MANGROVE FLORISTICS - CURRENT STATUS IN INDIA

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Introduction

Mangrovesare defined as a tropical or subtropical community of highly adapted shrubs, trees, or plant species growing in the estuarine area, intertidal zone and sheltered marine areas. They eventuate in soil having moderate oxygen at which point slow moving water helps in the accumulation of fine sediments. They act as a physical barrier to mitigate the effects of coastal calamities like floods, cyclones, tsunami, hurricanes and waves. Growing in the intertidal areas and estuary mouths between land and sea, mangroves provide critical habitat for a diverse marine and terrestrial flora and fauna. Mangrove habitat also attracts rich epifloral and faunal communities including bacteria, fungi, invertebrates and seaweeds(Sundararaman*et al.*, 2007). Prevailing among coastlines in tropical and subtropical areas, mangroves are a bridge between terrestrial and marine environments wherein there occurs a transfer of energy and organic matter from the land to the sea, forming the base to many marine food webs. Healthy mangrove forests are a key to healthy marine ecology and known to fix more carbon dioxide per unit area than phytoplankton in tropical oceans. However, these forests are considered to be one of the world's most threatened tropical ecosystems with major threats to their habitat being due tooverfishing, pollution,over harvesting and climate change.

Worldwide status of mangrove cover

Globally the total mangrove area is estimated to be 14.79 million hectares (ha), accounting to 1% of the tropical forests of the world. Mangroves are distributed in more than 113 countries with Indonesia (19%), Brazil (9%), Nigeria (7%) and Mexico (6%) accounting for >40% of the world's mangrove area (FAO, 2020). Among continents, the highest recorded mangrove area is reported in Asia (5.55 million ha), followed by Africa (3.24 million ha), North and Central America (2.57 million ha), South America (2.13 million ha) and Oceania (1.30 million ha).

Status of mangroves in India

In 1987, a survey based on remote sensing and Geographical Information System(GIS) bythe Forest Survey of India (FSI) had estimated the mangrove cover in India, to be spread over an area of 4975 km^2 accounting to about 3% of the total mangrove area in South Asia and 0.15% of the total geographical area of the country. Sundarbansin West Bengal adjudges for nearly half of the total area under mangrove in India. As per the FSI, the mangrove cover of the country has shown consistent increment in the last 32 years which has increased from 4046 km^2 in 1987 to 4975 km^2 in 2019 showing a growth rate of 22.96%. Of the total 4975 km^2 of mangrove area, 2020 km^2accounts foropen mangroves, 1479 km^2 by moderately dense mangrove and 1476 km^2byvery dense mangroves. Although a congruous growth has been recorded in the open mangrove areas since the last 16 years (2003-2019), there has been a sharp decline in the moderately dense mangrove area of the country.

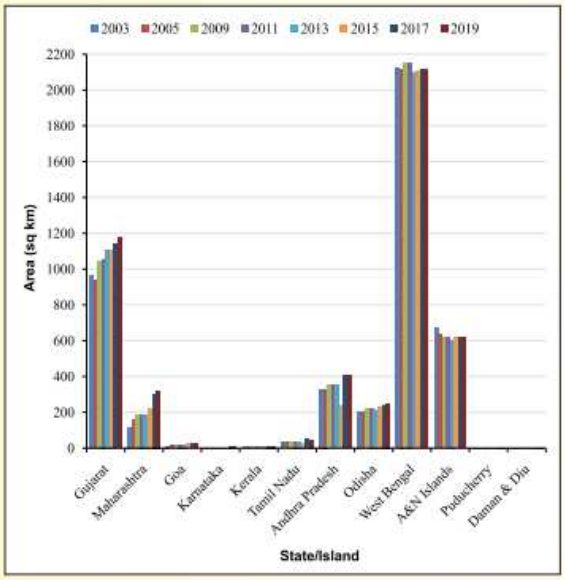
Changes in contribution of different mangrove ecosystem in last 16 years

Year	Changes in contribution of different mangrove ecosystem in last 16 years		
	Very Dense Mangrove	Moderately Dense Mangrove	Open Mangrove
2003	1162	1657	1642
2005	1147	1629	1669
2009	1405	1659	1575
2011	1403	1658.12	1601.44
2013	1351	1457	1819
2015	1472	1391	1877
2017	1481	1480	1960
2019	1476	1479	2020

(*Source: ISFR, 2019*)

The mangrove distribution among maritime states and islands in 2019 differs quite extensively. The total mangrove area in the country is located along the country's eastern coast adjoining the Bay of Bengal with 56.56%, along the western coast adjoining the Arabian Sea with 31.06%, while the remaining 12.38% is found in the Andaman and Nicobar Islands. The highest area under mangrove is accounted by West Bengal (2112 km^2),Gujarat (1177 km^2) and Andaman and Nicobar Islands (616 km^2)followed by Andhra Pradesh (404 km^2), Maharashtra (320 km^2), Odisha (251 km^2), Tamil Nadu (45 km^2), Goa (26 km^2), Karnataka (10 km^2), Kerala (9 km^2), Daman & Diu (3 km^2) and Puducherry (2 km^2) (ISFR, 2019). The mangroves of West Bengal are present in the Sundarban areas, the large deltaic complex of the river Ganges. In Gujarat, mangrove forests are present in the Gulf of Kachchh, South Gujarat and Gulf of Khambhat. While in Andaman and Nicobar Islands, majority of mangroves are found in the North Andaman and South Andaman districts. The mangroves of Maharashtra are distributed along the Mumbai, Raigarh, Ratnagiri, Sindhudurg and Thane districts. In Odisha mangroves are distributed in the Mahanadi,Brahmani and Baitarani deltas

while inAndhra Pradesh the mangroves are situated in the estuarine area of the Godavari and Krishna rivers. In Tamil Nadu, mangroves are restricted to Muthupet, Pichavaram and Gulf of Mannar.In Karnataka and Kerala the mangrove areas are very diminutivebeing distributed in Uttar Kannada and Udupi districts of Karnataka, Ernakulum, Kannur and Kasaragod districts of Kerala (ISFR, 2019).The mangrove area of different states has changed dramatically over the period of time. The mangrove areas of Gujarat and Maharashtra has increased consistently in the last 16 years while the mangroves of West Bengal and Andaman and Nicobar Islands have declined. There are forty six true mangrove species reported from the Indian coast encompassing 14 families and 22 genera (Ragavan*et al.* 2016). The key species being *Avicenniamarina, A. officinalis, A. alba, Rhizophoramucronata, Sonneratia alba, Bruguieracylindrica, Heritieralittoralis, Ceriopstagal, Phoenix paludosa and Morindacitrifolia.*



State/island wise distribution of mangrove area in India during last 16 years (*Source: ISFR, 2019*)

Importance

Mangroves form an ecosystem for large number of crustaceans, fishes, molluscs, birds, insects, reptiles, and monkeys that thrive along the coastline margin between land and sea in tropical and subtropical areas. They are considered to be one of the most productive, diverse, and crucial bio-resource in the coastal environment. They have tremendous ecological and socio-economic value as they provide goods and services to human societies, coastal and marine species(Youdon, 2020).They serve as a breeding ground and nurseries for various commercially important fishes and crustaceans' mainly shrimps and crabs. Economically mangrove ecosystem also provides income from the collection of the different ornamental shells of mollusks, crustaceans, and fish that inhabit these ecosystems. Mangroves serve as a potential site for recreational activities like fishing, boating, sight-seeing, bird watching, and photography which contribute significantly to the tourism potential in the country. They provide local communities with fuelwood, charcoal, timber, and wood chips which helps to stabilize coastlines. They maneuver as a filter for land runoffs and green walls for soil erosion, thus key in stabilizing the loose soil from high wind velocity, tidal surges, and cyclonic storms. Other services include the protection of coastal areas against erosion and various climate change events like storms and cyclones. They also help in sequestering large amounts of carbon as compared to other forest types thereby playing an important role in mitigating impacts of climate change.

Challenges

More than 35% of the world's mangroves have been lost with figures reaching as high as 50% in countries such as India, Vietnam, Philippines and Americas. Studies have found that the mangrove forests have been impacted by varied and complex anthropogenic phenomenon and natural disturbances. This includes clearing of mangrove forests for agricultural land, human settlements and infrastructure (such as harbours), tourist development, shrimp aquaculture, salt farms, and industrial areas. Deforestation is the single largest threat to the diversified mangrove ecosystem. Other major threats include the land-based pond aquaculture and overexploitation of fish and shellfish resources. The combustion of fossil fuels along with deforestation and other forms of land clearing are leading to aninevitable rise in atmospheric CO_2 concentrations and surrounding temperatures. The temperature rise may result in expanded latitudinal limits for some species, alteration of community composition and marginal increases in photosynthesis, respiration, microbial decomposition, floral and faunal diversity, growth and reproduction, but reduced rates of sediment accretion(Alongi, 2002). In general, impacts of climate change on mangrove use and exploitation are predicted to result in increased risks off looding and erosion in low lying coasts, intrusion of salt wedge and storm surges and collateral damage. Thus it is crucial to conserve them from further depletion and adopt measures to prevent area loss. Although, many legislative and non-legislative measures have been already setup in the early 1980s to conserve and regenerate them but proper regulation of these laws and measures is not successful due to various reasons. The keep going policies for mangrove utilization and conservation are cryptic and inconsistent as undetermined land ownership and rules governing are access to the mangrove areas. The guidelines made are too complicated and ambiguous to follow. Implementation of coastal land use and development plans by the Government and institution for effective management of coastal mangrove are ineffective(Mridula and Rajesh, 2007).

Further action: Conservation and Management

Mangroves provides huge beneficial products to human beings and are rich in biodiversity. Conservation and management of such an ecosystem is unavoidable due to the significant facts that mangroves provides nursery grounds for different aquatic organisms, suitable for aquaculture practices, possess medicinal properties, and income generation due to tourism. Sustainable use of the mangrove ecosystem requires a far more inclusive framework for understanding, predicting, and managing interactions between climate change, human activities, and coastal ecosystems which needs to be formulated. At the most basic level, efforts must be made to create awareness about the importance of mangroves and their utility in the local people is required through the dissemination of knowledge regarding mangroves among stakeholders. Recently efforts from NGOs, and local communities in India, have played an important role in sustaining and restoring mangrove forests. Some important techniques adopted for restoration of degraded mangrove habitats are large-scale plantation, development of new mangrove habitats

at suitable areas such as fishbone channel plantation, and capacity-building of managers and staff. The forest departments in various states have formed eco-development committees for joint implementation of projects in mangrove areas. Regular trainings are also being conducted not only for sustainable mangrove conservation but also to help protect and preserve these mangroves areas which are a religious and sentimental value to the local communities. The Kagekanu forest patch, which is dominated by species such as *Rhizophoramucronata*, *Avicennia officinalis* and *Kandeliacandel*, off Karwar coast in Karnataka, is an example of traditional conservation through sacred groves (Sahu *et al.* 2015).The forest department of Andaman and Nicobar islands has started the mangrove regeneration program by growing nurseries of mangrove saplings and planting them in appropriate areas. Participation of the local community in the conservation and prevention of illegal clearing and encroachment of mangrove areas is crucial. Hence, national and international collaboration is required to reach a commendable level. Strict implementation and enforcement of relevant legal measures are essential. The success lies in the basic understanding that mangroves are the source of significant and tangible socio-economic benefits to the community.

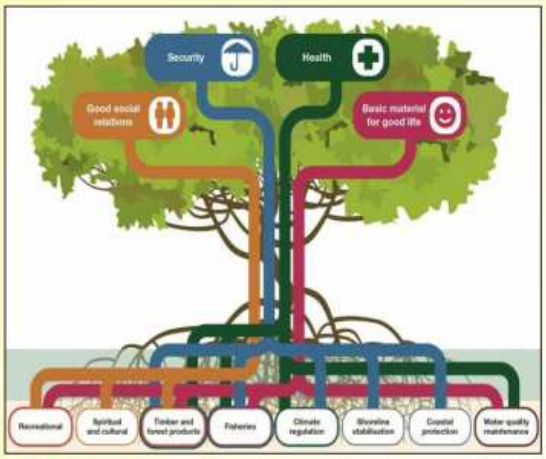
Mangroves of Sundarbans area, West Bengal ***(Source:https:// sundarbanmangroves.wordpress.com/2016/03/13/soils-of-sundarban-mangroves)***

Rhizophoramucronata ***(Source: https:// alchetron.com/ Rhizophora-mucronata)***

Mangroves of Maharashtra ***(Source:https:// mangroves. maharashtra.gov.in/Site/ViewPhoto?album=1013&type=1)***

Avicennia marina **(Source: Senthu herbals BlogSpot)**

Bruguieracylindrica **(Source: Sabah Wetlands Conservation Society)**



Mangrove ecosystem services ***(Source: https://www.unep-wcmc.org/resources-and-data/the-importance-of-mangroves-to-people--a-call-to-action)***

Mangrove crab ***(Source: https://footage.framepool.com/en/shot/654163426-mangrove-crab-zambezi-delta-sandy-soil-burrow-hole)***

Conclusion

The status of mangrove cover in India has increased since last three decades. West Bengal and Gujarat are the top most states accounting more than 66% of the mangrove cover of the country. However, recently the Indian mangroves have been affected byvarious anthropogenic and natural disturbances. Thus it is essential to conserve and nurture them from further depletion. Mangroves serve as a social, ecological, and subsistence benefits to the humans as well as to the associated organisms. They protect the shoreline from various climatic events and erosion control, thus playing an important role in the conservation of biodiversity. Hence, governmental and collaborative efforts are required for the sustainable utilization of mangrove ecosystem.

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ADOPTION OF INTEGRATED PEST MANAGEMENT PRACTICES IN BASMATI RICE IN WESTERN U.P.

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Rice, Oryzasativa L., is the important cereal crop which is grown in 117 countries and is a staple food for people in 39 countries, which includes 2.70 billion people in Asia alone (Sardesai et al. 2001). Its productivity is severely affected by numerous biotic and abiotic factors. About 52% of the total global production of rice is lost annually owing to the damage caused by biotic factors, of which nearly 21% is attributed to the attack of insect pests (Brookes and Barfoot 2003). Basmati Rice is a long-grain aromatic rice grown in several States of India and Pakistan. India is the leading exporter of the Basmati rice to the global market and cultivated in about 2.0 million hectares. Basmati rice crop suffers severely due to attack of various insect pests, which reduces its yield and quality. In general, yield loss due to insect pest of rice has been estimated at about 25% in different rice ecosystem. Findings of conducted surveys revealed excessive and injudicious use of chemical pesticides and fertilizers by farmers that aggravated the pest menace, secondary pest outbreaks, residue problems in grains, soil and water, environmental degradation and rejection of many export consignments. To achieve sustainable quality production of Basmati rice, it is important to manage the damage and yield loss by rice pests and options for the appropriate pest management practices. Hence, IPM should be treated as a yardstick for the productivity of a crop.

Rice is the major food grain crop in India. There is significant development in researching new varieties and other package of practices in relation to nutrient management, water management,