TECHNICAL AND TECHNOLOGICAL DEVELOPMENT IN UZBEKISTAN'S AGRICULTURE: AN ANALYSIS OF 2018–2024

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Annotation:

From 2018 to 2024, Uzbekistan's agriculture sector underwent substantial technical and technological transformation. This study analyzes national data on the agricultural machinery fleet—including tractors, grain harvesters, cotton pickers, and other machinery—and identifies key trends related to mechanization levels, equipment shortages, and the age and wear of the machinery park. The research also evaluates the introduction of digital agriculture practices such as drip irrigation, water-saving irrigation systems, drones, GPS tracking devices, and other precision farming technologies within the context of state-led modernization policies implemented during 2018–2024.

The findings indicate moderate growth in the number of tractors and grain harvesters, alongside rapid expansion in cotton-harvesting machinery. The adoption of advanced, water-efficient irrigation technologies increased sharply. However, despite these improvements, a large share of agricultural machinery remains outdated, and shortages—especially during peak agricultural seasons—continue to constrain mechanization. Although government programs providing subsidies, purchasing incentives, and infrastructure support have yielded positive results, additional measures are needed to achieve fully sustainable mechanization and comprehensive digital transformation in the agricultural sector.

Keywords: agricultural machinery; technical modernization; mechanization; digital transformation.

Introduction

Agriculture plays a crucial role in Uzbekistan's economy, accounting for approximately 28–30 percent of the country's GDP and employing a significant share of the labor force. Although agricultural production in the country has historically relied on labor-intensive methods, in recent years the government has prioritized technical modernization and mechanization with the aim of increasing productivity and ensuring food security. Since 2018, large-scale reforms and investments have been undertaken to upgrade tractors, combines, and other types of agricultural machinery. This was necessary because a substantial portion of the existing machinery fleet was inherited from the Soviet period and had become severely worn out or technologically obsolete.

At the same time, the development of digital agriculture has gained increasing relevance in Uzbekistan. Expanding water-saving drip irrigation systems, using drones to monitor crop fields, and equipping machinery with GPS technologies have become essential tools for enhancing agricultural efficiency—especially under conditions of water scarcity and other resource constraints.

Initial assessments conducted in 2018 revealed serious challenges in Uzbekistan's agricultural machinery provision. More than half of the machinery in operation had exceeded its service life, and the country required at least 100,000–200,000 additional units of equipment to carry out seasonal agricultural work fully and on time. Machinery shortages not only delayed agro-technical operations but also reinforced dependency on manual labor, particularly in cotton harvesting—an urgent issue the government sought to address.

In response, the state introduced policies aimed at stimulating domestic production of modern agricultural machinery as well as facilitating its import. These measures included tax incentives, simplified procedures, and permission—starting from 2019—to import used tractors, which helped rapidly replenish the machinery fleet. Major collaborative projects with leading foreign manufacturers were also launched—for example, a USD 300 million agreement with John Deere in 2020 for machinery supplies. Additionally, initiatives to develop a sustainable mechanization strategy were promoted in cooperation with international organizations such as the FAO.

From 2019–2020 onward, the concept of digital transformation in Uzbekistan's agriculture became increasingly prominent. To enhance efficiency, the government set ambitious targets for water-saving irrigation technologies and precision farming. Large subsidy programs and state initiatives were launched to scale up drip irrigation, sprinkler systems, and laser land leveling.

The Ministry of Agriculture and related agencies also began implementing pilot projects involving unmanned aerial vehicles (UAVs) and satellite-based monitoring for crop and water management. Notably, after regulatory restrictions on drone use were eased in 2022, the adoption of these technologies accelerated. By 2024, new regulations made GPS tracking devices mandatory on tractors and other agricultural machinery, integrating digital monitoring and management into everyday farming operations.

Against this backdrop, the present study conducts a comprehensive analysis of Uzbekistan's technical and technological capacity in agriculture during 2018–2024. It documents changes in the quantity and quality of agricultural machinery, evaluates mechanization levels and existing gaps, and examines the progress made toward adopting advanced technologies. The analysis draws upon national statistical data and official policy documents, situating the results within the broader government strategy for agricultural modernization.

The findings highlight substantial achievements in mechanizing agriculture and introducing digital technologies, while also revealing persistent challenges. These include significant wear and aging of machinery fleets, insufficient mechanization in certain subsectors, and ongoing issues related to efficient resource use. Such insights provide important practical implications for shaping future policy and investment decisions in Uzbekistan's agricultural sector.

Methodology

This study employs a descriptive–analytical approach and relies on secondary data derived from official national sources and sectoral reports published between 2018 and 2024. Data on Uzbekistan's agricultural machinery fleet—including the number of tractors, grain combines, cotton harvesters, and other agricultural equipment—were obtained from reports issued by the State Committee on Statistics, the Ministry of Agriculture, and its subordinate

agencies. Baseline indicators for 2018 are based on assessments conducted by Uzagrotechsanoatholding regarding machinery provision, which were compared with mechanization reviews prepared with FAO support as well as contemporary sources published in 2024. Mid-period indicators were compared with official statistics and agricultural news releases to identify overall trends.

To evaluate mechanization levels, indicators provided by the Ministry of Agriculture and FAO experts were used, particularly data showing the percentage of agricultural operations mechanized across different crop sectors. These figures (for 2018 and 2023) were taken directly from official statements and were not recalculated; instead, they were interpreted contextually and incorporated into qualitative analysis.

Information on the technical condition of machinery—its level of depreciation, age, and functional obsolescence—as well as data regarding machinery shortages were drawn from governmental conceptual documents and related official reports. For instance, the 2020–2024 "Concept for the Development of Agricultural Machinery" and accompanying informational materials outline the share of machinery exceeding its service life and the number of additional units required during peak agricultural seasons. These indicators were systematized to describe the situation in 2018 and highlight planned improvements through 2024.

Assessment of digital agriculture technologies focused on the adoption of water-saving irrigation systems, the use of drones, GPS technologies, and other digital tools. Data were compiled from strategic documents and conference materials issued by the Ministry of Water Resources and the Ministry of Agriculture, which regularly report the area covered by drip and sprinkler irrigation from 2017 to 2024. Policy documents—such as the 2020 Presidential Decree aimed at accelerating water-saving technologies—provided planned targets, while 2024 official reports offered actual implementation results. Information on drones and GPS technologies was largely based on regulatory changes (e.g., the authorization of agricultural drone use from 2022) and implementation mandates (e.g., compulsory GPS installation on tractors by 2025). Due to limited statistical data on drone usage, qualitative assessment was emphasized.

All data were triangulated by cross-validating information across multiple sources wherever possible. To provide clearer visualization, the findings were presented in tables and graphs: graphs illustrated trends in machinery numbers, mechanization levels, and the expansion of water-saving irrigation technologies; tables summarized key comparative indicators for 2018 and 2024. All cited information follows APA referencing style, and the full list of references is provided in the "References" section.

This study does not include new surveys or field research; rather, it is entirely based on the analysis of existing statistical data and official documents. Such an approach is appropriate for examining the dynamic changes in Uzbekistan's agricultural sector during 2018–2024, relying on the reliability of national statistics and policy documents.

Results and Discussion

Expansion of the Machinery Fleet and Mechanization Trends

By 2024, Uzbekistan's agricultural machinery fleet had expanded significantly across key categories compared to 2018. This growth reflects the government's systematic modernization policies and targeted investments aimed at renewing and enlarging the machinery stock. Table

1 summarizes the changes in the number of tractors, grain harvesters, and cotton-picking machines recorded between 2018 and 2024.

The number of tractors nearly tripled over the 2018–2024 period: while approximately 57.8 thousand tractors were in use in 2018, the figure approached 150 thousand by 2024. It should be noted that the 2018 estimate may not fully capture smallholder-level machinery, whereas the 2024 figure includes both newly imported and domestically assembled units.

A stable upward trend is also observed in grain harvesters. Their number increased from 3,608 units in 2018 to 6,149 units in 2024, driven by growing national grain production and the need to accelerate harvesting operations.

The most rapid growth occurred in cotton-harvesting machinery. Only 1,224 cotton pickers were available in 2018, whereas by 2024 their number exceeded 3,000 units. This sharp expansion reflects the state's comprehensive efforts to reduce dependence on manual labor in cotton picking. Subsidy programs, incentive mechanisms, and partnerships with major machinery suppliers played a decisive role in accelerating this process.

Machinery Category	2018 (units)	2024 (units)
Tractors	57,822	≈150,000
Grain harvesters	3,608	6,149
Cotton-picking machines	1,224	>3,000 (estimated)

Mechanization growth has been directly linked to the expansion of Uzbekistan's agricultural machinery fleet. According to the FAO-supported 2024 assessment, the overall mechanization rate — meaning the share of agricultural operations performed using machinery — increased from approximately 67% in 2018 to 81% in 2023. This indicates that, within five years, a significantly larger proportion of land preparation, planting, and harvesting tasks shifted from manual labor to mechanized methods.

Growth patterns vary considerably across crop sectors. Mechanization in cotton and grain production reached around 90% by 2023, reflecting a substantial rise compared to 2018. In contrast, the vegetable sector remains only about 50% mechanized, as many horticultural activities — such as seedling planting and manual harvesting — still rely heavily on labor-intensive practices. This demonstrates that horticulture remains one of the areas most in need of technological advancement.

Overall, the data show that mechanization has not progressed uniformly across all agricultural subsectors. Large-scale field crops, particularly cotton and grain, have achieved near-full mechanization in major operations such as plowing, sowing, and harvesting, although some manual processes in cotton remain. Meanwhile, other crop categories, especially fruits and vegetables, continue to lag behind significantly in mechanization levels.

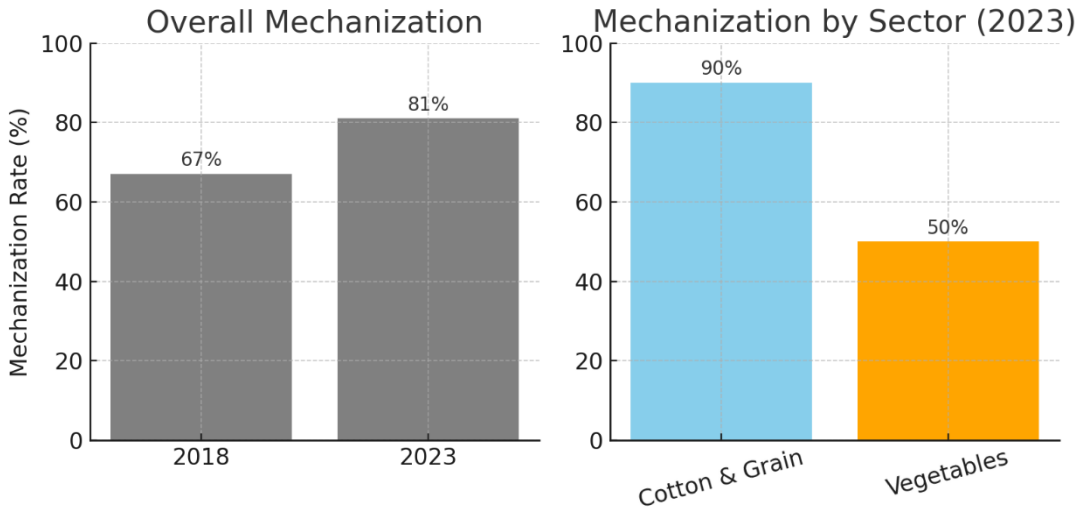

Figure 1. Mechanization Levels in Uzbekistan's Agriculture.

(Left) In 2018, the overall mechanization rate in Uzbekistan's agriculture was estimated at around 67%, while by 2023 it had increased to 81%. (Right) In 2023, sector-specific mechanization rates showed a strong imbalance: cotton and grain production reached nearly 90% mechanization, whereas vegetable farming remained at only 50%. These disparities indicate that large-scale field crops benefit more from available machinery, while labor-intensive or small-plot crops continue to face significant mechanization gaps.

The data confirm generally positive trends: farmers are better equipped with machinery than before, resulting in growing automation of agricultural operations. For instance, over the past five years, farms' technical provision increased from roughly two-thirds (≈67%) to more than four-fifths (≈80%).

However, these figures do not fully capture the reality on the ground. Experts emphasize that a large share of existing machinery is still outdated and prone to frequent breakdowns, which means that—despite numerical growth—the effective mechanization level may be lower in practice. The quality and reliability of equipment are just as important as quantity, a point discussed in the next subsection.

Additionally, uneven mechanization rates across subsectors suggest that government programs have primarily targeted strategic crops—cotton (due to its sensitivity to labor issues) and grain (critical for food security). While this prioritization is understandable under limited resources, future progress will require greater attention to mechanizing horticulture and vegetable production.

Finally, despite recent improvements, Uzbekistan continues to face seasonal machinery shortages. During peak periods such as sowing and harvesting, even with new machinery additions, it remains difficult to service all farms on time. In 2018, the seasonal deficit was estimated at 100,000–200,000 units. Although imports and new equipment have partially closed this gap, farmers in some regions still report waiting lines or reliance on expensive rental services.

This highlights the need to further accelerate machinery production and procurement—especially as cultivated areas expand, horticulture grows, and new crop types emerge, generating additional mechanization demands.

Condition of Agricultural Machinery: Wear, Age, and Domestic Production Capacity

At the start of the modernization process, the age and deterioration of Uzbekistan's agricultural machinery represented one of the sector's most pressing challenges.

For many years, insufficient investment in the machinery fleet meant that a large share of tractors, combines, and other agricultural machines were being operated well beyond their recommended service life. According to an official nationwide inventory conducted in November 2018, out of 176,957 units of agricultural machinery in the country, 109,157 had been in use for more than ten years — a threshold widely regarded as "beyond service life." In percentage terms, this meant that approximately 60–62% of the entire machinery fleet was technically and morally obsolete and required full replacement or major overhaul.

These figures clearly illustrate how difficult the situation was in 2018. The high proportion of outdated machines resulted in:

- frequent mechanical breakdowns,
- increased downtime,
- significantly higher fuel consumption, and
- reduced overall productivity.

Many farmers still relied on tractors and combines manufactured in the 1980s and 1990s, which operate more slowly, consume more fuel, and require more maintenance than modern machinery.

The shortage of functioning equipment, combined with widespread aging of machinery, prevented timely completion of critical agricultural operations such as planting and harvesting. This led to negative impacts on yields. Government officials identified the lack of machinery as a key factor contributing to major "bottlenecks" during peak agricultural seasons in 2018.

The shortage of machinery was felt particularly acutely in cotton harvesting. Even by 2020, more than 80% of cotton nationwide was still harvested manually, due to the limited availability of reliable cotton-picking machines (although some pilot regions achieved higher levels of mechanization).

Digital Transformation: Water-Saving Irrigation, Drones, and GPS Technologies

Alongside the expansion of the agricultural machinery fleet, Uzbekistan achieved substantial progress in the adoption of digital and precision farming technologies between 2018 and 2024. One of the most important areas of advancement has been the rapid development of water-saving irrigation systems, which is especially critical given the country's arid climate.

The government actively promoted modern water-efficient technologies such as drip irrigation, sprinkler irrigation, and other advanced methods. This direction is particularly significant because agriculture accounts for approximately 90% of total national water consumption in Uzbekistan. Beginning from a very low baseline in 2017, the area covered by water-saving technologies expanded at an exponential rate from 2018 to 2024.

Today, these technologies not only contribute to substantial water conservation, but also help to increase crop yields, preserve soil fertility, and reduce labor requirements across agricultural operations.

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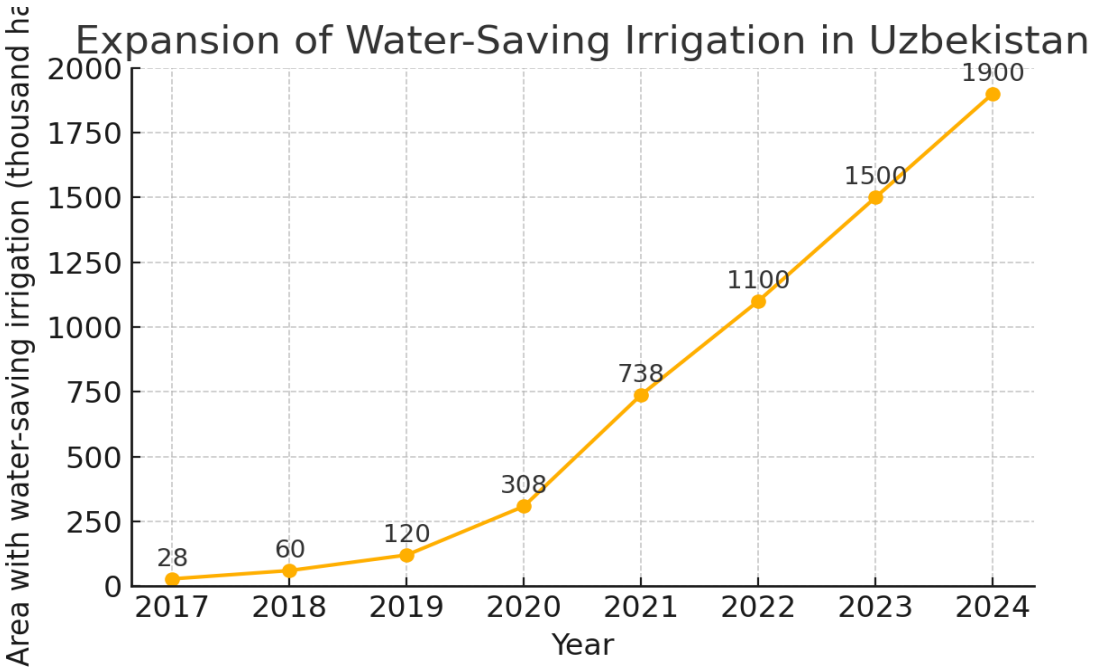

Figure 2. Expansion of Water-Saving Irrigation in Uzbekistan (2017–2024)

The area equipped with water-saving irrigation technologies (such as drip irrigation, sprinkler systems, and other efficient methods) expanded dramatically—from only 28 thousand hectares in 2017 to 1.9 million hectares by 2024. Growth accelerated especially after 2019, driven by government subsidies and mandatory implementation policies; for example, in 2021 alone an additional 430 thousand hectares were brought under these technologies. These figures represent one of the fastest adoptions of drip and sprinkler irrigation systems in the region, demonstrating Uzbekistan's strong commitment to efficient water use and the rapid development of digital and precision agriculture. Data points for 2018–2023 in the graph are interpolated based on official plans and progressively released statistical updates.

Conclusion

Overall, between 2018 and 2024, Uzbekistan's agriculture sector underwent substantial technical and technological transformation driven by state-led modernization initiatives. During this period, the country's agricultural machinery fleet expanded significantly: the number of tractors, grain harvesters, and especially cotton-picking machines increased sharply, enabling better coverage of farmers' operational needs.

Mechanization levels also improved considerably. By 2024, many routine field operations in cotton and grain farming had become mechanized, reducing the heavy reliance on manual labor that once characterized Uzbekistan's agricultural system. However, the analysis also shows that a large share of machinery remains outdated, which continues to limit productivity. Recognizing this challenge, the government introduced a range of measures—including incentives for domestic machinery production, easier import procedures for modern equipment, and subsidies for machinery purchases. These efforts have helped reduce the proportion of obsolete equipment and narrow the machinery deficit, although seasonal shortages have not yet been fully resolved.

Parallel to strengthening its mechanical capacity, Uzbekistan made rapid progress in adopting digital agriculture and precision farming technologies during 2018–2024. The expansion of drip and sprinkler irrigation to nearly two million hectares demonstrates

significant advances in water-use efficiency and reflects the country's transition toward a more climate-resilient agricultural system.

By 2024, Uzbekistan's agricultural sector had become far more technologically enabled compared to 2018. The dynamic analysis shows not only an increase in the quantity of machinery but also qualitative improvements aimed at efficiency, sustainability, and precision. The rapid expansion of water-saving irrigation technologies highlights the effectiveness of government policy in the agricultural domain.

Although the adoption of GPS systems, drones, and other digital tools is still in its early stages, it shows a clear strategic orientation toward modern agricultural practices. Nonetheless, an important challenge for Uzbekistan is ensuring that small-scale farmers are not left behind in this digital transformation. Otherwise, a technological divide may emerge between large, well-capitalized clusters and individual farms.

Technological capacity-building is inherently a long-term process that requires continuous investment not only in equipment but also in human capital. The findings of this study underscore the importance of a consistent and well-coordinated approach to establishing a modern, efficient agricultural system in Uzbekistan.

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