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ORGANISATIONAL AND ECONOMIC MECHANISMS FOR ENSURING SUSTAINABLE ECONOMIC GROWTH BASED ON RESOURCE-SAVING TECHNOLOGIES

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Abstract. The article analyses organisational and economic mechanisms for ensuring sustainable economic growth in Uzbekistan based on water-, energy- and material-saving technologies, using official statistical and administrative data. The area under water-saving technologies grew from 28 thousand hectares in 2018 to 2.6 million hectares in 2025 (62% of irrigated land), yet 62% of this area is accounted for by relatively low-efficiency laser land levelling. Power grid losses declined from 17.2% to 11.1%, while the household waste recycling rate stands at 6.1%. Mechanisms of results-based subsidies, differentiated resource pricing, energy performance contracting, extended producer responsibility and resource productivity monitoring are proposed.

Keywords: resource efficiency, water-saving technologies, energy efficiency, circular economy, resource productivity, sustainable growth, Uzbekistan.

INTRODUCTION

Amid limited natural resources and climate change, achieving economic growth without a proportional increase in resource consumption is becoming a key condition for sustainable development [12; 15]. This challenge is particularly acute for Uzbekistan: more than 90% of the country's water resources are used in agriculture, and irrigated land covers about 4.2 million hectares [10]. At a time when water reserves are shrinking and energy consumption and household waste volumes are rising rapidly, resource-saving technologies have become an essential factor in sustaining economic growth. The "Uzbekistan – 2030" Strategy identifies the widespread introduction of water-saving technologies on all irrigated land as a priority task [1; 2; 4], and a programme for water resources management and irrigation sector development for 2025–2028 has been adopted [5].

However, the economic efficiency of introducing resource-saving technologies, the structure of state support mechanisms and the directions for improving them have not yet been sufficiently substantiated.

The aim of the study is to develop scientific recommendations for improving the organisational and economic mechanisms for ensuring sustainable economic growth through resource-saving technologies, based on a statistical analysis of water, energy and material resource efficiency indicators in Uzbekistan.

LITERATURE REVIEW

The impact of resource constraints on economic growth was brought to wide debate by D. Meadows and co-authors in "The Limits to Growth" [9]. H. Hotelling developed the theory of the optimal use of exhaustible resources [7], while R. Solow established the conditions for maintaining sustainable consumption by substituting human and physical capital for depleted natural capital [14].

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E. von Weizsäcker and co-authors showed that welfare can be decoupled from resource use by multiplying resource productivity (the "Factor Four" concept) [16]. W.S. Jevons's "efficiency paradox" emphasises that resource-saving technologies may lower prices and thereby increase total consumption [8], which underlines the decisive role of pricing and institutional mechanisms.

In water resources management, E. Ostrom developed institutional principles for governing common-pool resources [11]. The International Resource Panel (IRP) and the OECD have proposed resource productivity indicator frameworks [12; 13]. Studies on Uzbekistan have mainly focused on assessing the agronomic efficiency of water-saving technologies, while assessing different types of resources within a single framework and analysing the economic efficiency of state support have received insufficient attention.

METHODOLOGY

The information base of the study comprises official information of the Ministry of Water Resources, the Ministry of Energy and the Ministry of Ecology [5; 6; 10], GDP data of the National Statistics Committee, and the parameters of state programmes. Dynamic and structural analysis, the decoupling coefficient, compound annual growth rate (CAGR), cost-effectiveness analysis and gap analysis against target indicators were applied. The economic efficiency of resource saving was estimated conditionally as the ratio of state subsidies to the unit of resource saved.

ANALYSIS AND RESULTS

Water-saving technologies. Table 1 presents the dynamics of the introduction of water-saving technologies.

Table 1

Dynamics of the area under water-saving technologies in Uzbekistan

Indicator	2018	2020	2023	2025	2028 (target)
Area, million ha	0.028	≈0.17	1.26	2.60	3.50
Share of irrigated land, %	0.7	4	30	≈62	≈80
Compound annual growth rate (CAGR), %	–	–	–	43.6*	10.4**

Source: author's calculations based on data of the Ministry of Water Resources and the Press Service of the President [5; 10]. * 2023–2025; ** rate required for 2025–2028.

The area under water-saving technologies expanded almost 15-fold in 2020–2025 and covered about 62% of irrigated land in 2025. In 2020–2024, UZS 60 trillion in budget funds and USD 622 million in foreign investment were allocated for these purposes [5]. To reach the 2028 target (3.5 million ha), it is sufficient to expand the area by an average of 300 thousand hectares, or 10.4%, per year. Hence, the main challenge is no longer coverage but the quality and efficiency of the technologies.

Table 2

Structure of water-saving technologies introduced in 2019–2025

Type of technology	Area, thousand ha	Share, %	Water-saving level
Drip irrigation	664	25.7	high

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Type of technology	Area, thousand ha	Share, %	Water-saving level
Sprinkler irrigation	124	4.8	high
Other modern methods	73	2.8	medium
Flexible pipes and film-lined furrows	124	4.8	medium
Laser land levelling	1,600	61.9	low–medium
Total	2,585	100.0	20–60%

Source: author's calculations based on data of the Ministry of Water Resources [10; 17].

Table 2 reveals a significant structural imbalance: laser land levelling accounts for 61.9% of the area introduced, while high-efficiency drip and sprinkler irrigation together account for only 30.5%. According to expert estimates, water-saving technologies reduce water use by 20–60% and fuel and mineral fertiliser use by 25–35%, and raise cotton yields by 10–15 centners per hectare [17]. The wide range of this indicator reflects precisely the difference in efficiency between technology types.

In 2026, water savings of 5 billion m³ are planned through the introduction of water-saving technologies on 504 thousand hectares, averaging 9.9 thousand m³ per hectare [18]. UZS 3.3 trillion has been earmarked for these purposes in the same year [17]. By a conditional estimate, this implies state expenditure of approximately UZS 660 per cubic metre of water saved. Monitoring this indicator would make it possible to compare the effectiveness of subsidies across technologies and regions.

Energy and material resources. Table 3 presents the main indicators of energy and material resource saving.

Table 3

Indicators of energy and material resource use efficiency

Indicator	2024	2025	Change
Electricity generation, billion kWh	81.5	86.7	+6.4%
Gap between generation and supply, billion kWh	14.0	9.6	–31.4%
Share of losses, %	17.2	11.1	–6.1 p.p.
Decoupling coefficient (electricity/GDP)	–	0.83	relative decoupling
Household waste generated, million t	14.8	…	–
Waste recycled, thousand t (share, %)	900.5 (6.1)	…	–

Source: author's calculations based on data of the Ministry of Energy [6] and the Ministry of Ecology [19].

Resource efficiency in the energy sector has improved considerably: the gap between generation and supply to consumers narrowed by 4.4 billion kWh in one year, and the share of losses fell from 17.2% to 11.1% [3; 6]. This volume is equivalent to the output of all solar photovoltaic plants commissioned in 2025. The 2025–2028 programme envisages reducing the annual electricity consumption of pumping stations from 6.8 to 6.2 billion kWh (8.8%) by replacing obsolete equipment [5]. At the same time, losses of 11% remain considerably higher than in developed countries.

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The situation with material resources is considerably more difficult: in 2024, 14.8 million tonnes of household waste were generated, of which only 900.5 thousand tonnes, or 6.1%, were recycled at 292 specialised enterprises [19]. Waste-to-energy projects worth a total of USD 1.3 billion envisage incinerating 4.7 million tonnes of waste per year (32% of the total volume) and generating 2.1 billion kWh of electricity [20]. However, incineration ranks below recycling in the circular economy hierarchy, so mechanisms for returning material resources to circulation need to be strengthened.

DISCUSSION

The results indicate that Uzbekistan is at the point of transition in the introduction of resource-saving technologies from the stage of "extensive coverage" to the stage of "intensive efficiency". While the area under water-saving technologies has expanded rapidly, cheaper but less efficient methods dominate its structure. From the perspective of the Jevons paradox [8], if the price of water remains low, the water saved may be used to expand cultivated areas, so that total water consumption may not decline. For this reason, the plan to differentiate water tax rates and subsidies according to water availability from 2027 [17] is scientifically sound and should be combined with strengthening the role of water users' associations in line with Ostrom's principles [11].

The limitations of the study include the fact that resource-saving indicators are published mainly in administrative releases, that annual official statistics on water use and waste are incomplete, and that data for different years are not fully comparable methodologically.

CONCLUSIONS AND RECOMMENDATIONS

The study leads to the following conclusions: coverage of water-saving technologies has reached 62%, but the share of high-efficiency methods is limited to 30.5%; losses in the power sector have fallen to 11.1% but remain high; the household waste recycling rate (6.1%) is low, and circular economy mechanisms are at the formation stage. On this basis, the following organisational and economic mechanisms are proposed (Table 4).

Table 4

Organisational and economic mechanisms for ensuring sustainable growth based on resource-saving technologies

Mechanism	Statistical basis	Proposed measures
Results-based subsidies	Share of laser levelling – 61.9%; 1 m³ of water saved ≈ UZS 660	Link subsidies to measured water savings rather than to hectares covered; raise subsidy rates for drip and sprinkler irrigation; verify water savings using smart water meters.
Differentiated resource pricing	Risk of the Jevons paradox; declining water reserves	Differentiate the water tax according to regional water availability; apply increased rates for consumption above established limits; pilot a mechanism for trading saved water quotas among water users.
Energy performance contracting (ESCO)	Losses – 11.1%; pumping stations – 6.8 billion kWh	Introduce energy performance contracts in public institutions and pumping stations (investment recovered from energy savings); mandatory energy audits for enterprises; equipment standards based on energy efficiency

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Mechanism	Statistical basis	Proposed measures
		classes.
Extended producer responsibility (EPR)	Waste recycling rate – 6.1%	Introduce recycling fees for producers and importers of packaging, electronics, tyres and vehicles; establish recycling clusters in 13 eco-industrial zones; provide tax incentives for enterprises using secondary raw materials.
Resource productivity monitoring	Fragmented administrative data	Introduce a national resource productivity indicator system covering water, energy and material use per unit of GDP; evaluate the performance of regional administrations (khokimiyats) through resource efficiency KPIs.

Source: developed by the author.

The comprehensive implementation of the proposed mechanisms will help shift the introduction of resource-saving technologies from coverage to efficiency, decouple economic growth from natural resource consumption and thereby ensure sustainable growth of Uzbekistan's economy.

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