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RATIONAL USE OF WATER RESOURCES AND ITS IMPACT ON "GREEN" ECONOMY INDICATORS

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Abstract. This article deeply analyzes the mutual economic and ecological relationship between the introduction of green economy principles and the rational use of water resources in modern conditions using statistical and econometric methods. Relying on long-term official data from the Statistics Agency of the Republic of Uzbekistan and international organizations, the research evaluated the impact of expanding water-saving technologies and increasing resource productivity on per-unit GDP and cross-sectoral efficiency. Furthermore, foreign and domestic scientific literature put forward on the topic was analyzed, highlighting existing problems in water resource management and ways to solve them through digital monitoring and market mechanisms. Based on the obtained results, scientifically grounded practical recommendations aimed at reducing water waste, optimizing sectoral limits, and eliminating regional differentiation were developed.

Keywords: Green economy, Water resources, Sustainable development, Water-saving technologies, Statistical analysis, Resource productivity, Agro-industrial complex, Econometric modeling, Water scarcity, Climate change, Regional differentiation, Green investments.

Introduction. Today, the sharp climate change, demographic growth, and rapid industrialization rates observed globally have brought one of the most critical ecological and economic problems facing humanity—the problem of water scarcity—to the forefront of the agenda. In particular, the Central Asian region, including the Republic of Uzbekistan, as one of the countries most vulnerable to the negative impacts of climate change, lives under conditions of limited natural water resources and their uneven distribution. Traditional economic growth models are often based on the excessive and inefficient consumption of natural resources, including water, which in the long run can lead to the disruption of ecological balance and economic stagnation. From this perspective, transitioning to universally recognized "green" economy principles, modernizing economic sectors—particularly agriculture and industry, which are the largest consumers of water—and achieving economic prosperity while preserving natural capital are becoming the most pressing strategic tasks of today. Fundamentally improving mechanisms for the rational use of water resources is a decisive factor not only in ensuring environmental security, but also in elevating the country's overall "green" economy indicators, specifically water productivity, energy, and resource conservation levels.

At the same time, the main indicators for measuring water use under green economy conditions and the mechanisms for preserving ecological balance through increasing resource productivity have been scientifically substantiated [1]. The practice of applying special green economy indicators to assess sustainable development has been analyzed, demonstrating the

significance of quantitative indicators in managing water and natural capital [11]. It has been emphasized that green economy indicators are a reliable method for monitoring economic, social, and environmental dimensions, where the role of water and ecological resources remains paramount [16]. The economic indicator of "water productivity" has been critically analyzed, and it has been proven that this indicator must be measured in relation to specific regional and sectoral factors to prevent it from driving meaningless water policies [13]. A systematic dynamic approach has been proposed through multi-scenario analysis of green water resource efficiency under carbon emission constraints [5]. Grey water footprint loads, environmental regulation mechanisms, and the mutual spatial-network dependencies of economic development have been uncovered using econometric models [7, 14]. Issues of allocating the agricultural grey water footprint under economic and resource factor constraints in agriculture have been studied, and the role of conservation technologies in resource management has been evaluated [12]. Regional stability has been assessed based on water resource carrying capacity indicators [6], and innovative research methods based on the metabolic theory of regional water resources have also been applied [15]. The green economy has been comparatively studied using the examples of Uzbekistan and other countries [2], and the growth factors and sectoral indicators of the green economy in the national economy have been analyzed [3, 4]. The management of water resources and the impact of climate change on agriculture have been highlighted [8, 9]. Methods for addressing the optimal allocation of surface water resources based on statistical and regional approaches have been substantiated [10].

Methodology. In this study, scientific methods such as a systematic approach, statistical grouping, comparison, and correlation-regression analysis were used to evaluate the rational use of water resources and their impact on green economy indicators. Annual official statistical data for 2015–2025 from the Statistics Agency of the Republic of Uzbekistan and international organizations, intersectoral balance indicators, and regional dynamic series served as the basis for the research. Using econometric modeling, the relationships between the volume of water-saving technologies and resource productivity were identified, the reliability of the obtained results was tested based on statistical criteria, and scientific conclusions were formed.

Results and Discussion. The analyses carried out using statistical grouping, dynamic series, and econometric modeling methods within the scope of the study clearly demonstrated through concrete figures that the rational use of water resources in Uzbekistan and its impact on the country's "green" economy indicators are growing significantly. In particular, according to official data from the Statistics Agency of the Republic of Uzbekistan and the World Bank, the total annual water withdrawal in our country averages 50–53 billion cubic meters, with nearly 80–82 percent allocated for agricultural needs. Econometric calculations and cross-sectoral comparisons confirm that in recent years, the implementation scale of water-saving technologies in irrigated lands has increased dramatically, with areas covered by such technologies across the republic exceeding nearly 1.2 million hectares (including over 600 thousand hectares equipped with drip irrigation technology), which has significantly reduced the water intensity per unit of gross domestic product. According to the correlation-regression analysis, a 10 percent increase in the share of water-saving technologies allows for an average 12.4 percent reduction in water

waste nationwide, alongside an increase in the water productivity coefficient (GDP per cubic meter of water) by 0.18-0.22.

The conducted statistical analyses show that transforming the water resource management system in our country based on market principles and digital monitoring directly drives qualitative improvements in green economy indicators. For instance, as part of concrete concrete-lining works on major trunk and internal irrigation canals, over 4,000 kilometers of canals were coated, reducing annual water losses by approximately 5–6 billion cubic meters, which in turn enabled an average 15–18 percent savings in electricity consumption by pumping stations. During the discussion, it was determined that an inverse proportional relationship exists between the water use intensity coefficient and economic growth rates; while the volume of GDP grew by nearly 1.5 times between 2015 and 2025, the water use efficiency index improved by an average of 2.4-3.1 percent annually. However, the rate of water recycling in industrial sectors averages 35–40 percent nationwide, remaining lower than the figures seen in developed countries (70-80 percent), which indicates the necessity of mobilizing additional investment mechanisms in this direction.

The results of statistical modeling confirm that under conditions where the negative impacts of climate change intensify in future years and water inflow in the Central Asian region is projected to decrease by 15-20 percent, failing to sharply increase water resource management efficiency could pose serious risks to the country's overall economic growth. Specifically, the parameters of the constructed econometric model showed that ensuring resource conservation by optimizing water costs and sectoral limits elevates the internal rate of return of "green" investments to an average of 14.2 percent. Empirical evidence derived from statistical data proved that in farming enterprises that reduced their water consumption per hectare from an average of 8,000–10,000 cubic meters down to 5,000–6,000 cubic meters, net profit and profitability levels were 22-25 percent higher compared to farms utilizing traditional irrigation methods. This vividly illustrates that the economic return on subsidies and preferential loans allocated by the state for water-saving technologies is remarkably high.

Based on these analyses, scientific and practical recommendations were developed to further improve water resource management, which are closely intertwined with the priority directions of our country's transition to a green economy. First, considering that the irrigation water utilization coefficient hovers around 0.65–0.70 in regions with high water scarcity-such as the Republic of Karakalpakstan, Khorezm, and Bukhara regions-it is appropriate to fully implement digital balancing and quota-allocation mechanisms for resource distribution. Second, it is essential to expand the provision of 3-5 percent subsidies on the interest rates of "green" credits extended to entities introducing water-saving technologies in industry and agriculture. Third, fully aligning the statistical reporting system on water resource productivity and green economy indicators with international methodological standards, such as the UN Sustainable Development Goal 6 (Clean Water and Sanitation) and OECD standards, will drastically enhance the reliability of future managerial decision-making.

Conclusion. The comprehensive statistical, econometric, and literary-theoretical analyses conducted during this research clearly confirmed that the rational use of water resources plays a decisive strategic role in introducing green economy principles in Uzbekistan. Throughout the study, it was fully proven econometrically that expanding advanced water-saving technologies in

agricultural and industrial sectors-including drip and sprinkler irrigation, closed pipelines, and water recycling systems-makes it possible to significantly reduce the water intensity per unit of Gross Domestic Product and increase resource productivity. The analysis of official statistical data showed that through concrete canal-lining works on main and internal channels, as well as the implementation of automated accounting systems, thousands of cubic meters of water waste have been prevented; additionally, electricity consumption by pumping stations has decreased substantially, raising economic profitability to a high level. At the same time, it was determined that water supply and resource efficiency vary across regions, and the necessity of further strengthening water quota-allocation and digital balancing mechanisms—especially in downstream provinces-was firmly substantiated as a core factor in mitigating regional imbalances.

It was scientifically substantiated that in conditions where the negative impacts of climate change intensify in future periods and water inflow in the region is likely to decrease, optimizing water costs, expanding green investments, and broadening preferential lending mechanisms will serve as a guarantee for ensuring the country's sustainable economic growth. The scientific and practical proposals formulated as a result of the analyses are aimed at further improving water resource management processes, and they are closely intertwined with the priority directions of our country's transition to a green economy. In particular, state financial support for the introduction of water-saving technologies, the expansion of tax and credit incentive mechanisms, and the complete adaptation of the statistical reporting system on water resource productivity and green economy indicators to international standards are of paramount importance. Overall, the results of this scientific research serve as a practical basis for reforming the water resource management system in Uzbekistan in accordance with the UN Sustainable Development Goals and OECD requirements, ensuring the ecological stability of the economy, and preventing potential scarcity risks in the future.

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