

# Assessing Status and Socio-Economic Impact of Private Forest Nurseries Under Ten Billion Tree Tsunami Programme in Gilgit Baltistan

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## Abstract

*A forest nursery is a managed area designated to produce tree seedlings grown under favourable conditions until they are ready for planting. However, the nursery aims to produce sufficient planting stock to fulfil the needs of seedling users, including government agencies and non-governmental organisations. Forest nurseries play an important role in large-scale afforestation or reforestation projects and local livelihood improvement. This study aims to assess the distribution and socio-economic contributions of private forest nurseries and to identify the major challenges they face in Gilgit Baltistan. A total of 212 nurseries were examined in this study across all 10 districts of Gilgit Baltistan. A structured questionnaire survey was conducted, and 212 nursery owners were interviewed to assess the current status and impact of private forest nurseries. Results showed that most of the nurseries are in District Gilgit, with a dominance of Popular species and reliance on canal-fed irrigation. Most nurseries are economically viable and have played a pivotal role in livelihood improvement, while major challenges include water scarcity, species diversification, and dependence on Government procurement. The study concludes that private forest nurseries play a crucial role in forest landscape restoration and rural livelihoods, but overcoming the challenges is essential to ensure long-term sustainability and climate resilience.*

**Keywords:** Forest Nurseries, Status, Local Community, Socio-economic Benefits, TBTP, Forest Management, Nursery Business, Gilgit Baltistan.

## Introduction

The forest nursery is where seedlings are grown, managed, and cared for. They grow and mature there, growing healthier and more resilient for final planting. A nursery's structure varies depending on its layout and features. Still, the objective remains unchanged: to guarantee that plants grow and mature healthily until they are prepared to be transported to the field (Maximiliano et al., 2025). Furthermore, forest nurseries play a pivotal role in providing planting stock for ongoing afforestation or reforestation projects (Perry et al., 2025).

Forests are becoming increasingly important in the battle against global warming. In addition to preserving biodiversity, forests provide essential ecological services to civilisation. However, several recent studies have shown that restrictions on the use of natural resources lead to

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unfavourable behaviour among rural communities that depend on forests for their livelihoods, posing several challenges for forest management (Ullah et al., 2021). Pakistan is a forest-poor state with just 4.478 million hectares (5.1%) of its land covered by forests. In contrast to the global average of 1 ha per person, this equals 0.021 ha per person. According to official calculations, the forestry sector's contribution to GDP and GNP appears relatively small. This is mainly because many non-timber forest products (NTFPs) and the forests' intangible ecological and environmental benefits are not taken into account (Rahman & Nasir, 2022). Despite being a low forest country, deforestation remains a serious ecological issue in most developing nations; Pakistan has a particularly high deforestation rate (Ullah et al., 2022).

Gilgit-Baltistan is endowed with abundant natural resources, including fresh water, glaciers, wildlife, arable soil, and natural forests (Ishaq et al., 2016). In addition to supplying many of the world's poorest people with food, medicine, and money, forest ecosystems also play a significant role in protecting water resources, generating economic goods, preserving biodiversity, and reducing climate change (Ismail et al., 2018). Gilgit Baltistan's total forest area is 337,491 hectares. *Cedrus deodara* (Deodar), *Pinus wallichiana* (Kail), *Abies pindrow* (Fir), *Picea smithiana* (Spruce), *Pinus gerardiana* (Chilghoza), and *Quercus ilex* (Oak) are some of GB's principal forest tree species (Ali, 2015).

Gilgit-Baltistan's forests have one of the highest deforestation rates in the world; thus, conservation and preservation are desperately needed. Unsustainable management and unregulated cutting for livelihood and wood products are the main threats to these forests (Hussain et al., 2022). In response to these challenges, Pakistan's government launched the Ten Billion Tree Tsunami Project to replenish the nation's depleted forests. Its main goal was to combat climate change through afforestation, and among its ancillary objectives was enhancing the economic circumstances of local communities (Haris, 2023). These plantation initiatives are becoming increasingly important in international politics and policy, and they are gaining traction worldwide (Ullah et al., 2024).

Government agencies, individuals and groups, projects, and non-governmental organisations (NGOs) can set up and run tree nurseries to supply seedlings for reforestation and community tree-planting initiatives, as well as to encourage the planting of trees in target communities (Dedefo et al., 2017). Since seedlings form the basis of many terrestrial ecosystems, they are an essential investment and factor to consider when implementing global forest and landscape restoration initiatives (Haase & Davis, 2017). The program's reliance on private forest nurseries as the primary method for producing seedlings suited to high-altitude ecological conditions is one of its distinctive features in Gilgit-Baltistan (*Report-File-10BillionTree-1652248180.Pdf*, 2021). The forest nursery is in a critical position because ongoing afforestation operations increase the demand for planting stock, which is typically provided as nursery-grown saplings (Perry et al., 2025). In addition to improving a community's social capital, technical capabilities, and leadership abilities, nurseries often allow their owners to earn money. For many smallholder farmers, smallholder tree nurseries are crucial training and research facilities (Roshetko et al., 2010).

Even though private forest nurseries play a pivotal role in implementing the TBTP initiative in Gilgit Baltistan, data on their overall status and socioeconomic impact are not well documented. This knowledge gap limits effective restoration planning and policy decisions.

### Significance of the Research

This research provides a comprehensive assessment of the status and socioeconomic impact of private forest nurseries under TBTP in Gilgit Baltistan. By examining spatial distribution, species

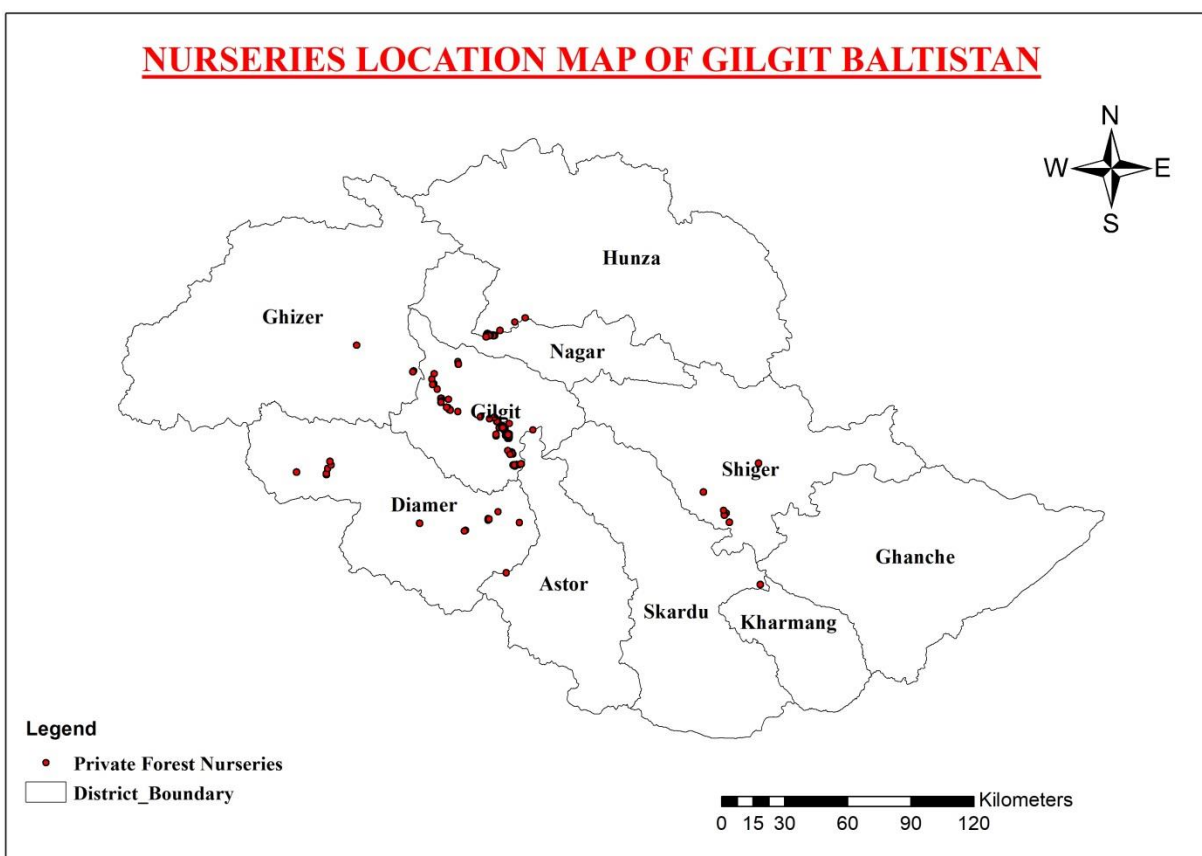
composition, socioeconomic contributions and operational challenges, the study fills a knowledge gap needed for informed policy and program improvement.

## Material and Methods

### Study Area

The study has been conducted in Gilgit Baltistan, also known as the Northern Areas, a strategically important region of Pakistan that borders China to the northeast, Afghanistan to the northwest, and Indian- and Pakistani-administered Kashmir to the southeast. GB is located in the Hindu Kush-Himalayan (HKH) area at 72°–76°E and 34°–37°N (Satti et al., 2024). With more than 700 peaks over 6000 meters and 5 exceeding 8000 meters, including K2 (8611 meters), the Karakorum, Hindu Kush, and Himalaya Mountain ranges dominate the area. The majority of the region's surface lies at elevations above 1500 meters above sea level (asl), with over half at elevations above 4500 meters (Hameed et al., 2022). The western Himalayas have a wet temperate climate influenced by the monsoon, whereas the northern Karakoram and Hindu Kush have dry, semi-arid cold deserts. There is significant variation with elevation, and above 6,000 masl, the equivalent of 2,000 mm of precipitation falls as snow each year. Below 3,000 masl, precipitation is minimal, seldom surpassing 200 mm. The valley bottoms can experience extreme temperatures, ranging from -10°C in winter to 40°C in summer (Ismail et al., 2018).

**Figure 1: Private Forest Nurseries Location Map of Gilgit Baltistan**



### Field Survey

The field survey was carried out from January 2025 to July 2025. In this study, primary data was collected by adopting cross-sectional research approach to assess the challenges and socio-economic impact of private forest nurseries in Gilgit Baltistan.

Out of more than 250 nurseries, data were successfully collected from 212 nursery owners through interviews by using structured Questionnaire. The questionnaire covered aspects including, Distribution, Financial performance, Cooperation and Monitoring by the Forest Department and Challenges faced. It represents almost 99 percent coverage and ensures a highly representative dataset.

### Data Analysis

In this study, quantitative research method was used. Therefore, the collected data was analyzed through percentage. Tabulation method and MS Excel was used as an efficient tool for clean and analysis of collected data.

## Results and Discussion

### Socio-economic impact

Under TBTTP, nurseries generally show positive economic performance with an average income of 412,000 (PKR) annually. Still, profit margins are limited due to higher implementation costs and dependent on seasonal buying trends, which affect income stability. Most of the expenditure with an average of 276,000 (PKR) annually primarily focused on labor, irrigation, and transportation. However, heavy reliance on government purchasing also causes nurseries to face administrative delays, while private sector involvement remains low. It is also in line with the study conducted by (Maximiliano et al., 2025) in Brazil also stated that, In terms of the social and economic effects of forest nurseries, it is important to mention that establishing a forest nursery benefits society by creating jobs and revenue. Given the present rates of forest destruction around the globe, this industry will have a guaranteed market because of the many efforts to restore and rehabilitate degraded regions in order to replenish some of the biodiversity that has been lost.

Boosting private sector demand and strengthening financial management can improve financial resilience. Table 1 offers an important information about nurseries financial performance, and market dependence.

**Table 1: Financial performance, Income, Expenditure, and Market Dependence**

| Indicator                   | Category               | Percentage (%) / Mean (PKR) |
|-----------------------------|------------------------|-----------------------------|
| Profitability               | Profitable             | 88.0                        |
| Profitability               | Loss-Making            | 12.0                        |
| Average Annual Gross Income | Mean                   | 412000                      |
| Average Annual Expenditure  | Mean                   | 276000                      |
| Net Average Profit          | Mean                   | 136000                      |
| Market Dependence           | Government Procurement | 74.2                        |
| Market Dependence           | Private/NGO Buyers     | 18.8                        |
| Market Dependence           | Local Households       | 17.0                        |

### Status of Private Forest Nurseries

In Table 2, the distribution of private forest nurseries shows high concentration in District Gilgit as compared to other Districts, where infrastructure and facilities are already in place. But this uneven spatial pattern affects the availability of planting stock for afforestation or reforestation efforts in other less developed Districts. In contradiction (Asiedu et al., 2012) stated that, although nurseries may be built anywhere, but the greatest locations for them are those that are seeing significant construction. These regions are seeing fast population increase, along with the development of individual homes or real estate. Due mostly to a lack of space, already developed places have less opportunities.

**Table 2: District wise distribution of Private Forest Nurseries**

| District | Percentage (%) | Remarks                |
|----------|----------------|------------------------|
| Gilgit   | 74.6           | Core Nursery Hub       |
| Nagar    | 5.6            | Moderate Participation |
| Diamer   | 5.2            | Expanding Presence     |
| Others   | 14.6           | Scattered Coverage     |

Table 3 shows that, Poplar (*Populus alba*) Specie dominates in nursery production due to its fast growth, financial worth and suitability to local conditions. However, it indicates limited species diversity, which can lead to environmental risks related to monoculture practice. Furthermore, (Kelty, 2006) conducted a research in USA and stated that, In addition to being linked to carbon and other nutrient sequestration goals, high stand-level productivity is undoubtedly a crucial feature for wood output. Combining species with different traits, such as shade tolerance, height growth rate, crown structure (especially leaf area density), foliar phenology (especially deciduous versus evergreen habit), and root depth and phenology, is a fundamental idea for creating highly productive mixed-species stands.

Water source also shown in table 2. Water availability plays a pivotal role in nursery performance, as most nurseries rely on irrigation canal system. But it indicates the limited use of alternative water source. To ensure the long-term sustainability of nurseries performance, it is essential to improve water management through diversified irrigation methods and water saving technologies. Whereas, (Molden et al., 2022) stated that Increased warmth and faster snow and glacier melting are obvious indicators of climate change in the Hindu Kush Himalaya HKH Mountains. For many people in the area, this puts their livelihood security and irrigation water at risk.

**Table 3: Species Composition and Water Source in Private Forest Nurseries**

| Variable     | Category                       | Percentage |
|--------------|--------------------------------|------------|
| Species      | Poplar ( <i>Populus spp.</i> ) | 84.0       |
| Species      | Mixed Species                  | 16.0       |
| Water Source | Canal-Fed                      | 85.4       |
| Water Source | Supplemental                   | 14.6       |

Water shortage becomes the biggest challenge for nurseries affecting more than one-fourth of operations as table 4 makes apparent. Seasonal changes in canal water availability for irrigation limit productivity and reduce plant survival.

Furthermore, low demand is another big challenge for nursery owners, mostly caused by fluctuations in government purchasing periods, which creates uncertainty for small nursery businesses and complicates financial planning. Additionally, extra operational risks include livestock damages, and insect attacks. Poor fencing further increases risk of damage from grazing animals, particularly in rural areas where access to pest management limited. It is also in line with the study conducted by (Heera, 2014) on problem faced by nursery owners in seedling production in Dhaka Bangladesh and also stated that, found barriers to implementing ecologically friendly farming methods. The top six restrictions were as follows, ranked by rank: (i) poor productivity as a result of limited fertilizer application (ii) absence of soil organic matter. (iii) the government's lack of backing for ecologically sustainable farming methods and demands for nursery stock. (iv) Insufficient funding and natural resources for integrated cultivation methods. (v) ignorance of integrated farm management; and (vi) a shortage of pest-resistant crop types.

**Table 4: Risk and Operational Challenges**

| <b>Challenge</b> | <b>Percentage</b> |
|------------------|-------------------|
| Water Scarcity   | 27.7              |
| Low Demand       | 20.7              |
| Pest Attack      | 11.7              |
| Livestock Damage | 8.5               |
| Overstocking     | 4.2               |

According to table 5, the results shows that nursery owners are largely unsatisfied with the support they get from the Forest Department, with almost two-thirds reports poor cooperation. While annual monitoring is common, it does not seem to provide enough practical guidance and technical help. Limited interaction between department staff and nursery owners created distrust and reduced effectiveness, which in turn affects overall nursery performance. In contradiction (Roshetko et al., 2010) stated that, In order to provide seedlings for reforestation and community tree planting programs and to encourage a tree planting culture within target communities, in the context of most developing countries, are typically made up of smallholder farmers—government agencies, individuals and groups, projects, and non-governmental organizations (NGOs) can establish and run tree nurseries by providing enough support and technical guidance. Additionally, farmers can produce tree seedlings for their personal consumption as well as to access markets.

**Table 5: Cooperation and Monitoring by Forest Department**

| <b>Indicator</b> | <b>Category</b>  | <b>Percentage</b> |
|------------------|------------------|-------------------|
| Cooperation      | Satisfactory     | 16.9              |
| Cooperation      | Non-Satisfactory | 66.7              |
| Training         | Received         | 2.3               |
| Monitoring       | Annual           | 78.4              |

## **Discussion**

The results of this study showed that private forest nurseries are unevenly distributed across Gilgit Baltistan, with most nurseries located in District Gilgit. In contradiction, (Clark et al., 2023). stated that the geographical distribution of production will limit Tree-planting initiatives, as species and seed suppliers are likely to be from comparable geographic or bioclimatic zones.

(Mudyiwa et al., 2015.) Conducted research in Zimbabwe and stated that, because there are fewer businesses in high-density areas than in low-density ones, there were fewer nurseries in the higher-density areas. Because they use trees and flowers in their home landscaping, residents of low-density suburbs have greater respect for trees. Additionally, compared to high-density urban areas, they have greater yard area for gardening, trees, and bushes.

The findings highlight the dominance of *Populus spp.* in nursery production due to its rapid growth, economic value, and suitability to local conditions. In contrast, Erskine et al. (2006) stated that numerous studies conducted in experimental temperate grasslands over the past 10 years have found that species diversity or richness increases production.

However, most nurseries rely on irrigation canal water. (McDonald, 1984) stated that avoiding undesired moisture stress in plants is the primary goal of irrigation, which is the artificial delivery of water to plants. Put simply. When the rate of transpiration—the loss of water from plants as vapour—exceeds the rate of absorption, moisture stress results. resulting in partially turgid plant tissues and cells. The degree of this stress might range from a little drop in water potential. observable solely with tools, from temporary midday wilting to desiccation-induced mortality.

Additionally, Singh et al. (2019) conducted extensive research in Bangladesh, India, Nepal, and Pakistan. They stated that an unprecedented population increase has, regrettably, resulted in the overuse of the area's water supplies, driving locals to despair. In the highlands, urban centres rely on rivers and springs (supplied via piped networks). The availability of water from these sources may be affected by climate change, making groundwater sources more crucial for certain cities during certain seasons, as they are supplied by snow and glaciers. Because current water sources are not enough to meet increasing demand, many metropolitan centres in mountainous areas are increasingly supplementing their water supplies by transferring water from distant sources; nevertheless, because mountain ecosystems are inherently delicate.

Private forest nurseries make a significant contribution to farmers' livelihoods, according to socioeconomic results (Tchoundjeu et al., 2010). Also stated that, in West and South Africa, some 200 village nurseries are now operational and have developed into on-farm businesses that produce planting material for both local and commercial markets. People in rural areas have reported improvements in their livelihoods, diet, health, and income production over time. These changes have changed their lives and given them hope for a brighter future.

The study also highlights key challenges faced by nursery owners, including a lack of cooperation from the forest department, limited market access, reliance on government purchasing, and low demand. Furthermore, operational challenges include water scarcity, livestock damage, poor fencing, and pest attack. It is also in line with the study conducted by Rahman et al. (2017), which stated that Sustainable natural resource governance is hampered by disparities and contradictions amongst organisations managing the same resource when such interactions are lacking or when regulations are inadequate (Paieste et al., 2022) also stated that if relentless attempts for efficient governance are made solely externally. The required intellectual, behavioral, and infrastructural settings for collaboration are not supplied, it will be difficult to improve the status of natural ecosystems in the field of natural resource management. as well as, (Gregorio, 2006) stated that, A steady supply of germplasm and a favourable seedling market environment are found to be crucial for maintaining the operation and enhancing the efficacy of smallholder nurseries. Training, which is typically the type of assistance provided by supporting agencies to smallholder nursery groups, may help smallholder nurseries continue operating.

## Conclusion

This study concludes that private forest nurseries play a pivotal role in implementing the Ten Billion Tree Tsunami Programme in Gilgit Baltistan. However, the uneven distribution of nurseries limits access to planting stock in remote valleys. Furthermore, key challenges affecting the sustainability of nurseries include monoculture practices, water scarcity, low demand, reliance on government purchasing, and a lack of institutional support.

## Recommendations

- Promote geographically balanced nursery development in all Districts of Gilgit-Baltistan.
- Increase species diversity by expanding production of native, climate-resilient species.
- Enhance water security through efficient irrigation practices, such as solar-powered pumps, alongside improved canal maintenance.
- Strengthen institutional support by introducing regular training programs and improving extension services across all Districts of Gilgit Baltistan.

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