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Native Ornamental Plants in Sustainable Landscape Design: Ecological and Economic Perspectives

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ABSTRACT

Rapid urbanization and climate change are reshaping landscape design, raising the demand for resilient, low-input plantings. Native ornamental plants—species naturally occurring within a region—offer a science-based alternative to exotic ornamentals dominating contemporary gardens. This review synthesizes ecological and economic evidence published up to 2025 on biodiversity support, pollinator attraction, carbon sequestration, water and maintenance savings, soil stabilization, and cultural value of native ornamentals, with a focus on Indian and global case studies. Findings indicate that native-dominated landscapes consistently outperform exotic counterparts in pollinator richness, faunal abundance, and climate resilience while reducing irrigation and management costs. Strategic policy, nursery development, and design integration are recommended to mainstream indigenous flora in sustainable landscapes.

Keywords: *Native plants; sustainable landscaping; biodiversity; pollinator conservation; ecosystem services.*

INTRODUCTION

Landscape design has historically prioritized aesthetic novelty, frequently favouring exotic ornamental species sourced through the global horticultural trade. However, mounting evidence indicates that this preference has produced ecologically impoverished green spaces, accelerated pollinator decline, and increased the resource footprint of urban gardens (Tallamy, 2020; & Tartaglia & Aronson, 2024). Sustainable landscape design seeks to reconcile aesthetic, ecological, and economic objectives by integrating species that are functionally aligned with the regional environment. Native ornamental plants—those that occur naturally within a defined biogeographic region—are now recognized as keystone components of such landscapes (Samsani, 2025).

India possesses approximately 12% of global floral diversity, distributed across four biodiversity hotspots and twenty-two agro-biodiversity zones (ICAR-DFR, 2021).

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Despite this wealth, Indian residential and institutional landscapes remain dominated by exotic species such as Lagerstroemia indica, Ficus benjamina cultivars, and ornamental palms imported from Africa and the Americas (Singh, 2024). The same trend is observed globally: 50–70% of invasive and naturalized plant species have entered new regions through horticulture (Tallamy, 2020). Against this backdrop, native ornamental plants are increasingly examined for their capacity to deliver multiple ecosystem services while restoring the cultural identity of place.

This review consolidates peer-reviewed and institutional literature published up to 2025 to evaluate the ecological and economic perspectives of native ornamentals in sustainable landscape design. The objectives are to (i) define native ornamental plants and outline their categories; (ii) examine ecological benefits including biodiversity, pollination, carbon sequestration, water conservation, and climate resilience; (iii) analyse economic dimensions such as maintenance cost reductions, livelihood opportunities, and the emerging native plant nursery sector; (iv) discuss design integration with particular reference to India; and (v) identify research and policy gaps that constrain wider adoption.

The methodology adopted for this review involved a structured search of peer-reviewed journals, institutional reports from the Indian Council of Agricultural Research (ICAR), botanical society publications, and credible governmental databases for the years 2010 to 2025. Search keywords combined 'native ornamental plants', 'indigenous flora', 'sustainable landscape', 'urban biodiversity', 'pollinator gardening', 'ecosystem services', and 'green infrastructure'. Studies were included if they reported quantitative or qualitative outcomes on ecological function or economic performance attributable to native plant selection. Both temperate and tropical case studies were considered, with deliberate emphasis on Indian conditions to contextualize findings for the South Asian reader.

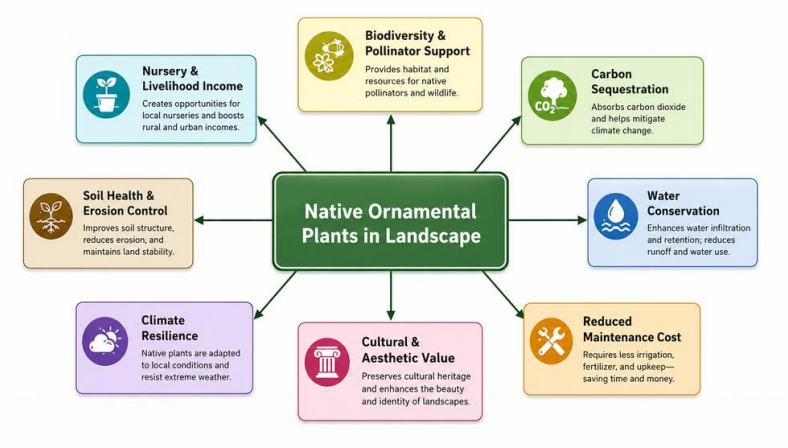

Figure1. Conceptual framework of ecological and economic benefits provided by native ornamental plants in sustainable landscape design

2. Native Ornamental Plants: Concept and Categories

Native ornamental plants are species that have evolved in a particular region over long ecological time, co-developing relationships with resident soil microbes, herbivores, and pollinators (Tallamy, 2020). When such species also possess aesthetic attributes—showy flowering, attractive foliage, structural form, or fragrance—they qualify as native ornamentals. Bansal et al. (2023), surveying the Aravalli ranges of Haryana, documented 88 wild ornamental species across 40 plant families that could be used as garden, potted, avenue, hedge, lawn-cover, and edible-religious ornamentals.

Native ornamentals span every horticultural habit: trees (e.g., Butea monosperma, Cassia fistula, Saraca asoca), shrubs (e.g., Bauhinia acuminata, Calotropis

gigantea, Nyctanthes arbor-tristis), climbers (e.g., Clerodendrum, Passiflora incarnata indigenous variants), herbaceous perennials (e.g., Curcuma, Hedychium), grasses such as Chrysopogon zizanioides, succulents, aquatic taxa, and bulbous plants. ICAR–Directorate of Floricultural Research (ICAR-DFR, 2021) estimates that 38% of trees, 15% of shrubs, 19% of climbers, 18% of palms and cycads, and 38% of aquatic plants in Indian gardens have indigenous representation, though most commercial cultivation continues to favour exotics.

It is important to distinguish native species from naturalized and invasive exotic species. Naturalized species, although introduced, reproduce independently in the new region without necessarily becoming aggressive, whereas invasive species spread rapidly and displace native flora, often through allelopathy or superior competitive traits (Tartaglia & Aronson, 2024). Sustainable landscaping prioritizes indigenous taxa while avoiding invasive ornamentals such as Lantana camara (in regions outside its native range), Prosopis juliflora, and Parthenium hysterophorus, which dominate disturbed Indian landscapes and erode ecosystem function.

Ornamental value in native species derives from multiple traits: showy inflorescences, distinctive leaf morphology, autumn or fresh-flush coloration, bark texture, fragrant blooms, and architectural form. Many indigenous species also carry cultural and spiritual meaning, such as Ficus religiosa (peepal), Aegle marmelos (bael), and Ocimum sanctum (tulsi), which makes their integration into landscape design simultaneously ecological and ethnobotanical.

3. Ecological Perspectives

3.1 Biodiversity and pollinator conservation

The strongest ecological argument for native ornamentals concerns biodiversity. A systematic review of 165 urban-planting studies by Tartaglia and Aronson (2024) concluded that yards, parks, and green roofs dominated by native species supported significantly higher abundance and richness of insects—including bees, butterflies, and beetles—and birds than equivalent exotic-dominated sites. Salisbury et al. (2015), in a long-term garden experiment in the United Kingdom, recorded greater pollinator abundance on native and near-native treatments compared with exotic plots, with short-tongued bumblebees and hoverflies particularly favouring native flora. Comparable results emerged from urban Madrid, where Casanelles-Abella et al. (2023) showed that natives attracted more pollinator individuals and species when flower availability was controlled.

Calotropis gigantea, Lantana camara (where native), and Bauhinia variegata in Indian landscapes support diverse butterfly assemblages and the larvae of Lepidoptera that depend specifically on indigenous host plants (Samsani, 2025). By contrast, exotic ornamentals may create floral resources for generalist pollinators but rarely sustain specialist herbivores; Tourbez et al. (2025) found that exotic invasive plants can functionally disconnect natives from their pollinators, lowering native plant fitness.

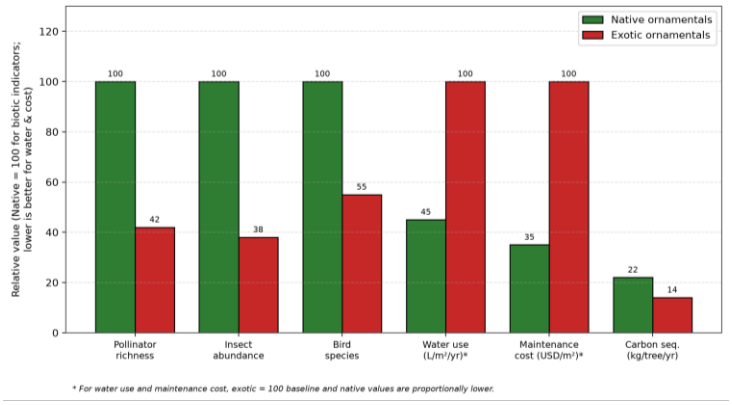

Figure2. Comparative ecological and economic performance of native vs. exotic ornamental plantings, synthesized from multiple studies

3.2 Carbon sequestration and climate regulation

Native ornamentals contribute to climate-change mitigation through carbon sequestration and micro-climate cooling. A multi-city assessment in India reported that native species such as Dalbergia sissoo, Azadirachta indica, and Pongamia pinnata sequester between 1.0 and 3.8 Mg C ha^{-1}, with denser wood and broader canopy structures than many exotic ornamentals (Sharma et al., 2025). Belaire et al. (2022) similarly demonstrated that residential yards with greater tree species richness and a higher percentage of natives stored more carbon than monocultures of imported ornamentals. Evapotranspiration from native canopies further mitigates the urban heat island effect, lowering ambient summer temperatures by 2–4 °C in densely vegetated neighbourhoods (Baxi, 2025).

Long-term monitoring across Indian metropolitan green spaces indicates that mature native trees such as Ficus religiosa, Tamarindus indica, and Mimusops elengi each store between 250 and 480 kg of above-ground carbon over a thirty-year lifespan (Sharma et al., 2025). Bibliometric synthesis by Frontiers in Environmental Science (2023) further suggests that green spaces with higher proportions of native species show 18-25% greater net primary productivity than equivalent exotic-dominated plots, indicating both higher carbon uptake and stronger long-term climate-mitigation potential.

3.3 Water conservation and soil health

Because they evolved under local precipitation regimes, native ornamentals typically require less supplemental irrigation than exotics. The Virginia Department of Conservation and Recreation reports that native plantings can reduce landscape water consumption by 50–70% (Route Fifty, 2023). Deep-rooted natives such as Vetiver (Chrysopogon zizanioides) stabilize soil, filter pollutants, and improve groundwater recharge (Samsani, 2025). Native vegetation also enhances stormwater capture; deeper root architectures improve infiltration, reduce surface runoff, and lower the risk of urban flooding.

Native ground covers also restore soil organic matter through litterfall, root turnover, and association with indigenous mycorrhizal fungi. Studies on Indian institutional campuses show that conversion of conventional turf to native meadow plantings increased topsoil organic carbon by 0.4-0.7% within three years, accompanied by measurable improvements in earthworm density and microbial biomass (Kumar et al., 2025). These below-ground services are often overlooked in landscape valuation but are critical to long-term soil sustainability and nutrient recycling.

3.4 Resistance to pests, diseases, and pollution

Co-evolution with local pests and pathogens equips native ornamentals with broader genetic resistance. Reddy et al. (2024) screened ten native ornamental species at polluted industrial sites in Andhra Pradesh and reported that Cordyline terminalis, Bougainvillea spectabilis, and Tabernaemontana divaricata performed strongly under sulphur dioxide and particulate loads, supporting their use in green-belt development. Such tolerance reduces dependence on synthetic agrochemicals and improves the safety of green spaces for human users.

Air-pollution tolerance index (APTI) studies of Indian native ornamentals reveal that species such as Ficus benghalensis, Polyalthia longifolia, and Mangifera indica register APTI values between 17 and 22, classifying them as tolerant to highly tolerant of vehicular and industrial emissions (Kumar et al., 2025). When incorporated along arterial roads and industrial buffer zones, these species reduce respirable particulate concentrations by an estimated 15-25%, functioning as living air-quality infrastructure.

3.5 Cultural ecosystem services

Beyond regulating and provisioning services, native ornamentals confer cultural ecosystem services that strengthen sense of place and community identity. Sacred groves of the Western Ghats, temple gardens of Tamil Nadu, and the Bishnoi community's reverence for Prosopis cineraria (khejri) illustrate how indigenous flora is embedded in regional heritage. Restoration of such culturally significant native ornamentals in public landscapes fosters inter-generational learning, environmental stewardship, and biocultural diversity (Samsani, 2025).

4. Economic Perspectives

4.1 Maintenance cost reductions

Lower input requirements translate directly into financial savings. Municipal landscape managers in Minnesota reported that converting turf and exotic ornamental beds to native plantings reduced mowing, irrigation, fertilization, and pesticide costs by 30–50% over a five-year horizon (Route Fifty, 2023). For institutional campuses and corporate parks in India, replacing high-water lawns with native ground covers such as Cynodon dactylon, Wedelia chinensis, and Ophiopogon japonicus cultivars has yielded annual savings of ₹40–80 per square metre (Singh, 2024).

Lifecycle analyses demonstrate that native plantings reach financial parity with conventional designs within three to five years and deliver progressively larger savings thereafter. In one comparative analysis of corporate campuses in Bengaluru, total ten-year landscape management expenditure was 38% lower for native-dominant sites than for exotic-ornamental sites of equivalent area, primarily due to reduced irrigation, replanting, and chemical input costs (Singh, 2024).

4.2 Livelihood generation and the nursery sector

The shift toward native plantings creates economic opportunities in nursery management, seed collection, and landscape services. ICAR-DFR (2021) emphasizes the 3-C strategy—Conserve, Cultivate, and Commercialize—to develop specialized indigenous-ornamental nurseries. Pilot studies in Himachal Pradesh and Uttarakhand show that mass propagation of Primula denticulata, Curcuma amada, and Jasminum humile generates employment for rural youth, with returns of ₹2.0–3.5 lakh per acre per year once agronomic protocols are standardized (ICAR-DFR, 2021).

4.3 Tourism, aesthetics, and property value

Landscapes that highlight regionally distinctive flora support eco-tourism and place-based branding. Native-themed gardens in Sikkim, Kerala, and the Western Ghats attract botanical tourists and contribute to the experience economy. Mitchell (2023) observed that properties with biodiverse native landscaping in North American suburbs commanded 5–9% higher resale values than equivalent properties with conventional turf-and-exotic designs, an effect attributed to mature canopy cover and reduced upkeep expectations.

4.4 Avoided costs and ecosystem-service valuation

Economic accounting that incorporates avoided pollination costs, stormwater management savings, and pollution mitigation reveals further hidden value. Native pollinator-friendly plantings adjacent to fruit and vegetable production zones contribute to crop pollination services valued globally at over USD 235 billion annually (Tartaglia & Aronson, 2024). At a city level, native bioswales and rain gardens replace conventional grey infrastructure for stormwater management at 40-60% lower lifecycle costs (Baxi, 2025), providing strong fiscal justification for municipal investment in native landscape design.

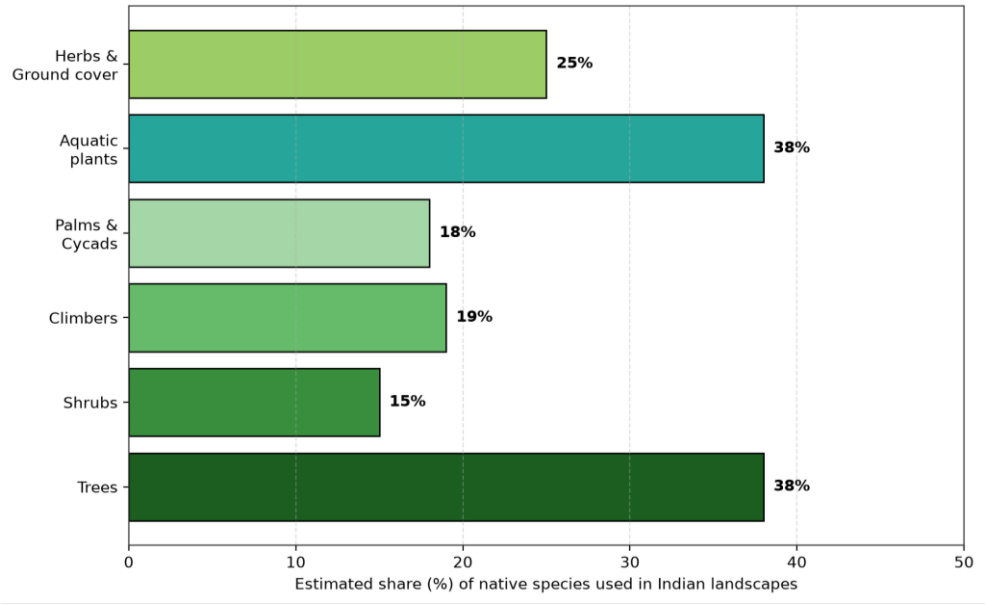

Figure3. Diversity of indigenous ornamental plant groups currently used in Indian landscaping

5. Design Integration: Indian Context

Sustainable landscape design with native ornamentals demands site-specific plant selection. The 'right plant for the right place' principle requires data on habitat, habit, flowering season, pollinator attraction, propagation, and tolerance to drought, flood, and salinity (ICAR-DFR, 2021). For warm-humid tropics, species such as Saraca asoca, Mussaenda frondosa, and Plumeria pudica suit avenue and shaded garden planting. Semi-arid Rajasthan and Haryana favour Tecomella undulata, Capparis decidua, and Salvadora oleoides for low-water design (Bansal et al., 2023). Cold dry temperate zones of the Himalayas support Acer pictum, Pistacia integerrima, and Vitis himalayana, valued for fall colour (ICAR-DFR, 2021).

Design strategies promoted by recent Indian research include: (i) layered planting combining native canopy, mid-storey, and ground cover; (ii) ecological corridors that link isolated green spaces along urban water bodies and roads, e.g., the Kahn River vegetated walkway concept in Indore (Patel & Joshi, 2025); (iii) community gardens centred on native medicinal and pollinator plants; and (iv) incentivized native green roofs and façade greening for high-density cities.

Successful case studies are now emerging from Indian institutions. The Jawaharlal Nehru Tropical Botanical Garden and Research Institute (JNTBGRI) in Thiruvananthapuram maintains living collections of Western Ghats endemics suitable for landscaping, while the ICAR-DFR native ornamental nursery programme in Pune has standardized propagation protocols for over forty indigenous taxa. Educational campuses such as the Indian Institute of Science, Bengaluru, and TERI University, New Delhi, have integrated native palettes into master plans, providing demonstration sites that influence private and municipal landscape practice.

Aesthetic design with native ornamentals benefits from naturalistic styling principles popularized internationally by Piet Oudolf and the New Perennial Movement, adapted for Indian contexts. Massed plantings of Andrographis paniculata, drifts of Bulbine frutescens substitutes such as Asphodelus tenuifolius, and feature specimens of Cochlospermum religiosum deliver year-round visual interest without recourse to imported species.

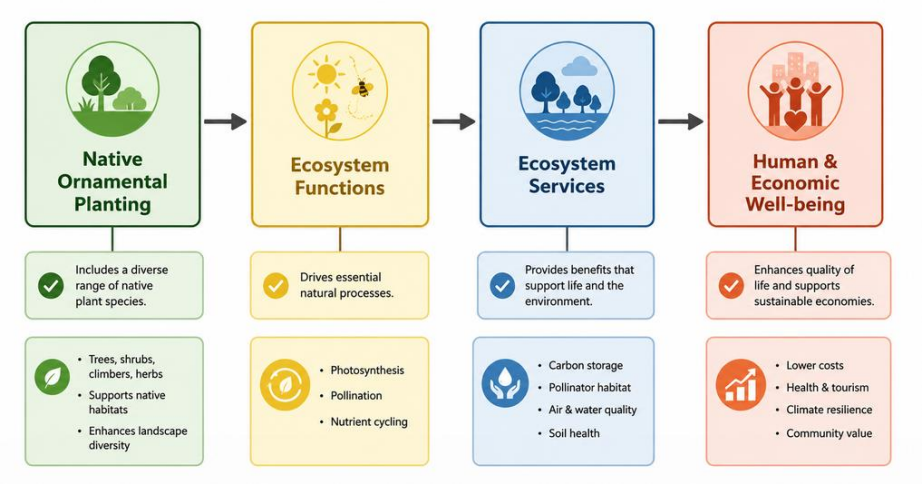

Figure4. Cascade from native ornamental plantings to human well-being via ecosystem functions and services

6. Challenges and Research Gaps

Despite their advantages, native ornamentals remain under-utilized. Key barriers include (i) limited commercial availability and small specialist nurseries; (ii) inadequate agronomic and propagation protocols for high-potential species; (iii) consumer perception that native plants are 'weedy' or unattractive; (iv) lack of cultivars improved for compact growth, prolonged flowering, or novel colours; and (v) policy gaps in municipal landscape specifications, which often default to exotic palettes (ICAR-DFR, 2021; Tartaglia & Aronson, 2024). Standardized carbon-accounting protocols for ornamental landscapes, particularly for below-ground carbon and soil organic carbon, are still emerging (Kumar et al., 2025).

There is also a need to balance the native-versus-exotic debate with nuance. Some studies show that carefully managed exotics can complement native flowering phenology and support generalist pollinators during shoulder seasons (Erickson et al., 2020). Sustainable design should therefore prioritize natives while avoiding rigid exclusion of well-behaved, non-invasive exotics that fill specific functional niches.

Climate change adds an additional layer of complexity. Some indigenous species may struggle under altered temperature and rainfall regimes, while exotic taxa adapted to drier or warmer climates could complement native palettes. A 'climate-resilient native' approach, prioritizing genotypes selected from drought-prone or heat-tolerant populations within a species' native range, offers a pragmatic compromise. Such an approach has been advocated by Mitchell (2023) and Samsani (2025) as the next frontier in sustainable landscape design.

Finally, knowledge dissemination remains uneven. Landscape architects, horticulture professionals, and municipal engineers in many Indian states lack ready access to native plant catalogues with reliable design specifications, propagation guidance, and seasonal performance data. Expanded extension services, illustrated field guides, and digital databases linking species traits to landscape uses are essential to bridge this gap and empower practitioners to specify native ornamentals with confidence.

CONCLUSION

Native ornamental plants emerge as ecologically and economically superior anchors for sustainable landscape design. They deliver demonstrable benefits across biodiversity, pollinator conservation, carbon sequestration, water and soil management, climate resilience, and cultural identity, while reducing maintenance costs and supporting rural livelihoods through nursery and seed-supply value chains. Evidence compiled up to 2025 consistently shows that landscapes with

higher native plant proportions outperform exotic-dominated equivalents on most ecological indicators, even after controlling for floral resource availability. Realizing this potential, particularly in biodiversity-rich countries such as India, requires concerted action: identification and domestication of promising indigenous taxa, expansion of specialized nurseries, integration of native palettes into municipal landscape codes, design education for landscape architects and horticulturists, and public-awareness campaigns that reframe natives as desirable rather than weedy. Coordinated effort across research, policy, industry, and community sectors can transition ornamental horticulture from a contributor to ecological homogenization into a powerful instrument of sustainability, climate adaptation, and human well-being. Future research should prioritize standardized below-ground carbon accounting for ornamental landscapes, cultivar development that retains ecological function while improving consumer appeal, and long-term monitoring of pollinator and avian populations in native versus exotic plantings across India's diverse agro-climatic zones to consolidate the evidence base for policy reform.

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