

WATER SAVING IRRIGATION TECHNOLOGIES IN UZBEKISTAN: TRENDS, TECHNOLOGY MIX, AND REGIONAL PATTERNS (2019–2023)

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Abstract: This paper provides an economic-statistical overview of the scale-up of water saving irrigation technologies in Uzbekistan during 2019–2023, using official administrative/statistical records disaggregated by region and technology type. We describe yearly dynamics, the composition of adopted technologies (drip irrigation, sprinkler irrigation, discrete irrigation, flexible-pipe irrigation, film-furrow methods, and laser land leveling), and heterogeneity across regions and crop groups. Descriptive indicators include year-on-year growth, shares, rankings, and simple comparative metrics to highlight the pace and structure of adoption. The total area reported under water saving technologies expanded from 35.7 thousand ha in 2019 to 348.9 thousand ha in 2023, peaking at 433.0 thousand ha in 2021. Over the whole period, the cumulative area reached 1.22 million ha. Technology composition is dominated by laser land leveling (about 52.2% of the cumulative area) and drip irrigation (36.5%), while sprinkler irrigation accounts for around 6.8%. Regional patterns are uneven: in 2023, Khorezm, Bukhara, Samarkand, Karakalpakstan and Kashkadarya together accounted for roughly half of the national water saving technologies area. These patterns suggest that further policy attention is needed to sustain adoption beyond one-off surges, strengthen financing and extension services, and tailor technology packages to region- and crop-specific water constraints.

Keywords: water saving technologies; irrigation; drip irrigation; laser land leveling; regional analysis; Uzbekistan; 2019–2023

1. Introduction

Uzbekistan's agriculture is highly dependent on irrigation and therefore particularly vulnerable to climate variability, rising temperatures, recurrent droughts, and increasing competition for water resources. In such a context, expanding water saving technologies is not only an agronomic necessity but also an economic strategy that can reduce production risk, stabilize yields, and improve resource productivity. Over the past decade, national reforms and sector strategies have increasingly emphasized modernization of irrigation practices and the adoption of efficient technologies. However, the pace and structure of adoption may differ substantially across regions and crop systems due to differences in water availability, infrastructure, farm structure, and policy implementation (FAO, 2012; World Bank Group, 2023).

The objective of this paper is to document and interpret the dynamics of water saving technologies adoption in Uzbekistan during 2019–2023. Specifically, we (i) describe annual trends in total water saving technologies area, (ii) analyze the composition of technology types and their crop breakdown where available, and (iii) compare regional patterns and identify leading and fast-growing regions. The analysis is intended as an evidence base for researchers and policy makers working on irrigation modernization, climate adaptation, and agricultural productivity.

2. Data and methods

The analysis uses an official dataset on the introduction of water saving technologies in Uzbekistan, covering the years 2019–2023 and disaggregated by administrative region and technology type. The dataset reports areas (hectares) under the following categories: drip irrigation (with a crop breakdown), sprinkler irrigation (with a crop breakdown), discrete irrigation, flexible-pipe irrigation, film-furrow methods, and laser land leveling. We apply

descriptive statistics and comparative indicators: totals by year and region, year-on-year changes, shares in the national total, rankings of regions, and simple growth metrics for 2019–2023. Figures and tables summarize the key patterns and facilitate year and regional comparisons.

3. Results

Table 1. National dynamics of water saving technologies area in Uzbekistan (2019–2023).

Year	water saving technologies area introduced (ha)	YoY change (ha)	YoY change (%)	Cumulative 2019–year (ha)
2019	35734.2			35734.2
2020	49499.1	13765.0	38.5	85233.3
2021	432977.9	383478.7	774.7	518211.2
2022	354738.1	-78239.7	-18.1	872949.3
2023	348939.7	-5798.4	-1.6	1221889.0
Year	water saving technologies area (ha)	Share of 2019–2023 total (%)	Year-on-year change (%)	
2019	35,734	2.9		
2020	49,499	4.1	38.5	
2021	432,978	35.4	774.7	
2022	354,738	29.0	-18.1	
2023	348,940	28.6	-1.6	

Note: Values are hectares (ha). The cumulative total over 2019–2023 equals 1,221,889 ha; the maximum annual introduction is observed in 2021 (432,978 ha).

Table 2. Technology composition of cumulative water saving technologies area (2019–2023).

Technology	Area (ha)	Share of total (%)
Laser land levelling	637156.6	52.1
Drip irrigation	446052.0	36.5
Sprinkler irrigation	48254.1	3.9
Flexible pipes	43284.3	3.5
Discrete irrigation	26503.2	2.2
Plastic-lined furrows	20639.0	1.7
Technology category	Area (ha)	Share of total (%)
Drip irrigation	446,052	36.5
Sprinkler irrigation	48,254	3.9
Discrete irrigation	26,503	2.2
Flexible-pipe irrigation	43,284	3.5
Film-furrow method	20,639	1.7
Laser land levelling	637,157	52.1
Total	1,221,889	100.0

Laser land levelling and drip irrigation together account for almost 89% of the cumulative water saving technologies area, indicating that the modernisation effort has primarily relied on land levelling and localised irrigation systems.

Regional adoption is highly uneven. In 2023, the leading regions by water saving technologies area were Хоразм, Фарғона, Самарқанд, Бухоро and Наманган. Together, these regions represented a substantial share of national adoption, reflecting differences in irrigation needs, water constraints, and implementation capacity. The spatial pattern is summarised in Figure 5.

Crop-level disaggregation (where available) suggests that drip irrigation is widely used in cotton and horticulture (orchards and vineyards), while sprinkler irrigation is concentrated in cereals and fodder/vegetable systems. The relative composition changes over time, consistent with shifts in policy priorities and investment.

Overall, adoption accelerated sharply in 2021 and then moderated in 2022–2023. The post-2021 decline (about 19% relative to the 2021 peak) may indicate that a portion of the expansion was driven by time-bound programs, investment cycles, or implementation bottlenecks. Sustaining long-term growth likely requires stable financing mechanisms, reliable energy and water delivery infrastructure, farmer training and advisory services, and careful targeting of technologies to local water constraints and crop profitability (Vinokurov et al., 2023; Fereres & Soriano, 2007).

4. Discussion and policy implications

The findings point to three policy-relevant insights. First, the rapid expansion in selected years shows that large-scale technology uptake is feasible when programs and incentives align. Second, the dominance of laser land leveling and drip irrigation suggests that modernization has prioritized foundational water-management improvements and localized irrigation systems; complementary measures (maintenance, operation training, water-user coordination) are essential to realize the full economic benefits. Third, strong regional heterogeneity implies that ‘one-size-fits-all’ programs may be inefficient. Regions with chronic water scarcity may benefit most from localized systems and drought-resilient crop choices, while areas with infrastructure constraints may require phased investments and institutional strengthening.

This paper is descriptive and relies on reported areas; it does not estimate causal impacts on yields, costs, or profits. Future work should link water saving technologies adoption to farm-level performance indicators and climate variables, and apply econometric approaches (e.g., adoption models, difference-in-differences, treatment-effect methods) to quantify economic returns and heterogeneous impacts across farms and regions.

5. Conclusion

Using official regional statistics for 2019–2023, this study documents a strong expansion of water saving technologies in Uzbekistan, with cumulative water saving technologies area exceeding 1.22 million ha. Adoption peaked in 2021 and subsequently stabilized at around 350 thousand ha per year. The technology mix is heavily concentrated in laser land leveling and drip irrigation, while regional patterns remain uneven. These results provide a baseline for policy evaluation and for future research on the economic impacts of irrigation modernization under climate change.

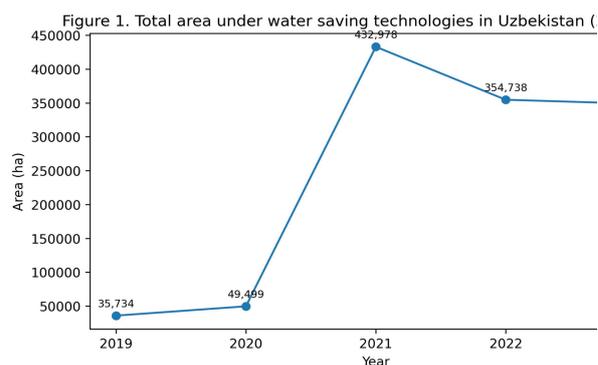


Figure 1. Total area under water saving technologies in Uzbekistan (2019–2023).

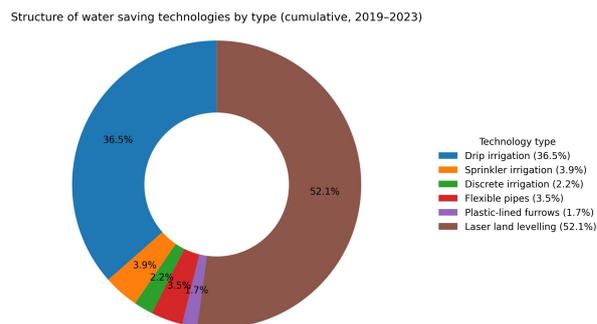


Figure 2. Structure of water saving technologies by type (cumulative, 2019–2023).

Figure 6. Drip irrigation within water saving technologies: crop structure (cumulative, 2019–2023)

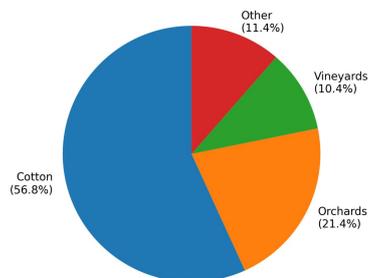


Figure 3. Drip irrigation within water saving technologies: crop structure (cumulative, 2019–2023).

Figure 7. Sprinkler irrigation within water saving technologies: crop structure (cumulative, 2019–2023)

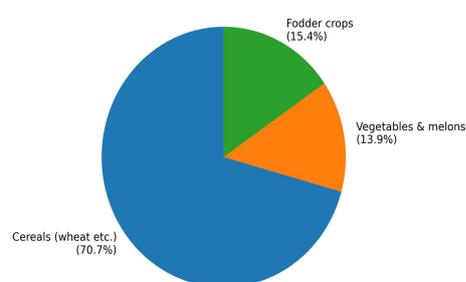


Figure 4. Sprinkler irrigation within water saving technologies: crop structure (cumulative, 2019–2023).

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