A Study on Threats and Sustainability of Mangrove Vegetation in India

E.Manjari Nandy, Aswin Alora
M.Tech. Student, Department of Earth Science,
IITR, Uttarakhand.

Abstract

Mangroves are one of the most endangered ecosystems globally found within the intertidal zones of tropics and subtropics. They afford numerous ecological and economical ecosystem services subsidising to coastal erosion protection, water filtration, provision of areas for fish and shrimp breeding, provision of building material and medicinal ingredients, and the attraction of tourists, amongst many other factors. Deprivations of mangrove ecosystems in India aremostly due to continuous growth in anthropogenic accomplishments such as alteration of mangrove wetlands for aquaculture and destruction of mangrove forest for timber. In the coastline areas residents are at dangers of trailing their livelihood and ecological communities are in the approach of extermination. The operative preservation and administration of mangrove habitats should be deliberated in association with local community contribution and application of remote sensing method and Geographic Information System (GIS)-based complete database approach. In this paper, we suggested that the risks and hazards of mangrove vegetation around the world. The purpose of this paper is to offer a complete overview and comprehensive summary of all of the work assumed, addressing the range of remotely sensed data applied for mangrove ecosystem charting, as well as the several methods and practices used for data evaluates, and to discuss their prospective and restrictions. A mixture of remote sensing and GIS-based methodology will have important ecologic and commercial welfares by gaining real-time data from isolated areas. This approach has cherished suggestions to other endangered mangrove wetlands universally.

Keywords: *Mangrove habitat, Climatic vulnerability, Management, remote sensing and Geographic Information System, Mangrove ecosystem.*

I. INTRODUCTION

Mangroves are a collection of extremely adaptive salt tolerant plant species inhabiting intertidal zones of tropical and subtropical coastlines. They necessitate provisional supply of fresh, non-saline water for growth and survival. Mangrove habitats (sporadic or dense strands and multi-/mono-species) are reported from 125 countries between 30˚N and 30˚S latitudes. The universal mangrove cover has been projected to be nearly 170,000 sq. km. They are broadly categorized into two groups are true mangroves and mangrove associates. True mangrove species only develop in intertidal zones, e.g., Avicennia alba, Bruguiera gymnorrhiza, Heritiera fomes, and Rhizophora mucronata.The mangrove associates can persist in both coastaland terrestrial environments, e.g., Hibicustilisaceus, Suaedanudiflora and The spesiapopulnea.

Mangroves retain significant biological and socio-economical functions: i) they proliferates soil and sediment deposit and alleviate coastlines, ii) they setup nutrient and heavy metals and facilitate improved water quality, iii) they help as a reserve of food, fuel and fodder for shoreline communities, iv) some mangrove species have medical standards, v) mangrove environments act as a breeding ground for different types of sea species vi) they assist as a home for large numbers of mammals, birds and reptiles, and vii) they act as a obstacle against natural tragedies in coastal areas, e.g., hurricanes, cyclones or tsunamis. Even though their ecologic, social and commercial functions, these ecosystems are incessantly under the risk due to anthropogenic action and climatic susceptibility. Consequently the species diversity index of mangroves is progressively decreasing in many areas. Forfeiture of mangroves all over the world may reach up to 70% by 2030. Mangrove forests are unceasing decreasing at a speedy rate (1 to 2% per year), nevertheless at a frightening level in the developing countries where they found in large quantity. Consequently, it is essential to produce awareness among coastal inhabitants concerning beneficial feature of mangroves and enactment of a proper management approach to protect these environments from further destruction. The objective of this study is to assess the recent threats and susceptibilities to mangrove ecosystems around the world with a superior importance to east coast of India and condenses key management considerations for fortification. We emphasized the significance of remote sensing data and Geographic Information System (GIS) technology to improve real-time information from remote and inaccessible areas in order to effectively achieve these delicate coastal ecosystems.

For the reason that mangrove ecosystems have an unresolved relevance ecologically and economically, there is an urgent demand for conservation and restoration measures. Therefore, retrieving up-to-date information with regard to the extent and condition of mangrove ecosystems is an essential aid to management and policy- and decision-making processes. Distinctive mangrove habitats are provisionally besieged and often located in isolated regions; subsequently, traditional field observation and survey methods are tremendously time-consuming and cost intensive. To report these subjects, large-scale, long-term, cost-effective monitoring and mapping implements are essential, which are obtainable by means of remote-sensing technology. The goal of this paper is to afford a critical investigation and summary of remote-sensing analysis activities distributed during the last two decades. A short synopsis of mangrove ecosystems and their welfares is shadowed by a depiction of remote-sensing applications in the field of mangrove examines and observing considered by their spatial resolution: aerial photography, high-resolution imagery, medium-resolution imagery, hyper spectral imagery, and radar data analyses. In this perspective, the different organisational methods for remote-sensing data information abstraction and the generation of value-added products are also examined. A debate on the complications and future contests of remote sensing of mangroves follows, before this paper condenses with decisions.

II. MANGROVE FOREST DISTRIBUTIONS

A. Global Mangrove Cover

Mangroves are a precarious forest ecosystem, controlling coastlines in tropical and subtropical regions of the globe. There are 54-75 species of true mangroves, which are originate only in the intertidal zones of coasts, and are taxonomically secluded from terrestrial complements. They are extremely amended to their environment, accomplished of excluding or ejecting salt, permitting mangroves to flourish in highly saline waters and soils. Salinity can still limit the distribution of mangroves, though, as can other environmental influences such as climate, tidal fluctuation, and sediment and wave energy. Mangroves are found worldwide, but the greatest species diversity is in Southeast Asia, with only twelve species inhabiting New World countries, and only four of those are found in the United States along the southern coast.

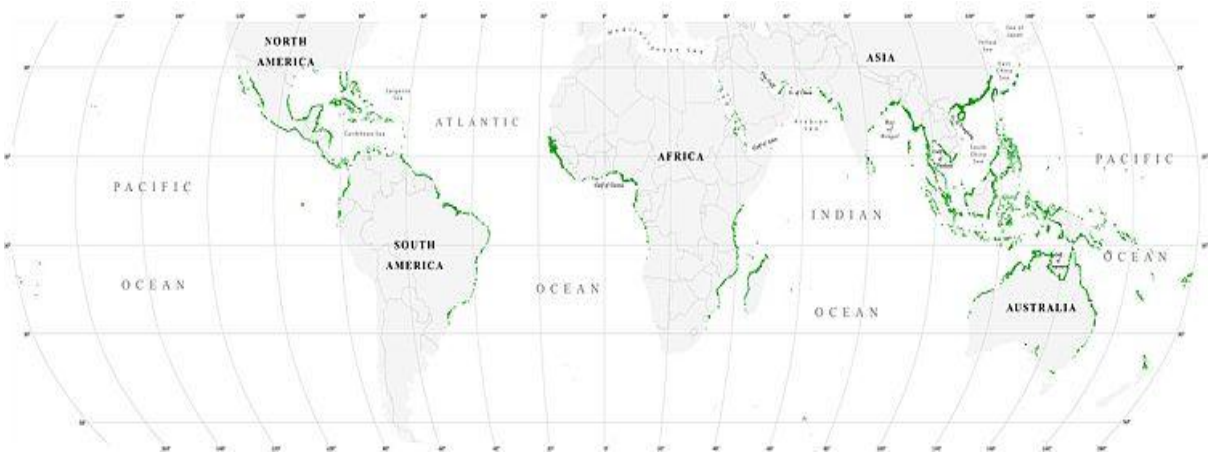

Figure 1: Distribution of Mangroves Throughout the World

Table.1: Worldwide Distribution of Mangrove Vegetation Cover

Sl. no	Country	Area (ha)	% of global total
1	Indonesia	3,112,989	22.6
2	Australia	977,975	7.1
3	Brazil	962,683	7.0
4	Mexico	741,917	5.4
5	Nigeria	653,669	4.7
6	Malaysia	505,386	3.7
7	Myanmar	494,584	3.6
8	Papua New Guinea	480,570	3.5
9	Bangladesh	436,570	3.2
10	Cuba	421,538	3.1
11	India	368,276	2.7
12	Guinea Bissau	338,652	2.5

Based on the first complete valuation of all mangrove forests of the world (Fig. 1), we projected that the total mangrove forest area of the world in 2010 was 137,760 km2 in 118 countries and

territories. The total mangrove area accounts for 0.75% of total tropical forests of the world. This real evaluation does not afford information about the quality of the forests. The largest extent of mangroves is found in Asia (42%) followed by Africa (20%), North and Central America (15%), Oceania (12%) and South America (11%). Approximately 75% of mangroves are concentrated in just 12 countries in Table 1. The mangroves develop in river deltas, lagoons and estuarine complexes. They also occur on colonized shorelines and islands in protected coastal areas with locally variable topography and hydrology.

B. Indian Mangrove Vover:

Mangrove forest covers an area of 4,628 sq. km along Indian coastlines which comprises of ~3% of world's mangrove forests (Table 2). These include 1,351 sq. km of very dense, 1,457 sq. km of moderate and 1,819 sq. km of open mangroves. Indian mangrove forest was increased over the last two decades concurrent with the strict conservation and a forestation program implemented by the Government of India to recover from decline during 1990's. Major mangrove wetlands spread along the east coast and Andaman and Nicobar Island while in the west coast they are predominantly localized (Figure 2). The location and diversity of these forests are influenced by the inflow of fresh water which is more pronounced in the east coast as major rivers of the Indo-Gangeticplain and Deccan plateau discharges into Bay of Bengal. The inflow of fresh water decreases from north to south likewise decrease in species diversity and mangrove cover.

The mangrove forest lies at the foot of the Ganges. The seasonally-flooded Sundarbans freshwater swamp forests lie inland from the mangrove forests. The forest covers 10,000 square kilometres (3,900 sq mi) of which about 6,000 square kilometres (2,300 sq mi) are in Bangladesh. The Sundarbans is interconnected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests. The area is known for the eponymous Royal Bengal Tiger as well as numerous fauna including species of birds, spotted deer, crocodiles and snakes. The fertile soils of the delta have been subject to intensive human use for centuries, and the Eco region has been mostly converted to intensive agriculture, with few enclaves of forest remaining.

Figure.2: Distribution of Mangroves Throughout the World

Table.2: Total Mangrove Vegetation Cover in India.

Sl.no	States/UTs with Highest Mangrove Cover 2013	Total Mangrove Cover in km^2
1	West Bengal	2097
2	Gujarat	1103
3	Andaman And Nicobar Islands	604
4	Andhra Pradesh	352
5	Orissa	213
6	Maharashtra	186
7	Tamilnadu	39
8	Goa	22
Total		4616

III. RISK FACTORS AND SUSCEPTIBILITIES TO MANGROVE ECOSYSTEMS

Mangroves plays a dynamic role in many features of human life (e.g.,therapeutic uses, e.g., malaria, diarrhoea, ulcer, skin infections, diabetes and snake bite), but these environments are in danger to anthropogenic accomplishments and climate change. In some coastal areas mangrove ecosystems are converted into farm lands, resorts and aquaculture. Damage of mangroves is also a significance of climate change, e.g., rise or fall of sea level, changing pattern and magnitude of cyclone, rainfall intensity and shoreline erosion. Natural occurrence has a lesser hazard to mangrove ecosystems than anthropogenic activity. Species diversity was decreased in many regions due to land use changes.

Numerous mangrove wetlands are situated along east coast of India, particularly in the state of Tamil Nadu (Pichavaram and Muthupet),Andra Pradesh (Godavari and Krishna), Orissa (Mahanadi and Bhitarkanika) and West Bengal (Sundarbans). These marshlands are the largest known continuous mangrove blotches in these regions. Biodiversity of Sundarbans has demoralized by humans for more than a few decades, where alteration of mangrove wetlands to paddy cultivation or shrimp farming is a common exercise. Sundarbans has many compactly occupied villages and local inhabitants rely on wetland forests for means of support.Local inhabitants are complicated in profitable manipulation of Heritierafomes and Avicennia marina for boat making, poles and rafters. They gather fire wood, leaves for roofing (especially from Nipafruticans and Phoenicpaludosa), grass for fodder and fish and shrimps

IV. IMPORTANCE AND POLICIES OF REMOTE SENSING AND GIS BASED APPROACH IN MANGROVE MANAGEMENTS

In spite of intensive management concerns, the mangrove habitats across the globe comprising east coast of India are facing dangerous levels of pressures and susceptibilities from land use changes and climatic variability. The main natural threats are from rising sea level, increasing coastal erosion and extreme weather events such as storm surges. Human-induced changes are conversion of mangrove habitat for aquaculture and agriculture. Population increase has a direct impact on mangrove habitats due to increase in demand for food production and industrial growth. In upcoming decades, maintainable conservation and management method for the protection of mangrove habitats will be of chief deliberations. Achievement of sustainable management plans will depends on micro-scale management plans. Real valuation of mangroves comprising their cost benefit exploration should be reflected before executing any conservation policy. In many circumstances it was found that community based management of mangroves are economically beneficial but ecological issues relating to biodiversity was not considered. An assured diversion of flow of water due to construction of dam may increase speed the rate of erosion in a specific area and the rate of sedimentation in some other areas. This statistics is very critical to plan a micro-level management plan for mangrove conservation. Consequently we also suggested a practice for micro-scale mangrove management under the Indian context through collection and valuation of primary and secondary data together with incorporation of traditional knowledge within the GIS platform. We have faith in that this approach will be of high importance for the localities which are unreachable located in other parts of the world.

V. CONCLUSION

The review exposes that mangroves are one of the most susceptible ecosystems in the world. They are in the margin of destruction due to continuous growth in anthropogenic anxieties along the coastal areas and climatic changeability. Climate change phenomenon e.g.Relative sea-level rise has been a minor threat to mangroves than anthropogenic activities. Though, it may embrace a substantial proportion of expected loss of mangroves in future. Influences of climate susceptibilities on mangrove ecosystems are less important than the possessions of relative sea level rise. Increase in global temperature and improved concentration of CO2 are likely to increase productivity of mangrove wetlands, modification in the timing of flowering and fruiting, and migration of mangrove species into higher latitudes. Though, agriculture and shrimp farming have been recognized as a major issue for mangrove destruction and thus growing the intensity of coastal disasters. In east coast of India, mangrove wetlands are tarnished due to increasing anthropogenic activities such as alteration of mangrove wetlands for aquaculture and destruction of mangrove forest for timber. The deployment and assessment of mangroves is restricted to a few geographic locations such as Indian subcontinent, south-east Asia and east Africa. Condensed mangrove cover and reduced health will increase liabilities of human safety from increased coastal storms and surges. This anticipated mangrove losses will also degrade water quality, biodiversity, eliminate fish nursery habitat, and reduces a major resource for forest dwellers that conventionally depends on mangroves for livelihood. There is a necessity of the better scientific approach for management of mangroves.

REFERENCES

[1] Giri, C.; Pengra, B.; Zhu, Z.; Singh, A.; Tieszen, L.L. Monitoring Mangrove forest dynamics of the Sundarbans in Bangladesh and India using multi-temporal satellite data

from 1973 to 2000. Estuar. Coast Shelf Sci. 2007, *73*, 91-100.

[2] Seto, K.C.; Fragkias, M. Mangrove conversion and aquaculture development in Vietnam: A remote sensing-based approach for evaluating the Ramsar Convention on Wetlands. Glob Environ. Change 2007, 17, 486-500.

[3] Blasco, F.; Gauquelin, T.; Rasolofoharinoro, M.; Denis, J.; Aizpuru, M.; Caldairou, V. Recent advances in mangrove studies using remote sensing data. Mar. Freshwater Res. 1998, 49, 287-296.

[4] Manson, F.J.; Loneragan, N.R.; McLeod, I.M.; Kenyon, R.A. Assessing techniques for estimating the extent of mangroves: topographic maps; aerial photographs and Landsat TM images. Mar. Freshwater Res. 2001, 52, 787–792

[5] Selvam, V.; Ravichandran, K.K.; Gnanappazham, L.; Navamuniyammal, M. Assessment of community-based restoration of Pichavaram mangrove wetland using remote sensing *data*. Curr. Sci. 2003, 85, 794-798.

[6] Ramasubramanian R, Gnanappazham L, Ravishankar T, Navamuniyammal M
(2006) Mangroves of Godavari – analysis through remote sensing approach.
WetlEcolManag 14: 29-37.

[7] Satyanarayana B, Mohamad KA, Idris IF, Husain ML, Guebas FD (2011) Assessment of mangrove vegetation based on remote sensing and ground truth measurements at Tumpat. Int J Remote Sens 32: 1635-1650.

[8] Gang PO, Agatsiva JL (1992), The current status of mangroves along the Kenyan coast: a case study of Mida Creek mangroves based on remote sensing. Hydrobiol 247: 29-36.

[9] Bahuguna A, Nayak S, Roy D (2008) Impact of the tsunami and earthquake of 26th December 2004 on the vital coastal ecosystems of the Andaman and Nicobar Islands assessed using RESOURCESAT AWiFS data, Int J App Earth ObsGeoinf 10: 229-237.

[10] Cornejo RH, Koedam N, Luna AR, Troell M, Guebas FD (2005) Remote Sensing and Ethnobotanical Assessment of the Mangrove Forest Changes in the Navachiste-San Ignacio. J EcolSoc 10: 16

[11] Gilman EL, Ellison J, Jungblat V, Lavieren HV, Wilson L et al. (2006) Adapting to Pacific Island mangrove responses to sea level rise and other climate change. Clim Res 32: 161-176.

[12] Kapetsky JM (1987), Conversion of mangroves for pond aquaculture: some short-term and long term remedies. FAO Fisheries Report Supplement, Rome 370: 129-141.

[13] Verheyden, A.; Dahdouh-Guebas, F.; Thomaes, K.; De Genst, W.; Hettiarachchi, S.; Koedam, N. High-resolution vegetation data for mangrove research as obtained from aerial photography. Environ. Develop. Sustain. 2002, 4, 113-133.

[14] Fromard, F.; Vega, C.; Proisy, C. Half a century of dynamic coastal change affecting mangrove shorelines of French Guiana. A case study based on remote sensing data analyses and field surveys. Marine Geology 2004, 208, 265-280.

[15] Danielsen, F. Sørensen, M.K. Olwig, M.F. Selvam, V. Parish, F. Burgess, N.D. Hiraishi, T. Karunagaran, V. Rasmussen, M.S. Hansen, L.B. Quarto, A. Suryadiputra N. The Asian tsunami: A protective role for coastal vegetation Science 2005, 310, 643.

[16] Guebas FD, Mathenge C, Kairo JG, Koedam N (2000) Utilization of mangrove wood products around mica creek (Kenya) amongst subsistence and commercial users. Econ Bot 54: 513-527.

[17] Guebas FD, Jayatissa LP, Nitto DD, Bosire JO, Seen DL, et al. (2005) how effective were mangroves as a defence against the recent tsunami? CurrBiol 15: 443-447

[18] Satyanarayana B, Raman AV, Lokman MDH, Dehairs F, Sharma VS, et al. (2009) Multivariate methods distinguishing mangrove community structure of Coringa in the Godavari delta, East coast of India. AquatEcos Health Manag
12: 401-408.

[19] Ravishankar T, Navamuniyammal M, Gnanappazham L, Nayak SS, Mahapatra GC, et al. (2004) Atlas of Mangrove Wetlands of India (Part - 3 Orissa) M.S. Swaminathan Research Foundation, Chennai.

[20] Pattanaik C, Prasad N (2011) Assessment of aquaculture impact on mangroves of Mahanadi delta, East coast of India using remote sensing and GIS, Ocean Coast Manag 54: 789-795.