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Inventory and Registry Development of Ornamental Tree Saplings in Urban Areas to Assess their Survival Rate

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Abstract: Although the inventory and registry development of ornamental tree saplings planted in urban areas is one of the most pressing issues today, to date, no scientific or regulatory-legal documents have been developed in Uzbekistan to define the procedures for inventorying saplings planted across various ecosystems of the country. Recognizing this gap, we have developed a procedure for conducting an inventory of ornamental tree saplings and establishing their registry. In this procedure, data on ornamental trees and shrubs are compiled in tabular form, and their enumeration is carried out using a method not previously applied in practice. Specifically, a counting technique that is not commonly used in the field of dendrology has been implemented for sapling inventory. Currently, this enumeration method is not utilized in standard practice. This article defines and proposes a procedure for the inventory and registry of ornamental tree saplings that aligns with contemporary needs and practical requirements.

Keywords: Inventory, trees, canopy, registering, forests, Uzbekistan

Introduction

The continuous growth of the world's population, alongside the rapid development of industry and increasing demand for various needs, is unfortunately leading many ecosystems toward serious risk [1, 2]. Environmental problems resulting from both natural and technogenic factors have transcended local and regional levels, contributing not only to national but also global ecological crises. These include land degradation, the depletion of drinking water resources, the destruction of the ozone layer, a decline in plant and animal species diversity, the reduction of natural landscapes and ecosystems, illegal logging, and global climate change. In some cases, such issues are causing irreversible damage to nature and society [3, 4].

Forests and green spaces play a vital role in ensuring the stability of ecosystems [5]. The decline of trees and vegetation cover is contributing to the emergence of various natural disasters [6]. Today, the accelerated development of industry and manufacturing, coupled with the sharp increase in construction activities, has led to a rise in cases of illegal tree cutting and destruction of vegetation resources. Such actions may pose dangerous environmental consequences for the future of humanity [7, 8].

The reduction of trees and forests accelerates desertification of the environment. The growing number of industrial enterprises, factories, and transport vehicles is polluting the air, water, and soil, contributing further to climate change and global warming [9-11].

Recognizing the importance of tree resources in addressing these environmental problems and maintaining the life of biocenoses, since 2021, under the leadership of President Shavkat Mirziyoyev, Uzbekistan has initiated a large-scale campaign to expand green areas, promote greening efforts, and ensure the effective planting and maintenance of trees and shrubs. As part of this initiative, it was proposed to plant 200 million ornamental and fruit tree saplings and shrubs annually, including 125 million in the spring and 75 million in the autumn across all regions and sectors.

As a result of the efforts carried out under the national "Yashil Makon" (Green Space) project, a total of 736 million tree and shrub saplings have been planted to date. Specifically, during the spring 2024 planting season, 138.1 million saplings were planted across the republic—exceeding the planned 125 million (110.5%). During the autumn 2024 season, 88.8 million saplings were planted—also surpassing the planned 80 million (111%).

All planted ornamental, fruit tree, and shrub saplings and cuttings have been registered in the "Yashil Makon" electronic platform.

Materials and methods

Despite the ongoing efforts in this field, several critical gaps and challenges persist, which hinder the effective assessment of current activities and the strategic planning of future actions [12, 13].

Firstly, there is currently no scientifically grounded methodology for conducting an inventory of ornamental tree saplings planted in urban areas with the aim of determining their survival rates.

Secondly, no unified scientific or methodological framework, nor any regulatory-legal document, exists to standardize the inventory process of ornamental tree saplings.

Thirdly, modern methodologies for developing a comprehensive registry based on the inventory results of planted ornamental trees are lacking.

Fourthly, the inventory and registration of saplings in urban areas are not approached through

scientifically based practical analyses aimed at evaluating their survival performance.

It is well recognized that the systematic inventory and registry development of ornamental tree saplings planted in urban areas serve as the foundation for assessing their survival rate, an essential component of urban ecological management and planning. This process holds significant scientific value [14].

In light of the above considerations [15], and in response to contemporary demands, there is an increasing need to establish a scientifically sound and modern system for conducting inventories and forming registries of planted tree saplings throughout the Republic. This system must be based on robust methodological approaches to ensure accuracy, transparency, and long-term environmental sustainability.

Results and discussion

A comprehensive study was conducted to analyze the current state of inventory practices and registry development for tree saplings planted across the territory of Uzbekistan using modern scientific approaches. The results revealed several critical institutional and methodological gaps.

To date, the only available document regulating survival rate assessments is the “Protocol for Evaluating the Success of Non-Contiguous Forest Plantations Based on Sapling Retention Percentage,” developed by the former Main Forestry Directorate under the Ministry of Agriculture and Water Resources and the "Urmonloyiha" Design Institute, and approved on May 17, 2000. However, this guideline applies solely to state forest fund lands and evaluates survival rates only for 48 species of fruit and ornamental saplings.

In February 2023, the Research Institute of Forestry under the Ministry of Ecology, Environmental Protection and Climate Change, in collaboration with the “Urmonloyiha” Design Institute, approved a temporary methodological guideline for the scientific evaluation of sapling survival in various regions. Despite this advancement, both the earlier protocol and the temporary guideline lack modern, scientifically grounded procedures for:

- systematic inventory of ornamental tree saplings planted in urban and non-forest areas;
- development and maintenance of standardized registries;
- Data recording and monitoring frameworks applicable across diverse ecological zones of the Republic.

Moreover, these guidelines have limited application and are still only used by select forestry enterprises operating on forest fund lands. No methodological or legal documents currently exist to guide sapling inventory processes in urban or other non-forest territories. Consequently, cities like Tashkent lack formal systems for maintaining sapling registries, making it difficult to assess green space per capita or monitor urban greening dynamics with precision.

The lack of comparative studies on the adaptability and survival of imported versus locally cultivated saplings under varying soil and climatic conditions also hinders effective forecasting and cost-efficient greening strategies.

Taking these factors into account, a scientifically driven field methodology for the inventory and registry of ornamental tree saplings in cities was developed. This methodology is based on practical analysis and includes the following key procedures:

1. **Formation of local inventory working groups.** Separate working groups are formed for forest fund and non-forest territories. Their composition includes representatives from the Forestry Agency, Ministry of Ecology, local administrations, municipal landscaping departments, and relevant sectoral bodies (agriculture, water, land cadaster).
2. **Selection of representative sampling plots.** Inventory plots are selected in typical areas that reflect the general condition of planted saplings. Survival is assessed on-site through direct

counts. Soil and climate conditions, species type, and agro-technical maintenance practices are considered in site selection and evaluation.

3. **Inventory of seed-propagated saplings in aerially sown areas.** For areas where tree and shrub seeds were sown using aircraft, inventory is conducted on 0.3%–1% of the total sown area by selecting representative plots along the sowing trajectory.
4. **Integration with the "Yashil Makon" digital platform.** All inventory and registry data are integrated into the "Yashil Makon" electronic platform. The system allows for digital input of coordinates, species, status, and photographic evidence using tablets or Android-based applications.
5. **Seasonal timing and objectives of inventory.** Inventory is conducted in late September to mid-October (depending on weather) before the end of the vegetation season. Two types of inventories are recognized:

- **Primary inventory**: conducted during the same planting season to collect information for digital input and monitoring (performed by district inspectors);
- **Survival assessment**: conducted in the year following planting to determine the percentage of surviving saplings and finalize the registry.

6. **Survival rate evaluation and registry compilation.** A standardized table (Table 1) is used to document field data, including area location, planting scheme, sapling numbers, type (fruit or ornamental), irrigation systems, responsible personnel, and number of surviving saplings. The survival rate is calculated as a percentage and recorded alongside the official inventory statement number and date.

Table 1. Documentation of the field data, including area location, planting scheme, sapling numbers, and type

Level of maturity of trees	Areas		
	Rainfed		**Irrigated lands**
	Sandy soils	**Foothills**	
Good	above 50%	above 60%	above 80%
Satisfactory	In accordance with the existing norms and standards		
	26%-50%	26%-60%	26%-80%
Unsatisfactory	In accordance with the existing norms and standards		
	26%	26%-30%	26%-35%
Dead	25% and lower		

7. **Application of modern remote sensing technologies.** In addition to manual counts, inventory may be supported by unmanned aerial vehicles (UAVs), drones, delta-planes, or modern scanning equipment, particularly for large or hard-to-reach areas.

This methodology addresses the urgent need for a scientifically justified, standardized, and legally supported inventory and registry system that aligns with Uzbekistan's national greening agenda. It also contributes to improved ecological forecasting, policy planning, and sustainable management of urban green infrastructure.

Table 2 illustrates a standardized format used to conduct field-based inventory of ornamental tree saplings planted in urban settings. The data include species-specific records such as the total number of saplings initially planted, the number that survived after the first vegetative season, and the corresponding survival rate expressed as a percentage. This format enables comparative evaluation across sites and seasons, supports spatial analysis of greening success, and provides a quantitative basis for future planning and resource allocation.

Table 2. Example of sapling inventory and survival assessment data table

Plot ID	Species Name	Area (ha)	Number of Planted Saplings	Number of Survived Saplings	Survival Rate (%)
TSK-001	*Ulmus pumila*	0.50	1,000	865	86.5
TSK-002	*Platanus orientalis*	0.75	1,500	1,305	87.0
TSK-003	*Acer negundo*	0.30	600	498	83.0
TSK-004	*Fraxinus excelsior*	1.20	2,400	2,136	89.0
TSK-005	*Gleditsia triacanthos*	0.45	900	792	88.0

Table 3 presents the structured composition and assigned responsibilities of working groups established to implement the field inventory and registry of ornamental tree and shrub saplings across different territorial jurisdictions of Uzbekistan. Two distinct group types are defined: those operating within state forest fund territories, and those responsible for non-forest or urban zones. Each group is composed of specialists representing key national and local institutions, including the Forestry Agency, the Ministry of Ecology, regional and district-level authorities, cadastre services, water and agriculture departments, and local land users. These working groups are tasked with ensuring accurate sapling enumeration, survival rate assessment, registry compilation, and subsequent data integration into the national "Yashil Makon" electronic platform. The delineation of roles and responsibilities aims to enhance institutional coordination, reduce data fragmentation, and ensure adherence to scientifically sound, legally compliant procedures across both forested and urbanized landscapes.

Table 3. Structure of the inventory working groups in urban and forest fund areas

Territory Type	Role	Institution/Agency	Responsibility	Remarks
Forest Fund Areas	Group Leader	Forestry Agency Regional Unit	Leads inventory in state forest territories	-
	Deputy Group Leader	Ministry of Ecology (district office)	Coordinates ecological data collection	-
	Group Members	Forest engineer, cadastre officer, forest division head, etc.	Conducts field measurement and data entry	-
Urban/Non-Forest Areas	Group Leader	District Deputy Governor (on greening/ecology)	Manages urban inventory operations	-
	Deputy Group Leader	Ministry of Ecology (district office)	Supports registry development	-
	Group Members	Municipal landscaping officer, forestry specialist, cadastre, etc.	Implements field inventory and registration	Involves local land users too

Conclusions

The study has revealed that, despite recent national efforts under the "Yashil Makon" initiative, Uzbekistan still lacks a unified, scientifically grounded, and legally regulated system for conducting inventories and developing registries of ornamental tree saplings planted in urban environments. Field assessments demonstrated that current methodologies are either limited in scope—applying only to forest fund areas—or outdated, failing to meet the operational and

planning demands of modern urban greening programs.

In response to these gaps, a new practical and scientifically informed methodology was developed for the systematic inventory of saplings, incorporating modern tools, institutional coordination mechanisms, and digital data integration. The proposed approach enables the accurate evaluation of sapling survival rates, supports transparent monitoring of planting outcomes, and facilitates the creation of reliable registries at district and national levels. This methodology not only reflects the ecological and climatic diversity of Uzbekistan's urban areas but also lays the foundation for a long-term, data-driven strategy for sustainable urban afforestation.

Furthermore, the establishment of interdisciplinary working groups and the integration of field data into the "Yashil Makon" electronic platform represent significant steps toward institutionalizing sapling management. These efforts will contribute to improved decision-making, optimized allocation of resources, and increased public accountability in greening initiatives. Ultimately, the implementation of this system will enhance the resilience of urban ecosystems, support climate adaptation goals, and strengthen the effectiveness of national policies aimed at environmental sustainability.

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