neighboring countries. Furthermore, the Aral Sea crisis has clearly demonstrated the environmental and social consequences of inefficient water resources management [7].

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Consequently, fundamental reforms have been initiated in Uzbekistan's water sector in recent years. In 2019, the Strategy for the Transition to a Green Economy until 2030 was approved [2], followed by the adoption of the Concept for the Development of the Water Sector in 2020 [1]. Subsequently, water conservation was also identified as a priority in the Uzbekistan–2030 Strategy [3].

The purpose of this study is to assess the current state of the transition toward green economy principles in water resources utilization in Uzbekistan, identify existing barriers, and substantiate scientific and practical recommendations aimed at overcoming them.

LITERATURE REVIEW AND RESEARCH METHODOLOGY

The study employs an analysis of regulatory and legal documents, comparative and systematic approaches, statistical data synthesis, and logical analysis. The information base comprises decrees and resolutions of the President of the Republic of Uzbekistan, reports published by international organizations such as the World Bank, FAO, and UNEP, as well as relevant scientific publications.

In international literature, the green approach to water management is primarily associated with the principles of Integrated Water Resources Management (IWRM). The Global Water Partnership (GWP) defines IWRM as a process that promotes the coordinated development and management of water, land, and related resources to maximize economic and social welfare equitably without compromising the sustainability of vital ecosystems [6].

Regional studies particularly emphasize the interdependence of water, energy, and food systems in Central Asia, as well as the necessity of strengthening transboundary cooperation [8].

MAIN BODY

1. The Essence of the Green Economy in the Water Sector

The green economy approach to water management encompasses three interconnected dimensions.

The first dimension involves improving water-use efficiency, particularly by increasing the economic value added generated per cubic meter of water and reducing water losses.

The second dimension focuses on reducing energy consumption in water management systems and increasing the use of renewable energy sources, since irrigation through pumping stations requires substantial amounts of electricity.

The third dimension concerns ensuring long-term sustainability by maintaining the ecological condition of ecosystems, including river basins, soil fertility, and groundwater resources.

In this context, water conservation is not merely a technical issue but rather a comprehensive set of economic, institutional, and social measures.

International experience identifies the discrepancy between water prices and the actual cost of water consumption, inadequate resource accounting, and weak incentive mechanisms for users as major obstacles to efficient water utilization [5, 8].

2. Current State and Regulatory Framework of Water Resources Utilization in Uzbekistan

According to the World Bank, more than 90% of total water withdrawals in Uzbekistan are allocated to agriculture, while the remainder is primarily used for domestic water supply (approximately 4.5%) and industrial purposes (approximately 4.3%) [9].

Therefore, the principal benefits of the green transition are expected to emerge in irrigated agriculture.

The regulatory framework has been developed in several stages.

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On October 4, 2019, Presidential Resolution No. PQ-4477 approved the Strategy for the Transition to a Green Economy until 2030, which emphasizes efficient resource utilization and improved energy efficiency [2].

On July 10, 2020, Presidential Decree No. PF-6024 adopted the Concept for the Development of the Water Sector for 2020–2030 [1].

The Concept establishes several quantitative targets to be achieved by 2030, as presented in Table 1.

Table 1. Key Indicators for the Development of the Water Sector

Indicator	Value / Target	Source
Share of agriculture in total water withdrawals	More than 90% (domestic supply: approximately 4.5%; industry: approximately 4.3%)	[9]
Efficiency coefficient of irrigation systems	Increase from 0.63 to 0.73 by 2030	[1]
Area covered by water-saving technologies	Up to 2.0 million hectares by 2030 (Concept target)	[1]
Irrigated land with inadequate water supply	Reduction from 560,000 to 190,000 hectares	[1]
Saline irrigated land	Reduction by 226,000 hectares	[1]
Annual electricity consumption of pumping stations	Reduction by 25%	[1]
Water saved through water-saving technologies in 2024	2.5 billion m³	[10]
Targets for 2026–2030	Water-saving technologies on 1.7 million hectares; reduction of irrigation losses by 25% and water supply losses by 30%	[9]

Note: The table was compiled by the author based on sources [1], [9], and [10]. Target indicators may be revised in different official policy documents.

The data presented in the table indicate that reforms in the water sector are directed toward three major objectives: improving irrigation efficiency, enhancing the reclamation condition of agricultural land, and reducing energy consumption.

According to official information, water-saving technologies have been introduced on nearly half of Uzbekistan's approximately 4.3 million hectares of irrigated land. In 2024 alone, these technologies contributed to saving 2.5 billion cubic meters of water [10].

Furthermore, the country has established the objective of introducing water-saving technologies across all irrigated land by 2030, with the potential to save up to 15 billion cubic meters of water annually [10].

The World Bank's strategic document for the water sector for 2026–2030 also envisages introducing water-saving technologies on 1.7 million hectares and reducing irrigation water losses by 25% [9].

3. Priority Directions of the Green Transition

The first priority direction involves the introduction of water-saving irrigation technologies, including drip irrigation, sprinkler irrigation, improved furrow irrigation, and laser land leveling.

These technologies not only reduce water consumption but also frequently increase crop yields and decrease the risk of soil salinization.

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Government subsidies and preferential loans provided to farmers and agricultural clusters have contributed to the wider adoption of these technologies [10].

The second priority direction is digitalization.

The Concept envisages the introduction of Smart Water measurement and control devices for water accounting, along with the automation of management systems at major hydraulic engineering facilities [1].

Real-time water measurement is an essential prerequisite for ensuring equitable resource allocation, identifying water losses, and supporting evidence-based decision-making.

The third priority direction concerns energy efficiency and renewable energy utilization.

A 25% reduction in electricity consumption at pumping stations has been planned [1].

This objective can be achieved by replacing outdated pumping equipment with modern energy-efficient technologies, installing solar panels, and expanding public-private partnership projects.

Such measures will reduce the carbon footprint of the water and energy sectors and directly contribute to the objectives of the green economy strategy [2].

The fourth priority direction involves economic mechanisms.

Establishing a water-use payment system, strengthening the activities of water users' associations, providing incentives for efficient water users, and increasing accountability for wasteful water consumption will create a financial foundation for water conservation.

International experience demonstrates that tariff policies based on metering systems and introduced gradually, in combination with social protection measures, can facilitate effective water consumption management [5, 8].

The fifth priority direction is the optimization of cropping patterns and land use.

Reconsidering the cultivation areas of water-intensive crops according to climatic conditions and water availability, while expanding the cultivation of crops with higher added value and relatively lower water requirements, represents an important instrument for reducing pressure caused by water scarcity [8].

The sixth priority direction involves wastewater treatment and reuse, as well as the rational utilization of collector-drainage water.

Introducing closed-loop water supply systems in industrial and municipal sectors is consistent with the circular economy approach within the green economy framework.

The seventh priority direction concerns institutional and transboundary aspects.

It is necessary to implement river basin-based water resources management, improve the Water Code, and strengthen cooperation with neighboring countries [1, 6].

The initiative proposed by the President of Uzbekistan at the Samarkand International Climate Forum to establish a regional program for introducing water-saving technologies in Central Asia further demonstrates the importance of a regional approach [10].

4. Major Problems and Risks

The analysis identified several significant challenges.

First, a substantial proportion of irrigation infrastructure is outdated, and water losses within distribution networks remain high. This situation is also reflected in the newly established targets to reduce water losses by 25–30% [9].

Second, water-saving technologies require considerable initial investment, while access to financing may be limited for small-scale farms.

Third, the incomplete coverage of water measurement and accounting systems prevents accurate assessment of the volume of water saved.

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Fourth, a shortage of qualified engineers, agronomists, and hydraulic engineering specialists limits the effective application of modern technologies.

Fifth, climate change is increasing the variability of river flows and the risk of droughts [8].

5. Recommendations

Based on the research findings, the following measures are recommended:

1. Introduce integrated water resources management principles at the river basin level and coordinate water, energy, and food sector planning through a unified approach.
2. Expand leasing arrangements, guarantee mechanisms, and cooperative financing models to support small-scale farms in adopting water-saving technologies.
3. Digitalize water accounting and monitoring systems, ensure data transparency, and develop an independent methodology for evaluating the volume of water saved.
4. Link water tariffs and incentive systems to metered consumption and gradually improve these mechanisms while taking social protection requirements into account.
5. Accelerate the modernization of pumping stations through energy-efficient equipment and solar energy systems based on public-private partnerships.
6. Develop regulatory requirements and standards governing the reuse of treated wastewater and drainage water.
7. Expand professional training in water management, agronomy, and digital technologies within higher education and retraining systems, while supporting practical training centers for farmers.

CONCLUSION

The study demonstrates that Uzbekistan has established a regulatory and legal framework for transitioning toward the green economy concept in water resources utilization and that practical achievements are already being observed.

Since agriculture accounts for the largest share of water consumption, the principal opportunities for the green transition lie in conserving irrigation water, reducing water losses, and improving energy efficiency.

At the same time, achieving the established targets for 2030 may become challenging unless existing problems related to financing, water accounting systems, human resources, and institutional coordination are adequately addressed.

The proposed measures are expected to contribute to strengthening water security, improving economic efficiency, and ensuring environmental sustainability.

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