Assessment of the Economic Effectiveness of Water Resource Management: In Case of Uzbekistan

Akhmedov Sayfullo Normatovich
Doctor of Economics, Professor of Tashkent State University of Economics,
Tashkent, Uzbekistan
https://orcid.org/ 0009-0004-1866-0434
s.axmedov@tsue.uz

Abstract. **This research paper aims to assess the economic effectiveness of current water resource management practices in Uzbekistan by analyzing the allocation, utilization, and conservation strategies employed across key sectors—primarily agriculture, industry, and municipal services. Using a mixed-method approach that combines macroeconomic indicators, water efficiency indices, and stakeholder interviews, the study evaluates both the direct and indirect economic outcomes of water management policies. Particular emphasis is placed on the challenges posed by outdated irrigation infrastructure, inefficient water pricing mechanisms, and the impacts of climate change. The paper further investigates regional disparities in water distribution and the effectiveness of recent reforms, including the implementation of water user associations and integrated water resources management (IWRM) frameworks. Based on the results of the assessment, proposals were made to determine the rational use and efficiency of water resources in the districts.**

Keywords: Water, water resources, rational use of water resources, efficiency, method of determining efficiency.

1. INTRODUCTION

Today, on a global scale, the issue of rational and efficient use of natural resources, in particular water resources, is acquiring global significance. Population growth, the expansion of industry and agriculture, climate change, and the disruption of the ecological balance sharply increase the demand for water resources. Especially for countries located in the center of Asia, where the risk of water shortage is high, the issue of rational use and effective water management has become an important factor in ensuring not only economic, but also social and political stability.

In the Republic of Uzbekistan, water resources are also recognized as a strategic reserve of the country's economy. Water consumption in the country is mainly directed to agriculture, industry, and meeting the needs of the population, and its misallocation, losses, and low efficiency cause many problems. Therefore, one of the urgent tasks is to increase the efficiency of economic management of water resources, assess this process based on a comprehensive approach, and form effective mechanisms through scientifically based methods.

Existing research often focuses on unilateral economic or environmental aspects of water management. But in real conditions, these processes are interconnected, and their integral and complex assessment is necessary. The development of methodological aspects for a comprehensive assessment of the effectiveness of water resource use is important for improving the quality of management decisions, optimizing costs, and ensuring sustainable development.[1]

From this point of view, this article provides for the development of scientific and theoretical foundations for a comprehensive assessment of the effectiveness of economic management of water resources, assessment methods, as well as practical proposals and recommendations for their improvement. This research aims to propose scientific and practical solutions that serve to ensure rational water resource management.

2. LITERATURE REVIEW

Many foreign scientists have conducted research on the comprehensive economic assessment of water resource use and its effective management, and the latest trends are characterized by the breadth of research related to the ecological environment. In particular, the research of Agarwal A. [3], Savenije H. H. G., Van der Zaag P. [4], Rahaman M. M., Varis O. [5], Biswas A. K. [6], Xiaojun Xiang [7] and others emphasizes that sustainable water resource management is an important process for ensuring life and the future of the Earth. It proposes a dynamic model of water resource planning (Dynamic Water Resource Planning - AIDWRP). This model is based on intelligent management of water resource allocation.

In the research of Zhaoyang Yang et al. [8], serious research was conducted on the concept of water resources carrying capacity (WRCC). In this study, a simulation model of the throughput capacity of water resources was created

based on models of the analytical hierarchy process (AHP) and system dynamics (SD). Based on this simulation model, 5 scenarios for the effective distribution of water resources across the regions of the country are proposed.

In the research of Ciriacy-Wantrup S. V. et al. [9], two approaches to assessing the use of water resources are proposed. Firstly, through various computational techniques of cost-benefit analysis, consideration through the use of water resources. The second approach is based on establishing established norms for water resources and identifying differences and deviations in relation to them.

In the research conducted by Russian scientists, the main attention is paid to research aimed at the rational use of water resources in the regions. In the studies of Juladan, V. Fomina [11], the features of water use were determined based on specific indicators of water capacity and water loss of products manufactured in the territory of the North-Western Federal District of Russia.

This article proposes a regional strategy for achieving water resource conservation by assessing the effectiveness of water use in the regions. The following are analyzed as the main indicators: (the level of use of fresh and treated water in production, specific water consumption for domestic and drinking needs, water losses, wastewater composition by volume and pollution level, etc.).

In general, the scope of research by Uzbek scientists aimed at developing methodological approaches to assessing the effectiveness of water resource use is low. Therefore, the development of research in this area is an important area.

3. ANALYSIS AND RESULTS

Water is a necessary tool for all aspects of life. It is considered the main resource of vital importance for meeting basic human needs, ensuring socio-economic development, as well as the integrity and preservation of ecosystems. Water is considered as a primary material resource for activities related to production and consumption in socio-economic processes. Therefore, in all countries, the conservation and rational use of water resources occupy an important place in the country's economy.

In Uzbekistan, issues of ensuring the efficient use of water resources, the introduction of water-saving innovative technologies in agriculture and industry, and the improvement of the melioration state of irrigated lands are considered as priority state policy.

One of the priority tasks is the effective management of water resources, the use of market mechanisms for their accounting based on modern technologies. Accordingly, the development of methods for a comprehensive assessment of the effectiveness of economic management of water resources at the macro level is one of the priority areas of research.

Along with the above, it is advisable to develop methods for assessing water consumption norms at the macro level and calculating indicators of the efficiency of water resources consumed by the regions for industries and sectors. For example, in the Russian Federation, the water resource component of the country's innovative development adopted water resource use strategies by evaluating the integral indicator - the water intensity of gross domestic product (GDP).

In our opinion, to assess the level of water use of regions, it is advisable to use the widely used in world and domestic practice criteria of water availability and criteria of water use efficiency.

One of the most important criteria for water availability is the water stress index, which is defined as the proportion of water in renewable sources. Based on the value of this indicator, the World Resources Institute1 classifies the impact of water based on the following conditions: <10% - low stress level; 10-20% - low and moderate stress; 20-40% - moderate and high stress; 40-80% - severe stress; >80% - very high stress. [10]

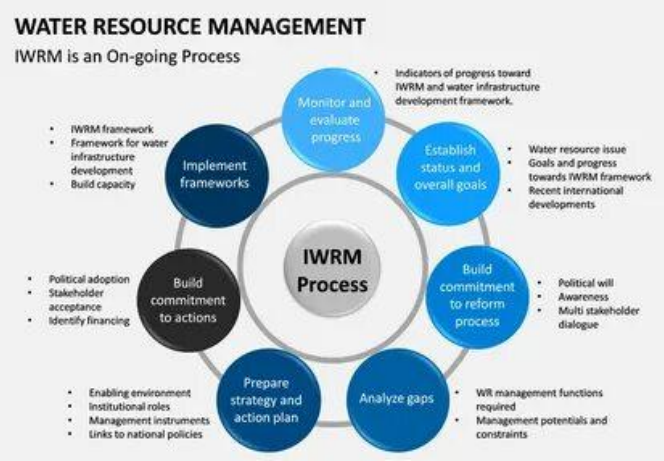

Fig.1. Water resource management

The study also analyzes policy reforms such as the introduction of water user associations and Integrated Water Resources Management (IWRM) principles, highlighting their mixed outcomes in terms of both economic and environmental sustainability.

Within the framework of the UN Priority Development Program, indicator 6.4.2 has been developed. In this case, the level of pressure on water resources: the level of fresh water extraction from existing freshwater sources and its processing (purification) indices are included as the main evaluation criteria. The global calculation of this indicator is carried out on the basis of a methodology, according to which the criterion of water stress is assessed, taking into account the environmental flow necessary for the preservation of aquatic ecosystems.

The "The Decoupling Diamond" model for assessing the sustainability of regional water use is the most tested methodology in international research in assessing the effectiveness of water use. The model assesses economic growth rates, resource consumption or environmental pollution, and the ratio of these indicators to economic growth based on the value of the elasticity coefficient based on eight critical criteria (Fig. 1). [10]

The visualization of the model shows that water consumption can be either elastic (expansive and recessive dependence) or segregated (strong, weak, recessive segregation - strong, weak) to changes in ΔEP and GDP (GRP by region). Or negatively isolated (strong, weak, recessive negative isolation - strong, weak, recessive negative isolation).

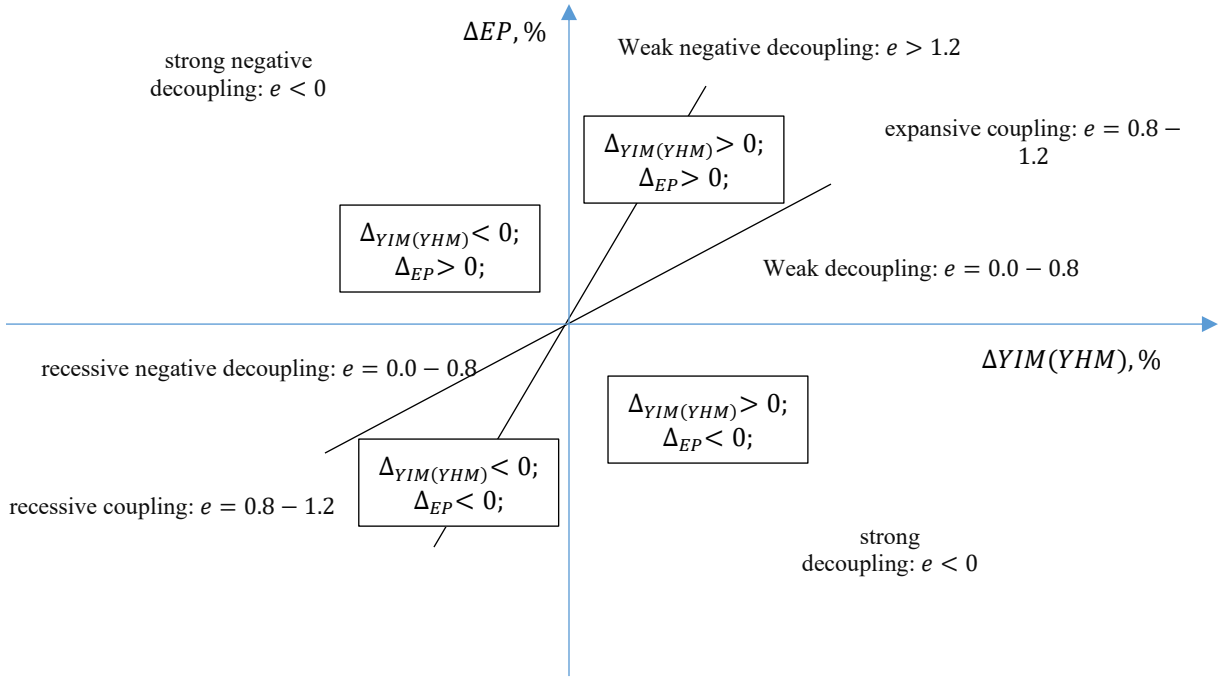

Figure 1. Distribution state according to the Taipō Diamond Separation Model (Tapio Decoupling Diamond model)

For global and regional assessments, it is recommended to use the values of various variables of the generalization formula, i.e., to determine the value added by industry and the level of water use, increase or decrease in the level of water consumption.

There are eight logical possibilities for placing variables in the distribution system (Fig. 1). In this case, the rates of change in the volume of water consumption in the regions i ER (ΔER), million m3, and GDP (Δ GDP) can be combined, separated, or negative. The increase in water consumption as a result of economic growth is expressed as a percentage and is calculated based on the elasticity of GDP to a percentage change over a certain period. The elasticity coefficient "e" is calculated using the following formula (1.1.):

e=%ΔVERV_ /%ΔYAIM (1.1.)

Here;

e-elasticity coefficient;

ER - growth rates of water consumption in economic sectors, %;

GDP - growth rates of gross domestic (regional) product, in percent;

The longer the studied time period, the more reliable the results. [10] In this study, to study the use of water resources and their impact on regional development, it is advisable to determine the long-term period 2010-2021 and the short-term period 2015-2021. This provides an opportunity to compare the impact of water resource use on economic growth in the long and short term.

A change in the elasticity coefficient within ±20% of 1;0 is considered a connection, which leads to the emergence of a causal connection. Elasticity values from 0.8 to 1.2 are introduced as critical values.

The rate of change of variables can be positive, expressed as an expanding relationship, negative, expressed as a recessive relationship. The main critical criteria for the assessment are presented in Table 1.

Table 1: Critical criteria for the diamond separation model

Separation status		**Elastic Decoupling Value "e"**	ΔEP	ΔGDP
Negative	expansive negative decoupling	e >1.2	>0	>0
	weak negative decoupling	0< e <0.8	<0	<0
	strong negative decoupling	e<0	>0	<0
Disconnection	recessive decoupling	e >1.2	<0	<0
	weak decoupling	0< e <0.8	>0	>0
	strong decoupling	e<0	<0	>0
coupling	expansive coupling	0.8< e <1.2	>0	>0
	recessive coupling	0.8< e <1.2	<0	<0

For this model, data from 2010-2022 for all regions of the Republic of Uzbekistan on the level of use of territorial water resources and GRP are used and placed on the corresponding coordinate axis, and trends are studied.

4. CONCLUSION

If the efficiency of water resource use is accurately calculated for each region, it will be possible to identify the competitive types of products and services of the regions and determine specific directions for the relocation of water-intensive industries.

Along with the above, it is advisable that all regions today have a clear strategy aimed at the efficient use of their water resources, if these strategic goals are determined from the general to the specific. Although the results of the research conducted cannot provide specific conclusions for each industry or sphere, they make it possible to establish water consumption norms in the regions, cities, and districts of the republic.

REFERENCES

[1]. https://www.fao.org/land-water/en.

[2]. Hering J. G., Ingold K. M. Water resources management: what should be integrated? //Science. – 2012. – T. 336. – №. 6086. – C. 1234-1235.

[3]. Agarwal A. et al. Integrated water resources management. – Stockholm : Global water partnership, 2000. – C. 1-67.

[4]. Savenije H. H. G., Van der Zaag P. Integrated water resources management: Concepts and issues //Physics and Chemistry of the Earth, Parts A/B/C. – 2008. – Т. 33. – №. 5. – С. 290-297.
[5]. Rahaman M. M., Varis O. Integrated water resources management: evolution, prospects and future challenges //Sustainability: science, practice and policy. – 2005. – Т. 1. – №. 1. – С. 15-21.
[6]. Biswas A. K. Integrated water resources management: a reassessment: a water forum contribution //Water international. – 2004. – Т. 29. – №. 2. – С. 248-256.
[7]. Xiang X. et al. Urban water resource management for sustainable environment planning using artificial intelligence techniques //Environmental Impact Assessment Review. – 2021. – Т. 86. – С. 106515.
[8]. Yang Z. et al. Comprehensive evaluation and scenario simulation for the water resources carrying capacity in Xi'an city, China //Journal of environmental management. – 2019. – Т. 230. – С. 221-233.
[9]. Ciriacy-Wantrup S. V., Bishop R. C., Andersen S. O. Water policy and economic optimizing: Some conceptual problems in water research //Natural Resource Economics. – Routledge, 2019. – С. 67-76.
[10]. Tapio, P. (2005) 'Towards a theory of decoupling: degrees of decoupling in the EU and the case of road traffic in Finland between 1970 and 2001', Transport Policy, vol. 35, pp. 137-151.
[11]. Fomina V. F. Identifying the Effect of Decoupling in Major Economic Sectors of the Komi Republic //Ekonomicheskiei Sotsialnye Peremeny. – 2022. – Т. 15. – №. 1. – С. 176-193.