Enhancing Technologies and Capacity for Mass Production of Quality Planting Materials to Support the National Reforestation Goals in Kazakhstan

BACKGROUND

Kazakhstan is one of the least forested countries in the region, with forests covering only about 5% of its land area, or approximately 13.9 million hectares. Despite this limited coverage, forests are essential for maintaining ecological balance, conserving biodiversity, supporting livelihoods, regulating water systems, and contributing to climate change mitigation through carbon sequestration. However, increasing forest degradation caused by wildfires, droughts, harsh climatic conditions, soil degradation, and limited access to quality planting materials has significantly affected the country's restoration efforts.

To address these challenges, the Government of Kazakhstan has strengthened its commitment to environmental restoration and climate action, including large-scale afforestation targets and the goal of achieving carbon neutrality by 2060. Nevertheless, achieving these ambitions requires modernized reforestation systems, resilient planting materials, and stronger technical and institutional capacities. Traditional dependence on bare-root seedlings has also resulted in low survival rates, especially under extreme environmental conditions.

In response, the AFoCO/044/2024 project entitled "Technology and Capacity Enhancement for Massive Production of Quality Planting Material to Support the National Reforestation Goals in Kazakhstan," was developed as a strategic intervention to support the country's national reforestation agenda. Implemented in the Akmola Region, the project focused on establishing a mechanized forest nursery complex, developing protective forest plantations, and strengthening capacity building, technical training, and knowledge-sharing activities.

The project introduced closed root system (CRS) technologies to improve seedling quality, resilience, and survival rates while enhancing institutional and technical capacities for modern forest restoration practices. By integrating technological innovation, ecosystem restoration, and human resource development, the project provides a scalable and replicable model for climate-resilient reforestation in Kazakhstan. It also contributes to broader global restoration and climate initiatives, including the Bonn Challenge, the Paris Agreement, and sustainable land management efforts.

Key Messages

1. **Modernizing Reforestation through Advanced Nursery Technologies :** The project demonstrates how advanced nursery systems, particularly closed root system technologies, can improve seedling quality, survival rates, and production efficiency. By establishing a mechanized nursery with an annual capacity of approximately 1.5 million seedlings, it addresses the shortage of high-quality planting materials and strengthens Kazakhstan's capacity for large-scale afforestation.
2. **Promoting Ecological Restoration and Climate Resilience :** The establishment of protective forest plantations highlights the multiple environmental benefits of reforestation, including erosion control, wind protection, moisture retention, and ecosystem restoration, contributing to more resilient landscapes under changing climatic conditions.
3. **Building Capacity and Establishing a Scalable Restoration Model:** Through technical training, knowledge exchange, and institutional strengthening, the project enhances the capacity of forestry professionals and stakeholders while providing a practical, technology-driven restoration model that can be replicated and scaled across Kazakhstan and other regions facing similar environmental challenges.

Figure 1. The design for the mechanized nursery complex.
Source: Project Completion Report 2025

IMPACTS

Strengthening Forest Restoration through High-Quality Planting Materials

One of the project's major achievements is the successful establishment of a mechanized forest nursery complex equipped with a greenhouse facility, automated seed sowing line, and seedling hardening infrastructure. The facility enables the controlled production of Scots pine seedlings using closed root system technology, ensuring improved seedling quality and significantly higher survival rates compared to conventional bare-root systems.

With an annual production capacity of approximately 1.5 million seedlings, the nursery complex represents a substantial contribution to Kazakhstan's national reforestation efforts. The project strengthens the country's capacity to produce consistent and high-quality planting materials required for large-scale afforestation and forest landscape restoration.

Enhancing Climate Resilience and Ecosystem Stability

The introduction of closed root system technology improves the resilience of seedlings to drought, temperature extremes, and other harsh climatic conditions commonly experienced in Kazakhstan. Higher survival rates and faster establishment of forest stands contribute to improved ecosystem recovery, increased carbon sequestration, and enhanced climate adaptation.

In addition, the establishment of 25 hectares of protective forest plantations around Shchuchinsk contributes to reducing soil erosion, minimizing wind impacts, stabilizing degraded lands, and improving local microclimatic conditions. These interventions demonstrate the important role of forests as nature-based solutions for climate resilience and environmental protection.

Advancing Technological Innovation and Knowledge Systems

The project contributed to the modernization of Kazakhstan's forestry sector through the introduction of innovative nursery technologies and the development of technical knowledge products. Operational guidelines and practical approaches for nursery management and closed root system applications were developed to support forestry practitioners and institutional learning.

The integration of international expertise, technical cooperation, and research collaboration further strengthened the scientific and technical foundation of reforestation practices in Kazakhstan, promoting evidence-based and adaptive forest management approaches.

Figure 2. The situation of mechanized nursery complex durin.
Source: Project Completion Report 2025

Strengthening Institutional Capacity and Human Resources

Capacity-building activities engaged more than 150 participants, including forestry specialists, local communities, technical staff, and other stakeholders. Training activities covered key areas such as seed collection and handling, nursery management, forest regeneration, plantation establishment, and sustainable forest management practices.

These initiatives improved technical knowledge, encouraged innovation, and strengthened institutional capacity within the forestry sector. The project also promoted inclusive participation by encouraging balanced involvement of both men and women in project activities.

Generating Socio-Economic and Regional Development Benefits

The project contributes to local economic development through the creation of employment opportunities related to nursery operations, plantation establishment, maintenance activities, and forest management.

Improved forest conditions and enhanced green infrastructure also increase opportunities for environmental services, ecotourism, and long-term landscape productivity. These benefits contribute to strengthening local livelihoods, environmental sustainability, and regional resilience.

FUTURE OPPORTUNITIES

Establishing a National Seedling Supply System

Building on the success of the mechanized nursery complex, Kazakhstan has the opportunity to establish an integrated national seedling production and distribution system based on modern closed root technologies. Such a system would ensure a reliable supply of high-quality planting materials suited to diverse ecological conditions across the country.

Diversifying Species and Enhancing Genetic Quality

While Scots pine remains a priority species for reforestation, future initiatives can expand to include a broader range of native and climate-resilient tree species. Strengthening seed certification systems and genetic improvement programs can further enhance adaptability, productivity, and ecosystem resilience.

Promoting Smart Nursery and Digital Forestry Systems

The integration of digital technologies, including automated climate control systems, remote sensing tools, geographic information systems (GIS), and data-driven monitoring platforms, can improve nursery efficiency, plantation monitoring, and decision-making processes.

Developing smart nursery systems would position Kazakhstan as a regional leader in technology-enabled forestry management.

Figure 3. The Project Team during the establishment of protective plantations around the city of Shchuchinsk on an area of 25 hectares.
Source: Project Completion Report 2025.

Scaling Up Landscape-Level Restoration Approaches

There is significant potential to expand from site-specific interventions toward integrated landscape restoration approaches that connect protective plantations, production forests, and natural ecosystems.
Such approaches can generate multiple benefits, including biodiversity conservation, watershed protection, climate resilience, and sustainable socio-economic development.

Positioning Kazakhstan as a Regional Knowledge Hub

Through its experience in modern nursery technologies and climate-resilient afforestation practices, Kazakhstan has the potential to become a regional center of excellence in Central Asia.

The country can facilitate regional cooperation by hosting technical exchanges, study visits, research collaborations, and capacity-building programs focused on sustainable forest restoration and modern nursery management systems. Sharing practical experiences and lessons learned from the project can support neighboring countries facing similar challenges related to forest degradation, climate change, and limited availability of quality planting materials.

Furthermore, strengthening partnerships with international organizations, academic institutions, and regional forestry networks can enhance knowledge generation, innovation, and cross-border collaboration in afforestation and ecosystem restoration initiatives.

Figure 4. The Project Team during the forest pathology examination of the project site.
Source: Project Completion Report 2025.

THE WAY FORWARD

Future efforts should focus on improving production planning, quality assurance systems, resource efficiency, and operational performance within the nursery complex. Continuous monitoring and adaptive management will be essential to ensure sustainable and efficient seedling production aligned with national reforestation demands.

To maximize long-term impact, project innovations and technical approaches should be institutionalized within national forestry policies, operational standards, and implementation frameworks. Formal recognition of closed root system technologies and modern nursery systems can help strengthen Kazakhstan's national afforestation strategy.

Effective reforestation depends not only on seedling production but also on efficient storage, transportation, and distribution systems. Strengthening logistics and supply chain management will help ensure that planting materials reach restoration sites in optimal condition and within appropriate planting periods.

Long-term sustainability of reforestation efforts requires continuous post-planting management, including regular monitoring of survival rates, growth performance, and ecological impacts. Adaptive silvicultural practices and science-based management approaches should be applied to ensure healthy forest establishment and long-term ecosystem stability.

Strong coordination among government agencies, local authorities, research institutions, development partners, and local communities will be critical for scaling project impacts. Collaborative planning, shared accountability, and continuous stakeholder engagement can improve implementation effectiveness and ensure that interventions remain responsive to local needs.

Future interventions should incorporate comprehensive risk management strategies to address climate variability, wildfire risks, operational uncertainties, and market fluctuations. This includes diversifying production inputs, strengthening institutional preparedness, developing contingency plans, and enhancing technical capacity to respond effectively to emerging environmental and economic challenges.

Figure 5. The Project Team during one of the Project's capacity building activities..
Source**:** Project Completion Report 2025

Figure 6. Automated nursery equipment used for large-scale production of containerized forest seedlings
Source: AFoCO

ACKNOWLEDGEMENT

AFoCO sincerely acknowledges the Kazakhstan's national project directors, country project directors, project manager, and key stakeholders for their hard works and contributions in implementing the project. Here we examine the project's impacts on the "Technology and Capacity Enhancement for Massive Production of Quality Planting Material to Support the National Reforestation Goals in Kazakhstan (AFoCO/044/2024).

https://afocosec.org/project/044/

This Project Impact Brief (PIB) is prepared by the Fellowship Officials (Rogelio Caramihan Gibe and Hsu Sandar Aung) serving at the AFoCO Secretariat under the Fellowship Program. Designed as a sustainability-focused brief, it highlights selected projects with strong potential for scale-up, communicates the expected impacts and added value of expansion, and recaps key achievements. It also serves as a platform to encourage engagement and collaboration among relevant experts and partners.