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Mangrove Forest cover Changes (1972-2017) in Palghar District (Maharashtra) West Coast of India by Spatial Analysis

G.P.Gangode, R.S.Saler, P.M.Nalawde
Department of Environmental science
K.R.T.Arts, B.H.Commerce & A.M.Science Collage,Nashik, Maharashtra, India

***Abstract*:-** *Mangroves are key species of sea coast. To protect other flora and fauna of coast, protection, conservation and restoration of mangroves is necessary. In a view above aims and objective species wise mangroves distribution data required. Present study analyses spatial data to estimate changes in mangrove cover over a period of time and recent species wise mangroves distribution in a study area. Study found that about 32%, 19.7%,11.9% and 9.6% mangrove cover of study area estimated from 1972 ,1990,2013 and 2017 years satellite images respectively and about 70% (1838ha) mangrove cover lost within 45 years from 1972 to 2017. The study had an overall classification accuracy of 91.67% and Kappa coefficient (K) 0.89. Mangroves species (chlorophyll concentration) shows higher variation in reflection at NIR bands and possible to species wise detailed mapping and monitoring. Study area dominant with Avicennia marina mangrove species. Mangroves in study area distributed in small fragmented patches with low height and their surface reflection combines with mudflat, water and sand shows variation in spectral signature of same mangrove species at different locations.*

Keywords: *Mangroves, spectral radiation*

1. Introduction

Coastal ecology is the most diverse and productive than the other parts of planet [1]. Mangrove is the key species of sea coast which protect coastal biodiversity. Due to anthropogenic developmental activities, such as overpopulation, agriculture, urbanization, deforestation, industrial growth, unscientific disposal of waste in to the ocean etc. Maharashtra mangroves most threatened [2]. Global warming, climate change, increase in pollution level and living on our planet become difficult in coming days. In a view of future global problems we need to increase green cover on earth. In such way detail coastal biodiversity study is necessary for protection, conservation and restoration coastal ecology.

Present study aims to find out changes in mangrove forest over the time and estimation present species wise mangrove cover of Palghar district coast by using remote sensing and GIS. In view of availability quality and cost of hyper spectral data present work use ResourceSat-2,LISS 3and Landsat 8, OLI,TIRS reflectance data to estimate species wise mangrove cover. The species are quite differentiable in the Near Infra Red region [3], Individual mangrove species have a unique spectral reflectance and can be easily identified and mapped with a narrow contiguous wavelength bands in the NIR region [4]. The reflectance pattern of the

dominant mangroves species of mangrove forests, using spatial technique and the results will help to distinguish mangrove communities from the other features like water and sediment based on reflectance [5]. Due to the similar spectral features between mangroves and other land cover types, challenges are posed since the accuracy is sometimes unsatisfactory in distinguishing mangroves from other land cover types with traditional classification methods [6]. With the efforts to improve the design of methodologies and reduce the cost of the resources required, Remote sensing will be even more an effective tool that provides adequate information at considerable savings of time and money, and provide decision-makers with information on a clear evaluation of various class types of ecosystem services to grasp the amount of finite natural resources to manage them in a sustainable manner [7].

Palghar district of Maharashtra is fast developing area, having about 112 km coastal length and about 20 km coastal width, adjacent to Mumbai and thane and now facing huge anthropogenic pressure. Today development is unavoidable but by loss of nature is not acceptable. Present study makes efforts for sustainable development. Mangrove diversity support coastal flora and fauna and protects coastal area, having number of direct indirect benefits to society from medicinal to livelihood.

1.1 Study area

The study conducted at Dahanu coastal block in Palghar district (4697 sq. km. in area, and 112 km coast) study area extending between longitude 19°51´54´´-20°07´42.33´´N, 72° 37´35.41´´-72° 48´40.44´´E) located north shore of Thane, Mumbai, west coast of India during 2015 to 2017(fig.1). Study area divided into 11 parts /sites for ground truth data collection.

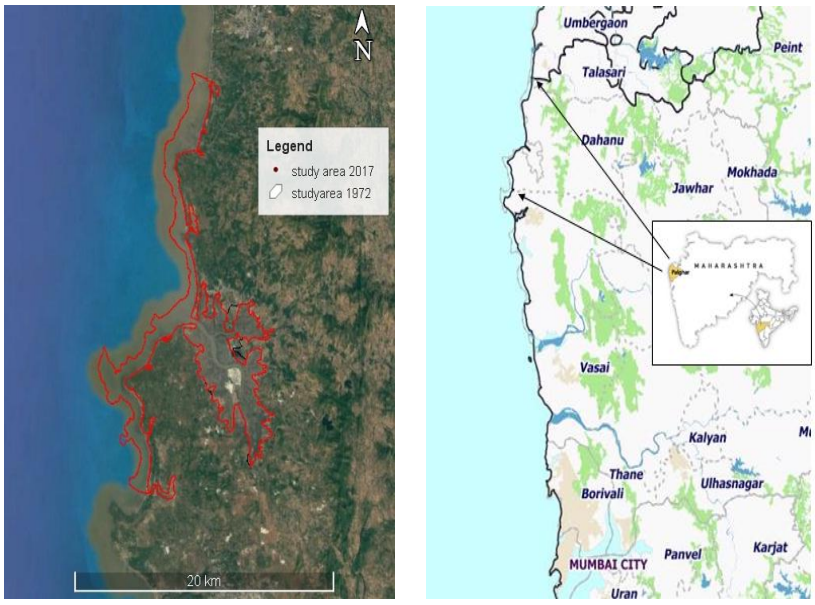

Fig1: Study area [8] [9]

1.2 Objective

Study changes of mangrove cover over the period of time (1972-2017) and estimation species wise mangrove cover with minimum expenditure. To understand past, present mangrove density, diversity and

predict future loss of mangrove forest if necessary protection, conservation and restoration measures not taken.

2. Methodology

2.1 Estimate species wise mangrove cover:

By using RS & GIS Technique species wise Mangrove area estimation was done. Data requirement is survey of India toposheet, district map, village maps, satellite imagery and ground truth data. For estimation of mangrove cover by spatial analysis, satellite images of study area year 1972,1990 and19 March 2017 are obtain from GLCF: Landsat imagery. Resourcesat LISS-3 image year 2013 collected from Bhuvan (ISROs web portal). By supervise image classification mangrove cover estimated [10]. The accuracy interpretation after ground truth verification was more than 91%. A stratified random method is used for accuracy assessment and this is appropriate sampling method for accuracy assessment on a per category basis [11].

Satellite	Number of bands	Wavelength range (micrometers)	Resolution (meters)	Swath (kilometer)
Landsat, 1-3 MSS	4, 4 to 7, G,R,NIR,NIR	0.5,0.6,0.7,0.8,1.1	60 (79×57)	170NS,183EW
Landsa,t 4-5 MSS	4, 1 to 4, G,R,NIR,NIR	0.5,0.6,0.7,0.8,1.1	60 (79×57)	170NS,183EW
Landsat,4-5 TM	7,1to7, B,G,R,NIR,SWIR1,Thermal,SWIR2	0.45 to 12.50	30 Thermal 120(30)	170NS,183EW
Landsat 8, OLI,TIRS	11,1to11, UB,B,G,R,NIR,SWIR1,SWIR2,PAN,Cirrus,TIRS1,TIRS2	0.43 to 12.51	30 PAN 15 TIRS 1,2 100(30)	170NS,183EW
ResourceSat-2,LISS 3	4, 2to 5 , G,R,NIR,SWIR	0.52 to 1.70	24	141
IMS1:Hyperspectral imager(HYSI)	64, 1 to 64	0.45 to 0.95	505.6	128

Table1:- Satellite imagery used for analysis

For Estimation of species wise mangrove cover hyperspectal image obtained from Bhuvan (ISROs web portal) and landsat 8 surface reflectant on demand from Earth explorer (USGS web portal). Use of available data spectral signature of mangroves species extracted. Mangroves species shows higher variation in reflection at NIR bands and possible to species wise detailed mapping and monitoring [12].

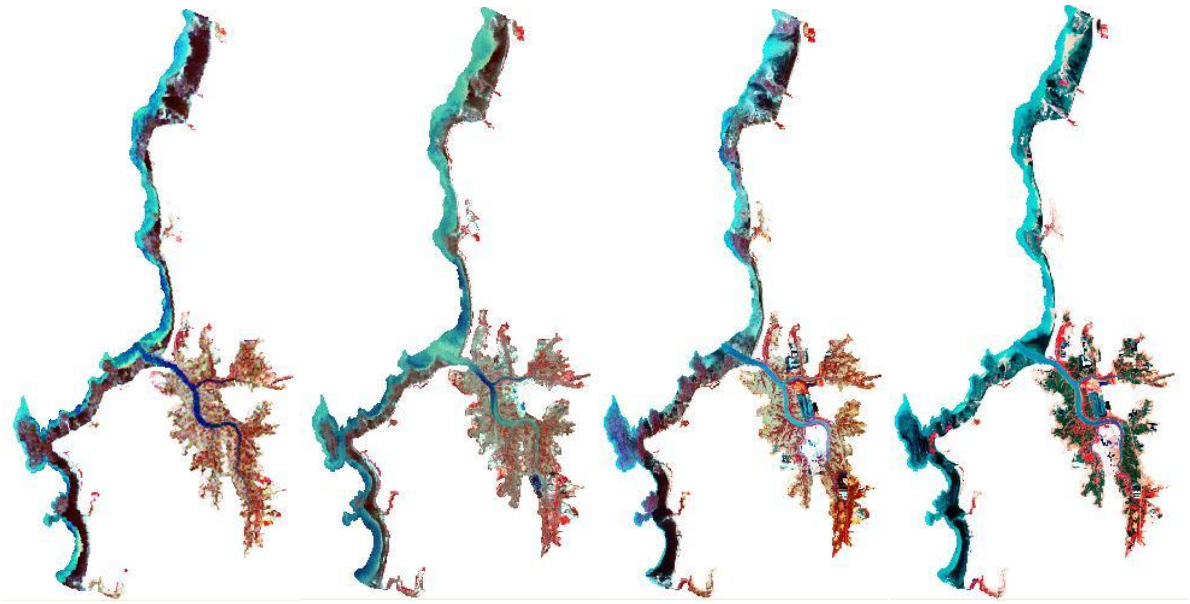

Fig 2: Subset of images 1972, 1990, 2013 and 2017 in FCC.

3. Results and Discussion:

3.1 Estimate species wise mangrove cover:

For estimation of mangrove cover by spatial analysis, satellite images of study area year 1972,1992 and19 March 2017 are obtain from GLCF: Landsat imagery. Resourcesat LISS-3 image year 2013 collected from Bhuvan (ISROs web portal), by superwise image analysis about 32%, 19.7%,11.9% and 9.6% mangrove cover of study area estimated from 1972 ,1990,2013 and 2017 data respectively and about 70% mangrove cover lost within 45years from 1972 to 2017. About more than 10% coastal area converted in to aqua culture, salt pan, built-up, agriculture etc.

Table 2:- Change in Mangrove cover from 1972 to 2017

	Area in hector (%)			
Class/Year of Images	1972	1990	2013	2017
Mangroves	2629(32%)	1616(19.7%)	978(11.9%)	788(9.6%)
Mudflat	3539(43.1%)	2870(35%)	5077(61.8%)	3524(42.9%)
Sand/Saltpan/Built-up	434(5.3%)	1128(13.7%)	776(9.4%)	2037(24.8%)
Water body	1620(19.7%)	2606(31.7%)	1387(16.9%)	1871(22.8%)

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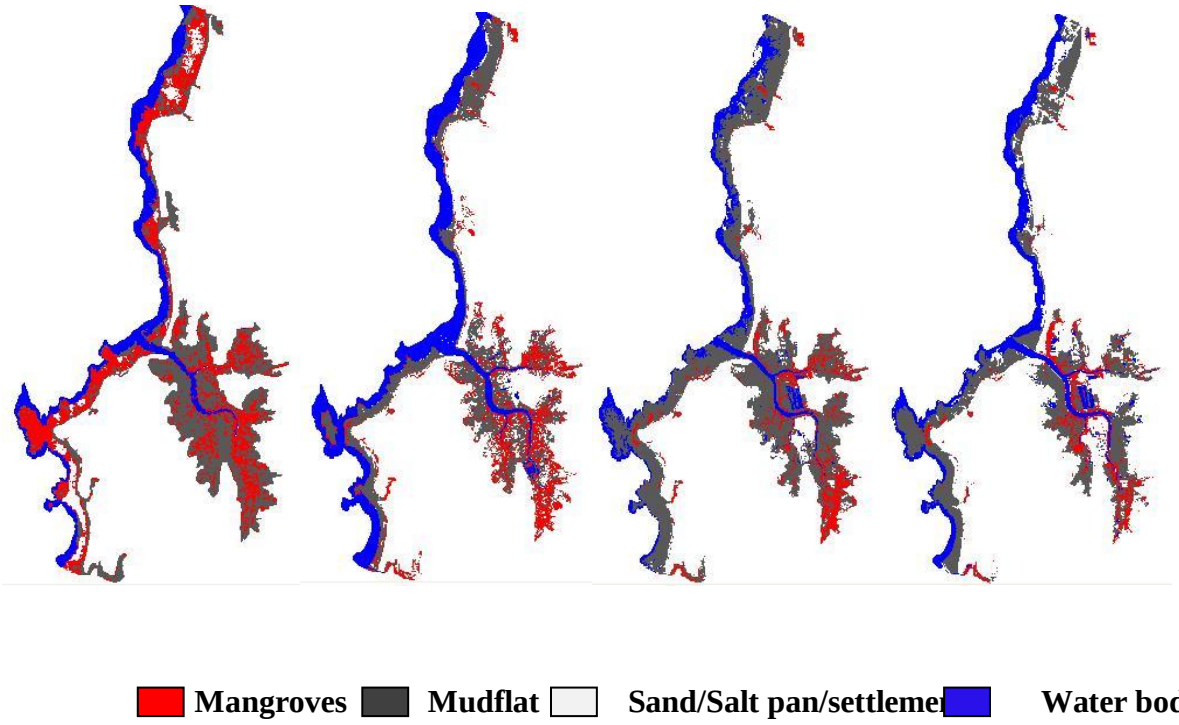

Fig 3: Classified images 1972, 1990, 2013 and 2017 change detection

For Estimation of species wise mangrove cover hyperspectal image obtained from Bhuvan (ISROs web portal) and landsat 8 surface reflectant on demand from Earth explorer (USGS web portal). Use of available data spectral signature of mangroves species extracted. Mangroves species shows higher variation in reflection at NIR bands and possible to species wise detailed mapping and monitoring. Study area dominant with *Avicennia marina* mangrove species . Mangroves in study area distributed in small fragmented patches with low height their surface reflection combines with mudflat, seawater and sand shows variation in spectral signature of same mangrove species at different locations. Availability of high spatial resolution hyper spectral data and for groundtruth data of difficult asses areas use of unmanned Ariel vehicle (UAV) or unmanned ariel system (UAS) and remotely operated vehicle (ROV) mounted with specroradiometer make it possible more accurate species wise estimation of mangroves.

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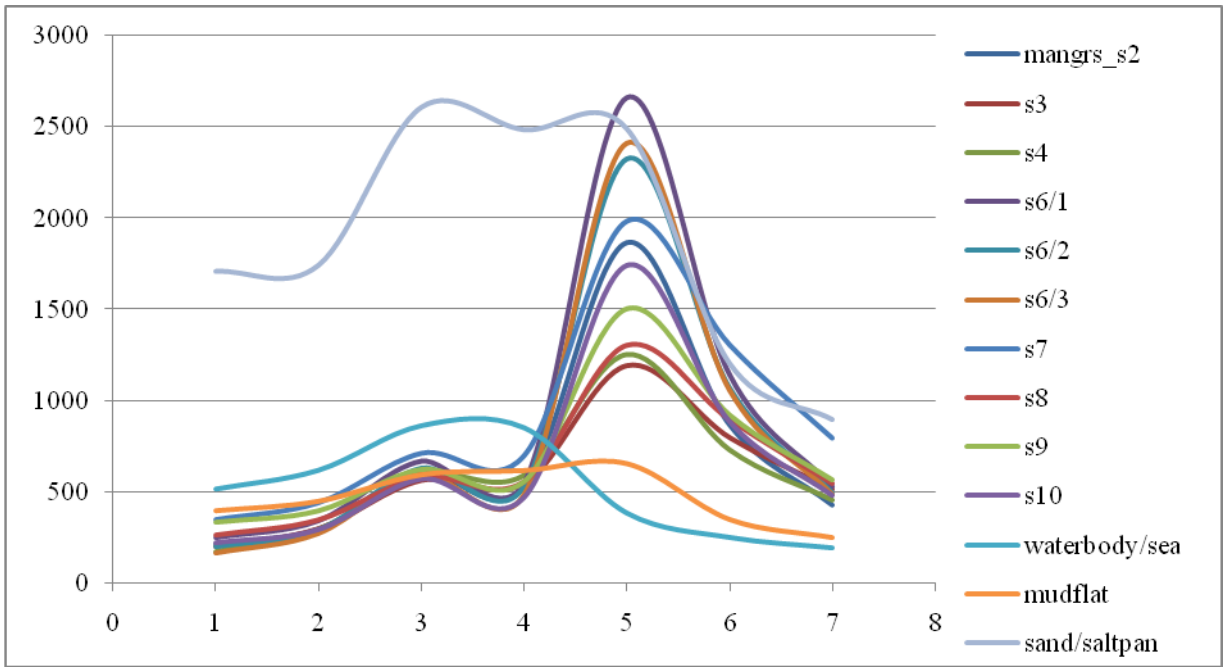

Fig 4: Spectral radiance of Mangrove (*Avicennia marina*) of diff. sites (s2 to s10), Mudflat, Sand and Water body

3.2 Accuracy assessment

Class Name	Mangroves	Sand/ saltpan	Water body	Mudflat	**Referenced total**	**User accuracy**
Mangroves	26	0	0	2	28	92.86%
Sand/saltpan/buildup	1	27	1	2	28	96.43%
Water body/sea	3	1	30	1	32	93.75%
Mudflat	2	2	1	27	32	84.38%
Classified Totals	30	30	30	30	120	
Producer accuracy	86.67%	90%	100%	90%		

Overall accuracy = (Number of pixels correctly classified/Total number of pixels used in accuracy assessment) × 100 = (110/120) ×100= 91.67%, **Kappa Coefficient (K) = 0.89** .

4. Conclusion:

Despite increasing anthropogenic pressures, the mangrove cover in India increases annually at the rate of 1.9%, as against the global mangrove cover that disappears at 0.66% [13]. Due to illicit felling, encroachment, shrimp culture, saltpan, agriculture, industrial growth etc. Dahanu coastal block of Palghar district shows 70% reduction in mangrove cover within 45 years. Palghar district have huge potential for marine production and recreation. Protection, conservation and restoration of mangrove species become beneficial to healthy coastal ecology.

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