

Floristic Diversity and Anthropogenic Impact on Coastal Vegetation: A Comparative Study of Purba Medinipur and Balasore Coastal Zones

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Abstract

Coastal ecosystems are critical for biodiversity conservation, shoreline protection, and supporting livelihoods. This study presents a comparative ecological assessment of floristic diversity and anthropogenic impact across ten coastal sites in Purba Medinipur (West Bengal) and Balasore (Odisha). Stratified quadrat sampling and seasonal vegetation surveys were conducted to analyze species composition, abundance, and habitat distribution. A total of 68 plant species belonging to 29 botanical families were recorded, with Fabaceae emerging as the most dominant family. Mangrove-associated halophytes such as *Rhizophora mucronata* and *Avicennia marina* were prevalent in Balasore, while *Casuarina equisetifolia* dominated plantation zones in Purba Medinipur. Seasonal analysis showed post-monsoon peaks in herbaceous species like *Ipomoea biloba*, whereas perennial species like *Casuarina* remained stable. GIS-based land-use analysis (2017–2024) revealed a nearly 50% reduction in vegetative cover in Purba Medinipur due to tourism and urban expansion, in contrast to Balasore’s relatively lower disturbance. The study highlights the ecological value of native flora and the risks posed by monoculture plantations. It emphasizes the need for habitat-sensitive land-use planning, restoration using resilient native species, and conservation policies to safeguard the biodiversity and ecological integrity of India’s vulnerable eastern coastline.

Key Words: Floristic Diversity, Coastal Vegetation, Anthropogenic Impact, Land- Use Change and Purba Medinipur and Balasore.

Introduction

Coastal ecosystems are globally recognized as biodiversity hotspots and ecological buffers, playing a vital role in shoreline protection, carbon sequestration, and supporting livelihoods through fisheries, agriculture, and tourism (Alongi, 2002). India's eastern coastline along the Bay of Bengal is particularly rich in coastal biodiversity but faces escalating threats from both natural and anthropogenic disturbances. Among these, the coastal districts of Purba Medinipur in West Bengal and Balasore in Odisha are ecologically sensitive yet socio-economically significant regions, known for their estuarine landscapes, mangroves, sand dunes, and agricultural belts (Ghosh et al., 2015; Chakraborty & Mukhopadhyay, 2019).

Over the past few decades, rapid urbanization, unsustainable tourism, conversion of mangrove forests to monoculture plantations (especially *Casuarina equisetifolia*), and infrastructural expansion have led to significant habitat loss and a decline in native flora (Das & Bandyopadhyay, 2013; Kathiresan & Bingham, 2001). Furthermore, climate-induced phenomena such as sea-level rise, saline intrusion, and cyclonic storms have amplified the ecological stress on these habitats, impacting floristic composition and ecosystem stability (Dutta et al., 2013).

This study aims to conduct a comparative analysis of floristic diversity and anthropogenic pressure in selected coastal zones of Purba Medinipur and Balasore. By integrating vegetation surveys with local ecological knowledge and GIS-based land-use assessment, the research seeks to identify key species under threat, understand human-induced transformations, and propose conservation strategies for maintaining coastal plant diversity and ecosystem resilience.

Materials and Methods

The study was conducted in ten coastal sites across Purba Medinipur (West Bengal) and Balasore (Odisha), chosen for their ecological importance and

exposure to anthropogenic influences. Vegetation data were collected through field surveys using stratified quadrat sampling: 10×10 m for trees, 5×5 m for shrubs, and 1×1 m for herbs (Misra, 1968; Kershaw & Looney, 1985). Species were identified, and their frequency, density, and abundance were calculated. Seasonal variation (pre-monsoon, monsoon, post-monsoon) was recorded. Ethnobotanical insights were gathered via interviews with local residents and traditional healers to assess human interactions with vegetation (Kala, 2005). Additionally, GIS and remote sensing (Landsat 8, Sentinel-2) were applied using QGIS software to evaluate land-use changes between 2017 and 2024 (Jensen, 2007; Lillesand et al., 2015). Collected plant specimens were preserved and authenticated using regional floras and stored in a reference herbarium (Jain & Rao, 1977).

Results and Discussion

Floristic Composition and Diversity

Vegetation surveys across ten coastal sites in Purba Medinipur and Balasore revealed a total of 68 plant species from 29 botanical families. The Fabaceae family emerged as the most dominant (16 species), followed by Moraceae and Arecaceae (Table 1). The dominance of Fabaceae aligns with their established ecological roles in nitrogen fixation, salinity tolerance, and soil stabilization, making them key players in disturbed and marginal ecosystems (Singh et al., 2010; Alongi, 2002).

Table 1. Dominant Plant Families in the Study Area

Family	No. of Species	Notable Features
Fabaceae	16	Nitrogen-fixing, coastal stabilizers
Moraceae	5	Large-canopy trees, shade providers
Arecaceae	4	Coconut palms, ornamental, salt-tolerant
Meliaceae	3	Timber species, shade
Rhizophoraceae	3	Core mangrove halophytes

Frequency and Habitat Preferences

Species distribution varied across three primary coastal habitats: mangrove, plantation, and transitional zones. In Balasore, mangrove-associated

halophytes such as *Rhizophora mucronata* and *Avicennia marina* were dominant. In contrast, Purba Medinipur featured high frequencies of *Casuarina equisetifolia*, a fast-growing exotic plantation species widely used in afforestation programs but known to suppress native biodiversity (Kathiresan & Bingham, 2001; Das & Bandyopadhyay, 2013). Transitional areas such as dunes and disturbed zones were occupied by herbaceous colonizers like *Ipomoea biloba* and *Pandanus odorifer* (table 2).

Table 2. Frequency (%) of Dominant Species Across Habitats

Species	Mangrove Zone	Plantation Zone	Transitional Zone	Overall Dominance
<i>Rhizophora mucronata</i>	84	10	0	Mangrove
<i>Avicennia marina</i>	80	12	6	Mangrove
<i>Casuarina equisetifolia</i>	0	93	42	Plantation
<i>Ipomoea biloba</i>	0	20	88	Transitional
<i>Pandanus odorifer</i>	0	14	62	Transitional

Seasonal Variation in Species Abundance

With reference to table 3, post-monsoon surveys recorded the highest abundance of herbaceous species like *Ipomoea biloba*, favored by moist, sandy substrates typical of coastal dunes. In contrast, halophytes like *Avicennia marina* and planted species like *Casuarina equisetifolia* remained relatively stable across seasons, suggesting tolerance to environmental fluctuations or management through replantation (Ghosh, et al., 2015; Magurran, 1988).

Table 3. Mean Seasonal Abundance (Individuals per Quadrat)

Species	Pre-Monsoon	Monsoon	Post-Monsoon
<i>Ipomoea biloba</i>	3.2	4.8	7.1
<i>Casuarina equisetifolia</i>	5.5	6.0	6.8
<i>Avicennia marina</i>	4.6	4.9	5.0

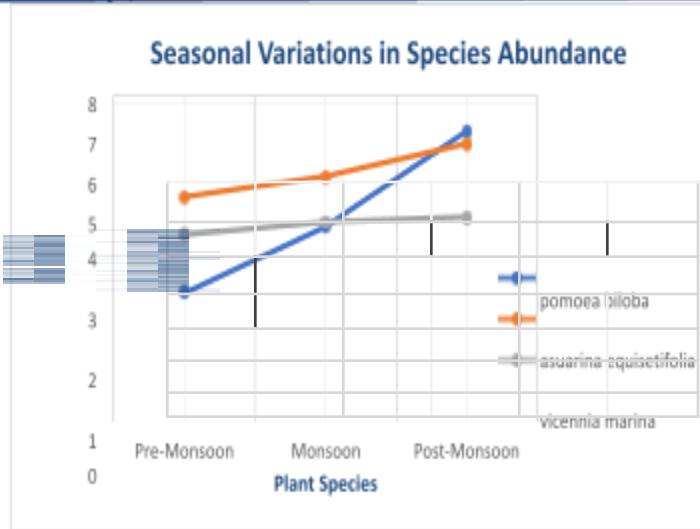


Figure 1. Seasonal Abundance Trends of Dominant Species (Line graph showing increasing trend for *Ipomoea biloba*, stability for *Casuarina* and *Avicennia* across seasons.)

Anthropogenic Influence and Land-Use Change

GIS-based land-use analysis using Sentinel-2 imagery and QGIS revealed a 50% reduction in vegetation cover in Purba Medinipur between 2017 and 2024 (Figure 2). In contrast, Balasore, particularly near Talsari and Udaipur, retained more native vegetation due to less tourism and development pressure. These patterns corroborate prior findings on coastal degradation from unregulated tourism and plantation expansion (Chakraborty & Mukhopadhyay, 2019; Jensen, 2007).

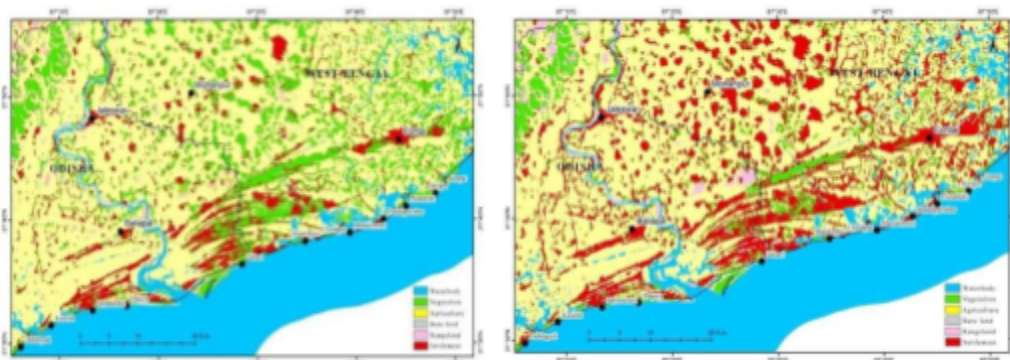


Figure 2. Land Use Change from 2017 to 2024 (left & right respectively in Study Sites; LULC Maps of Coastal Region comparing vegetative cover and built-up areas using Sentinel-2 imagery and QGIS analysis.

Table 4. Land Use Comparison Between Districts (2017–2024)

District	Vegetative Cover		Built-Up Area Increase (%)
	In 2017 (km ²)	In 2024 (km ²)	
Purba Medinipur	613	309	102%
Balasore	498	388	53%

Ecological Implications

The study underscores the ecological significance of Fabaceae, not only as dominant taxa but also as potential agents for coastal restoration due to their nitrogen-fixing ability and adaptability (Singh et al., 2010). However, monoculture plantations such as *Casuarina equisetifolia* risk displacing native dune and mangrove flora, leading to habitat homogenization and lower resilience (Kathiresan & Bingham, 2001). Declining trends in native species like *Bruguiera gymnorhiza*, *Ipomoea pes-caprae*, and *Pandanus odorifer* further highlight the need for ecologically sensitive land-use policies (Alongi, 2002).

Conclusions

This comparative study of the coastal zones in Purba Medinipur and Balasore reveals significant variation in floristic diversity, habitat structure, and anthropogenic impact. While Balasore retains relatively intact native vegetation, Purba Medinipur faces rapid degradation due to urbanization and monoculture plantations. The dominance of Fabaceae and halophytes like *Avicennia marina* reflects ecological resilience, while the decline of native dune and mangrove species signals habitat stress. GIS-based land-use analysis underscores the urgent need for sustainable coastal management. Restoration using native species, controlled tourism, and community-led conservation can help maintain biodiversity and ecosystem stability in these fragile regions.

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