

Mangrove Vegetation in Karnataka: Importance, Challenges, and Sustainable Solutions for Coastal Development

E. B. Sedamkar

KLE Society's Gudleppa Hallikeri Arts, Science and Commerce College, Haveri – 581 110 Karnatak,
India

Abstract

In recent years, the ecological importance of mangrove vegetation has gained increasing attention due to its role in maintaining environmental balance and protecting coastlines. In Karnataka, however, mangroves are limited to three coastal districts—**Uttara Kannada, Udupi, and Dakshina Kannada**—which, despite their rich biodiversity and relatively pollution-free environment, remain underdeveloped. Tourism is minimal, and economic benefits for local communities are limited. This study examines the causes of underdevelopment, the consequences of neglecting mangrove-based opportunities, and proposes sustainable strategies to integrate ecological conservation with socioeconomic development. Utilizing recent data, district-level mangrove maps, and field observations; the study highlights practical measures for promoting eco-tourism, community-based restoration, and sustainable economic growth along Karnataka's coastline.

Keywords: Mangrove vegetation, Coastal vegetation, Ecological balance, Mangroves in Karnataka, Mangrove districts in Karnataka.

Introduction:

Mangrove forests are specialized coastal ecosystems that thrive in saline and tidal environments, primarily in tropical and subtropical regions. They serve as natural shields against cyclones, storms, and coastal erosion, while also providing essential nursery grounds for fish and other aquatic species and playing a crucial role in carbon storage. Karnataka's mangroves are confined to a narrow 320 km strip along the Arabian Sea, mainly across **Uttara Kannada, Udupi, and Dakshina Kannada** districts. Despite their high ecological value, these areas have experienced limited economic development. While largely free from industrial pollution and urbanization, the districts suffer from inadequate tourism infrastructure and minimal promotional efforts, resulting in poor socio-economic conditions for local communities.

Mangrove plants in Karnataka belong to a specialized group of **halophytes** adapted to saline, waterlogged conditions. They include shrubs and trees with broad, leathery evergreen leaves, stilt roots, and pneumatophores (breathing roots) that allow them to survive in oxygen-poor mud. Many mangrove species exhibit **vivipary**, where seeds germinate while still attached to the parent plant, enhancing survival in challenging coastal habitats. These adaptations, along with their ecological, economic, and

commercial benefits, make mangroves indispensable for coastal protection, biodiversity conservation, and the livelihoods of local communities.

Objectives of the Study:

1. To assess the present status and distribution of mangrove vegetation in Karnataka's coastal districts.
2. To identify the causes of environmental and economic underdevelopment in these areas.
3. To analyse the consequences of neglecting mangrove-based opportunities.
4. To propose sustainable strategies combining ecological conservation with livelihood promotion.

Material and Methods:

According to Untawale and Wafar (1986), Karnataka's mangrove flora comprises 14 species belonging to 9 genera and 7 families. The coastal region of Karnataka extends across three districts—Uttara Kannada, Udupi, and Dakshina Kannada—covering a coastline of approximately 320 km from Karwar in Uttara Kannada to Mangalore in Dakshina Kannada. Numerous rivers and streams originating in the Western Ghats flow through this region before joining the Arabian Sea, creating ideal estuarine conditions for mangrove growth. Some of these rivers are particularly wide, notably the Swarna-Sita-Kodi, Gangoli, Kali, and Aghanashini rivers, which host several significant mangrove habitats along their banks. Uttara Kannada has the largest mangrove cover, especially in the Aghanashini and Sharavathi estuaries, while Udupi contains smaller patches near Kundapura, Saligrama, and Udyavara backwaters. In Dakshina Kannada, mangroves are scattered near Mangalore, Mulki, and the Netravati River mouths. Although these mangrove regions are ecologically healthy, they lack modern tourism infrastructure and large-scale development projects.

Distribution of Mangrove Vegetation in Karnataka:

Mangrove vegetation in Karnataka thrives best in regions that receive abundant rainfall and maintain high humidity throughout the year, creating highly favourable environmental conditions for their growth. The coastal region of Karnataka experiences an average annual rainfall ranging between 2,500 mm and 3,000 mm, primarily during the monsoon season from June to September. This consistent rainfall, combined with the warm coastal climate, supports the luxuriant growth of mangrove ecosystems.

The soil along the Karnataka coast is predominantly lateritic, rich in iron and aluminum oxides, which provides a suitable substrate for mangrove establishment. According to the studies conducted by Untawale and Wafar (1986), Karnataka's mangrove flora comprises 14 species belonging to 9 genera and 7 families. Geographically, the mangroves are distributed across three main coastal districts—**Uttara Kannada, Udupi, and Dakshina Kannada**—which together form a coastline of approximately **320 kilometres** along the Arabian Sea.

Several rivers and estuaries originating from the Western Ghats flow through these coastal plains before joining the Arabian Sea, creating ideal brackish-water environments for mangrove growth. Major river systems such as the **Kali, Aghanashini, Gangavali, Swarna-Sita-Kodi, and Gangoli** estuaries serve as prominent mangrove habitats. These regions exhibit dense and diverse mangrove cover, contributing significantly to Karnataka's coastal ecology and playing a vital role in maintaining biodiversity, preventing erosion, and supporting local livelihoods.

This study uses data from the **Forest Survey of India (ISFR 2023)**, reports from the **Karnataka Biodiversity Board, Energy & Wetlands Research Group (IISc)**, and **field-level observations** from local communities and forest departments.

GIS-based mapping approach:

- **Satellite Data:** Sentinel-2 (10m resolution) and Landsat imagery.
- **Indices Used:** NDVI, NDWI, and Mangrove Vegetation Index (MVI).
- **Analysis:** Supervised classification to distinguish mangroves from other vegetation and mudflats.
- **Validation:** Field points from Forest Department and Google Earth images.

Results and Discussions:

Mangroves provide food security:

Mangroves play a crucial role in ensuring food security by supporting diverse aquatic and terrestrial life forms that contribute to both local and global nutrition. Today, there is growing worldwide awareness of the importance of mangrove ecosystems as habitats for various aquatic organisms such as fish, prawns, crabs, clams, and oysters, which are commonly harvested for human consumption. In addition to providing these marine resources, several mangrove-associated plant species are also directly used as food by humans in many countries. For example, the young foliage of *Acacia farnesiana* is used as a substitute for tamarind in chutneys, while the young leaflets of *Acrostichumaureum* are cooked and eaten (Wealth of India, Vol. I, 1985). The fruits of *Bruguiera gymnorrhiza* are edible (Kothari and Rao, 2002), and the soft pods of *Canavalia* species, belonging to the Fabaceae family, are consumed as vegetables. *Salvadora persica* provides tender foliage and shoot tips that are used in salads, and its fruits are fermented to produce juice. Similarly, *Sonneratia caseolaris* bears edible fruits that can be eaten raw or cooked, and their juice serves as an alternative to vinegar and as a condiment (Hajra and Sanjappa, 1996). Thus, mangrove ecosystems not only support aquatic biodiversity but also offer a variety of plant-based food resources, highlighting their integral role in sustaining both ecological and human food systems.

Mangrove Distribution Area in Karnataka:

District	Mangrove Area (sq. km)	Equivalent in hectares	Remarks
Uttara Kannada	10.47	1,047 ha	Largest cover, concentrated in Aghanashini and Sharavathi estuaries
Udupi	1.69	169 ha	Found around Kundapura and Saligrama creeks
Dakshina Kannada	0.45	45 ha	Scattered patches along Netravati and Gurupura estuaries
Total	12.61 sq. km	1,261 ha	As per Forest Survey of India and Times of India reports (2023)

Though the total mangrove area is small compared to other Indian states, its ecological significance for coastal Karnataka is enormous (Map 1-4).

Causes of Underdevelopment:

1. **Lack of Infrastructure:** Poor Road access, limited accommodation, and absence of guided tourism facilities.
2. **Policy Restrictions:** Strict Coastal Regulation Zone (CRZ) rules hinder low-impact development.
3. **Low Awareness:** Local communities are often unaware of the eco-tourism and livelihood potential of mangroves.
4. **Neglect in Promotion:** Unlike Goa or Kerala, Karnataka's mangrove-rich areas are rarely advertised or promoted.
5. **Conservation-Only Focus:** Overemphasis on protection without parallel economic planning for local people.

Consequences of Neglect:

- **Economic Stagnation:** Coastal residents depend mainly on small-scale fishing, which is unstable.
- **Migration:** Young people migrate to cities due to lack of local opportunities.
- **Loss of Traditional Livelihoods:** Skills like boat-making and bivalve harvesting are fading.
- **Underutilized Natural Resources:** Mangrove-based eco-tourism and education centers remain untapped.
- **Decline in Community Interest:** Without financial benefits, local people lose motivation to conserve mangroves.

Ecological Importance of Mangroves:

Mangrove vegetation protects coastal areas from damaging storm and hurricane winds, waves, cyclones, typhoons, and floods. Their stilt root systems help prevent erosion by stabilizing sediments, while the vegetation also purifies water by trapping sediments and filtering pollutants. Mangroves play a crucial ecological role by serving as primary producers that support zooplankton, prawns, fishes, crustaceans, and mollusks. They absorb 3–5 times more carbon than terrestrial forests, provide breeding and nursery grounds for diverse marine species including crabs, shrimps, mollusks, and migratory birds, and regulate local climate by maintaining humidity and temperature balance. Overall, mangrove ecosystems are vital for coastal protection, carbon storage, biodiversity conservation, water purification, and climate regulation.

Mangrove Sites in Karnataka:

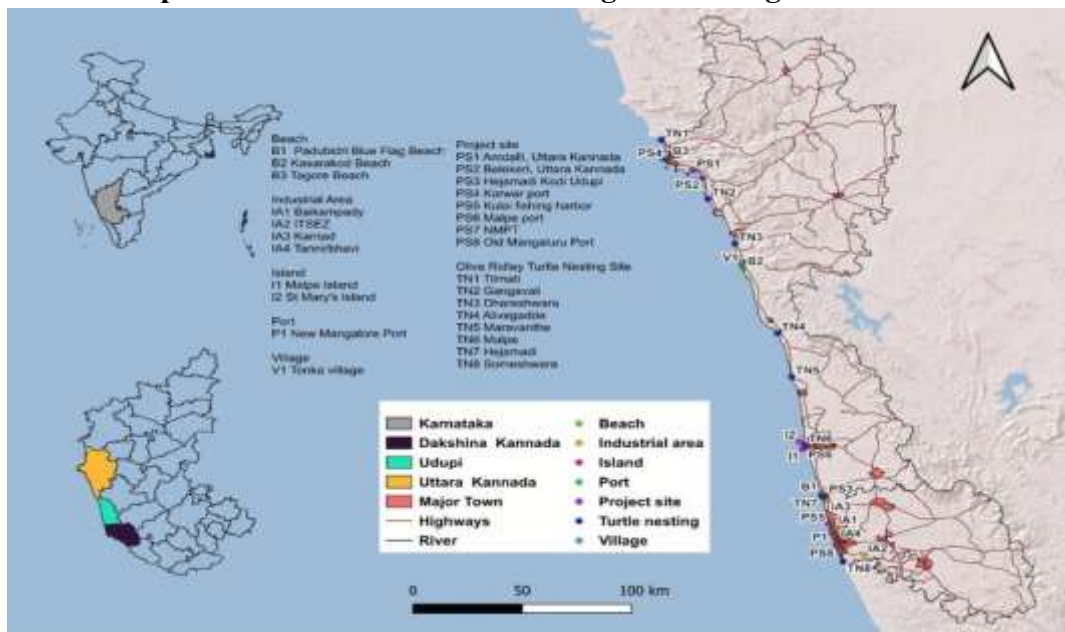
1. **Aghanashini Estuary (Uttara Kannada):** The largest and healthiest mangrove ecosystem; proposed as a **Ramsar site** due to its biodiversity.
2. **Sharavathi River Mouth:** Dense mangrove cover near Honnavar, supporting traditional fisheries.
3. **Saligrama Estuary (Udupi):** Popular site for mangrove plantation and eco-tourism potential.
4. **Mulki-Netravati Estuary (Dakshina Kannada):** Small but significant patches supporting brackish-water fauna.

Table:1. Mangroves Species of Karnataka:

Sl. No.	Family	Species
1	Acanthaceae	<i>Acanthus ilicifolius</i>
2	Combretaceae	<i>Lumnitzera racemosa</i>

3	Euphorbiaceae	<i>Excoecariaagallocha</i>
4	Myrsinaceae	<i>Aegicerascorniculatum</i>
5	Poaceae	<i>Porteresiacoarctata</i>
6	Rhizophoraceae	<i>Bruguiera cylindrica</i> , <i>Bruguiera gymnorrhiza</i> , <i>Kandeliacandel</i> , <i>Rhizophora apiculate</i> , <i>Rhizophora mucronata</i>
7	Sonneratiaceae	<i>Sonneratia alba</i> , <i>Sonneratiacaseolaris</i>
8	Verbenaceae	<i>Avicennia marina</i> , <i>Avicennia officinalis</i>

Map 1: Karnataka coastline showing three mangrove districts.



Map 2: Aghanashini Estuary mangrove distribution and Ramsar boundary.



Map 3: Potential mangrove restoration zones near Saligrama and Udupi.**Map 4: Tourism and eco-trail opportunities in Udupi district.**

These maps were created using Sentinel-2 data and validated using field observations from IISc's Energy & Wetlands Research Group.

Sustainable Solutions and Recommendations:

I. Environmental Solutions

1. **Mangrove Restoration:** Expand natural regeneration through community-based planting of native species like *Rhizophora mucronata* and *Avicennia marina*.
2. **Monitoring & Research:** Establish mangrove research centers in Udupi and Uttara Kannada for mapping, training, and biodiversity studies.
3. **Integrated Coastal Zone Management (ICZM):** Balance conservation with development under clear eco-friendly guidelines.

II. Economic and Social Solutions

1. **Eco-Tourism Development:** Introduce guided boat tours, boardwalks, and homestays run by local youth and fisherwomen.
2. **Community Participation:** Form “Mangrove Protection Committees” under Gram Panchayats.
3. **Skill Training:** Provide training for eco-guides, handicraft making, and sustainable fishing.
4. **Government Incentives:** Financial aid for local entrepreneurs starting mangrove-based tourism ventures.

Awareness Programs: Organize school-level campaigns and “Mangrove Day” celebrations in coastal villages.

Proposed Action Plan:

Time Frame	Action	Responsible Agencies
Short-term (1–2 years)	Community-based eco-tourism pilot projects in Aghanashini and Saligrama	Forest Dept., Tourism Dept.
Medium-term (3–5 years)	Mangrove restoration and livelihood training programs	ICZM, NGOs, Fisheries Dept.
Long-term (5+ years)	Blue carbon credit schemes, sustainable tourism networks	MoEFCC, State Biodiversity Board

Conclusion:

There is only one solution to overcome and maintain our environment clean and green—to motivate mangrove growers through active state and central government initiatives. The government should undertake special projects and schemes that help coastal people grow economically while focusing on developing these regions as canters for fish cultivation in marine estuaries, bird sanctuaries, and recreational hubs. Training programs must be provided to unemployed youth and local communities to educate them on the ecological, economic, and commercial importance of mangroves. The mangrove ecosystems of Uttara Kannada, Udupi, and Dakshina Kannada are ecological treasures that protect coastlines and sustain biodiversity; however, their potential for economic and tourism development remains largely underutilized. This study concludes that through community participation, eco-tourism, and sustainable development policies, Karnataka’s coastal districts can achieve a balance between environmental conservation and economic growth. Promoting mangrove-based livelihoods will not only enhance income opportunities for coastal residents but also ensure the long-term protection and prosperity of these fragile ecosystems.

Acknowledgement

I am sincerely grateful to our Management and Principal, Prof M.M. Holliyavar, for his constant support and encouragement throughout the preparation of this research review article.

References:

1. Survey & documentation of Mangroves in Coastal Karnataka
2. Untawale and Wafar, 1986: Mangrove vegetation in Karnataka.
3. Wealth of India, vol. I., 1985: Mangroves for Food
4. Kothari and Rao, 2002: Mangroves for Food
5. Hajra and Sanjappa, 1996: Mangroves for Food
6. Forest Survey of India (FSI), 2023. *India State of Forest Report*.
7. Karnataka Biodiversity Board, 2022. *Coastal Ecosystem Studies in Karnataka*.
8. Energy & Wetlands Research Group, IISc. *Mapping of Mangrove Ecosystems in Uttara Kannada District*.
9. Ramachandra, T.V. (2023). *Aghanashini Estuary: A Ramsar Site Proposal Report*.
10. Times of India, 2023. "Karnataka's Mangrove Cover Rises to 12.61 sq km."
11. MoEFCC, Government of India, 2021. *National Mangrove Management Action Plan*.