

Altitudinal variations in floristic composition and stand structure of teak farm forestry plantations in the Eastern Himalayan foothills

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Teak-based farm forestry plantations represent a vital land management practice in the Eastern Himalayan foothills of West Bengal, India, and play a key role in conserving biodiversity and providing ecosystem services. However, despite their importance, the floristic diversity of these land use systems, particularly across different altitudinal gradients, remains inadequately documented. The present study investigates floristic composition, species richness, community structure, and diversity patterns in teak-farm forestry plantations across three altitudinal classes (AC): ACI (low; 0–200 m above sea level), ACII (mid; 200–500 m), and ACIII (high; over 500 m). Phytosociological assessments were conducted using a stratified random nested quadrat approach. A total of 50 species, belonging to 28 families, represented by 2,227 individuals, were recorded, with species richness decreasing progressively from ACI (43 species) to ACIII (34 species). Corresponding decreases were observed in key diversity indices, including Menhinick (2.26), Margalef (7.35), and Shannon–Wiener (3.13); all values were highest in low-altitude plantations. Species evenness remained relatively high across altitude classes (0.79–0.83), indicating balanced species distribution. Sorenson similarity values showed moderate overlap, with the greatest similarity occurring between ACII and ACIII (0.57). Diversity profile (hill number) analyses further confirmed consistently higher diversity in ACI across all q -orders. In addition to teak, several associated species, such as *Bombax ceiba*, *Macaranga pustulata*, and *Swietenia macrophylla*, contributed substantially to the overall stand structure. The study demonstrates that the teak-based farm forestry plantations can support substantial biodiversity, and the findings offer valuable insights for optimising plantation design, integrating biodiversity within production systems, and formulating elevation-specific management strategies that enhance both livelihood benefits and ecological sustainability in the Eastern Himalayan foothills.

Keywords: Altitudinal gradient, community structure, Eastern Himalayas, floristic diversity, species richness, teak-farm forests

TREE-BASED farming systems have emerged as a cornerstone of sustainable agriculture, covering nearly 43% of global agricultural lands and delivering essential environmental services alongside productive benefits¹. These agroforestry landscapes function as significant carbon sinks and enhance soil fertility, water regulation, and biodiversity conservation by providing habitat for diverse plant and animal species^{2,3}. Beyond their ecological roles, such systems strengthen rural livelihoods by diversifying income sources and improving household food security, particularly in tropical and subtropical regions that are facing increasing land pressures and climate vulnerabilities. The multifunctional capacity of agroforestry to simultaneously address production, conservation, and climate mitigation goals positions it as an indispensable strategy for sustainable land management in developing agricultural economies.

Teak (*Tectona grandis* L.) is one of the most economically important timber species integrated into smallholder farming systems across South and Southeast Asia. Well-managed teak plantations can yield up to 15 m³ ha⁻¹ yr⁻¹, nearly three times the productivity of many conventional forestry systems⁴. In the Eastern Himalayan foothills of West Bengal, teak cultivation has transformed underutilised agricultural lands into productive assets, generating ecosystem carbon stocks exceeding 80 Mg ha⁻¹ while supporting smallholder incomes through timber and intercropping opportunities⁵. The sub-humid tropical climate, favourable rainfall regime, and suitable soil conditions of the region provide an ideal environment for teak-based agroforestry development⁶. This convergence of ecological suitability and economic viability has driven widespread adoption of teak-farm forestry among resource-constrained farmers seeking sustainable land-use alternatives.

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