iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** V **Month of publication:** May 2017

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Landscape Level Zoning Plan for Resource Management in Vulnerable Coastal Areas of Maharashtra: A case study of Sindhudurg District

Prajakta Babasaheb Jadhav[1], Dr. Tapati Mukhopadhyay[2]
[1]*M. L. Dahanukar College, Vile Parle, Mumbai,* [2]*Retd. Emeritus Fellow, UGC*

Abstract: ***Western coastal region of India is identified with unique coastal features like estuaries, sandy beaches, saltpans, mangrove, mudflats, etc. Several parts of Western coast of India -particularly Sindhudurg coast of Maharashtra state is facing threats pertaining to anthropogenic hazards. Alteration of natural environment and over exploitation of the resources has marked significant changes in the coastal features of the district. The situation became critical with the emerging tourism activity in the region. Host of mining companies invaded the region and altered the native occupation of the locals. This ultimately brought pressure on the natural resources of the area. This requires an integrated approach for its sustainable development. Taking this concept, the present paper wants to prepare the landscape level-zoning plan for this coastal area. This plan will help to identify the resource potential of the area and will find out the conflicting zone, where traditional activities are affected due to the emerging new functions. To fulfill this objective, the present paper will include the resource analysis, biodiversity features, and typical features of the coastal talukas, shoreline classification and landuse analysis of the coast. Data have been obtained through toposheets and satellite imageries. These imageries have been classified by using GIS packages. Based on this, a landscape-zoning plan is prepared.***
Keywords: Resource governance; Sustainability; Landscape zoning; Landuse plan.

I. INTRODUCTION

The Sindhudurg Coastal and Marine Eco-system (SCME), located on the western coast of India (Maharashtra), is one of the eleven ecologically and economically critical habited identified along the Indian coast. Critical habited includes Rocky bay, Sandy shore, Rocky island, Estuarine, Mud flats, Marshy land, Mangrove, Coral reef, Sargassam forest. There are 367 species of marine flora and fauna reported from the area. There are some globally significant species include Whale Shark, Indo Pacific Humpback Dolphin, Olive Green leather bag turtle and Corals. Avifauna presents 121 species including 24 migrants' birds. Vengurla rock is an important bird area. The area has a rich repository of corals with a resent discovery of a large coral area in Angria Bank.

Due to high ecological importance, 29.12 sq.km of the area was designated as Malvan Marine Sanctuary (MMS) in 1987. Sindhudurg coastal area has enormous economic significance as well, being one of the major fish-landing center and as a rapidly emerging tourism destination. The primary drivers of ecosystem degradation in Sindhudurg, in both Malvan and Vengurla include unsustainable fishing by trawler and emerging tourism destination.

II. OBJECTIVES

In view of the emerging and potential threats and challenges, the Sindhudurg coast requires an integrated approach for the conservation of coastal and marine biological diversity, cultural attributes and wise use of natural resources of sustainable livelihood. To deal with this situation, the main objective of the paper is to prepare a landscape level-zoning plan for resource governance in the coastal area of Sindhudurg district, Maharashtra

III. STUDY AREA

Sindhudurg district lies between $15^0$37' to $16^0$40' north latitude and $73^0$16' to $74^0$14' east longitude in the Survey of India toposheet numbered 47H, 47L and 48E, 48I at the scale of 1:250,000. The district is bordered by Sahyadri Hill ranges in the east beyond which Kolhapur district is situated, Arabian Sea towards the west, Belgaum district of Karnataka state to the south and by Ratnagiri

Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

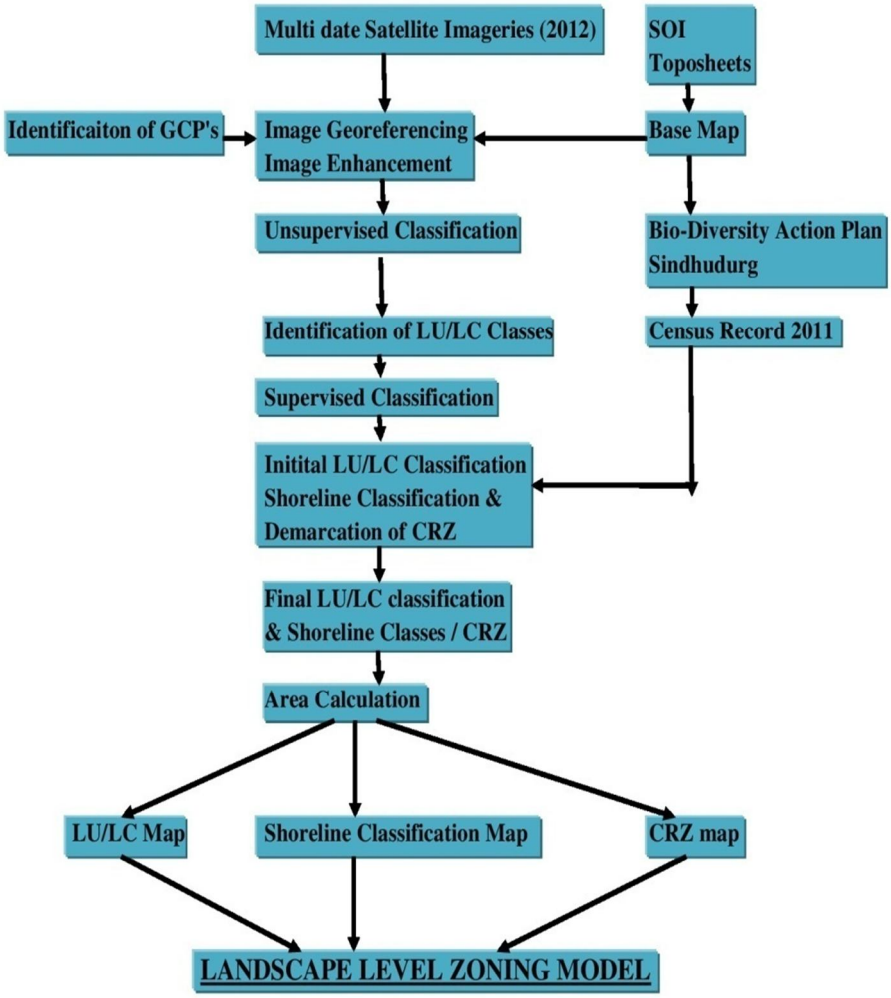
district in the north. Kudal is the district headquarters and Devgad, Kankavli, Malvan, Sawantwadi, Vengurla and Banda are some of the important townships. It has a total area of 5,207 sq.km and a coastline of 121 km (17% of the total coastline of Maharashtra). The district comprises of eight talukas, out of which three are coastal talukas namely, Devgad, Malvan and Vengurla, and five are inland talukas – Vaibhavwadi, Kankavli, Kudal, Sawantwadi and Dodamarg.

IV. DATA AND METHODOLOGY

An attempt has been taken to prepare a landuse plan for sustainable development by assessing terrain character, analyzing the elevation of the area and studying the resource characteristics of the study area. As far as the imageries are, concerned most of the imageries are extracted from Google satellite and Bhuvan (2012). Survey of India toposheet of 1:50,000 and 1:25,000 are widely used. Wide field checking is carried during the preparation of the map. After the preparation of land use area under each land function are calculated and presented in tabular form and pictorial graph. All these data are integrated to form large range of spatial information including urban services, infrastructure, land uses and other socio economic services. Finally, after insertion of the map features, the ArcMap was exported to jpeg for deriving final output.

Simultaneously, shoreline classification map was prepared based on toposheets and satellite imageries. CRZ map is overlayed on the shoreline map for final output.

For the preparation of landscape level zoning model, references were taken from Bio-diversity action plan for Sindhudurg district and data gaps in it were completed using the Census Record of 2011. This information was tagged with the maps prepared to draw final zoning.



Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

V. RESULTS AND DISCUSSIONS

A. Resources of Sindhudurg District

1) Fishing Sector: The principal economic activity on the Sindhudurg coast is fishing. The Sindhudurg district contributed 9.6% of the total fish production for Maharashtra State in 2013-14, which was 2.65 lakh tons. Within the SCME, the top two contributors were Malvan and Anandwadi (38.4% and 26.2% of the total fish production of the district, respectively).Gross value of fisheries sector in 2011-12 is 6413 lakhs and 6926 lakhs in 2016-17(Agricultural Statistics of Sindhudurg). By 1998 total fish catch of Sindhudurg district was around 35,000 tons. By 2009 it has shown 50% decline. After 2009 fish stocks have shown little increment and it has stabilized for 24,000 tons by 2012. Of the 33 varieties of fish harvested from the Sindhudurg coast, the prominent are ribbonfish, sardines, mackerel, and otolithes species. In Devgad, Malvan and Vengurla *talukas*, mackerel is the most caught variety, followed by sardines and otolithes.

2) Tourism Sector: Tourism is considered to have good potential in Sindhudurg and is being explored by the government and private sector. The district was declared a "tourism district" by the Maharashtra government in 1997. The district has the best beaches in the state, and the abundance of marine biodiversity (particularly corals) and cultural attributes significantly enhances the tourism potential.

Annual tourist inflow to Sindhudurg district stands at more than 700,000 in 2010 as compared to 100,000 in 2006. Most of the tourist activities are located around the coast, amongst which the popular tourist attractions are the forts (forts of Sindhudurg, Vijaydurg, Devgad, Yeshwantgad, and Teracol), beaches, dolphin watches, backwater cruises, houseboat stays, snorkeling and scuba diving.

3) Agro-Horticulture and Animal Husbandry: Agriculture and animal husbandry are the other livelihood activities taking place in the project area. Agriculture is mainly rain-fed. The net cultivated area of the district is 2626 sq.km of which 218 sq.km is irrigated land (Sindhudurg, DSA, 2013). Rice and *nagali* (a type of millet) are the principal food crops of the Sindhudurg district. Improved rice varieties are sown but methods are still traditional. Pulses like *tur, udid, waal, pawta, kulith* and *moong* are also grown. Main oilseeds grown are *karala, sesamum* and groundnut. Mango, coconut and cashew are the major cash crops grown in the district. Gross contribution of agricultural sector to Sindhudurg is 27000 lakhs in 2011-12 and 27675 in 2016-17. Gross contribution of horticulture sector to Sindhudurg was 66506 in 2011-12, which have increased to 70496 lakhs in 2016-17.

Rearing of local cows and buffaloes for milk and milk products is a secondary occupation to agriculture. Farmers have both non-descript cows and buffaloes and cross breed cows. Goats are reared for meat and milk, and poultry for meat and eggs. The poultry population in Sindhudurg district is 503361(2011). Gross value of animal husbandry in Sindhudurg is 4773.84 lakhs in 2011-12 and 4964.647 in 2016-17

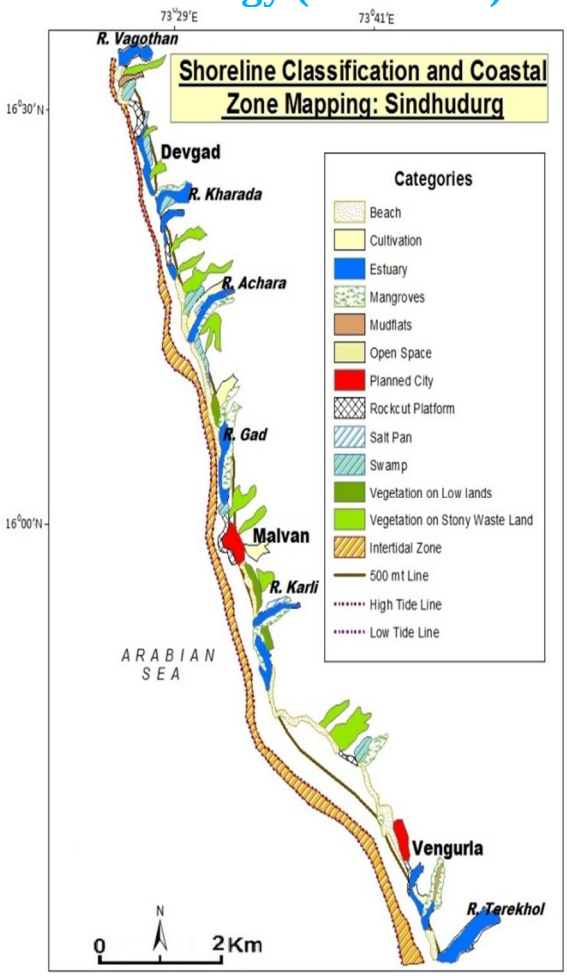
4) Mining and Industrial Activities: Sindhudurg is primarily an agricultural district with industrial areas accounting for less than 1% of the total area of the district. There is an industrial estate at Kudal and two "Udyamnagars" at Kudal and Majgaon in Sawantwadi taluka. The core industries are plastic engineering, aluminum utensils, cashew processing, oil paints, cement pipe manufacturing, sleepers manufacturing and a pig iron factory at Redi in Vengurla taluka. At present, there are four mining units operating from this area, comprising of two iron ore mining units, one unit that processes imported iron ore and another involved in silica and mining.

B. Shoreline Analysis of Sindhudurg Coast

The major concentration of resources such as fishing, horticulture, tourism, mining, agriculture and industries are in the coastal area. Taking this pattern of concentration, analysis of shoreline has to be undertaken. Richness of the coastal resources is related to character of shoreline. Shoreline classification is done on the guidelines given by Shailesh Nayak (2001**)**, where he has given three zones of land utilization. While classification of shoreline both natural as well as manmade features were taken into consideration. These included Bay, Estuary, Mangroves, Mud flats, Open Land, Sand Beach, Sparse Mangroves and Vegetation areas as natural features whereas Cultivation, Planned City, Salt Pans and Settlements as manmade features.

While preparing shoreline classification map, shoreline survey was carried using Aerial Photography, LISS III imageries and the data so collected was merged with the toposheet of 1:50,000 scale. The obtained results were then checked with field survey. The data so collected was integrated in ArcGIS software. Demarcated layers were then characterized separately using different symbols.

Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)



Map 1: Shoreline Classification and Coastal Zone Mapping, Sindhudurg

CATEGORY	AREA (%)
Beach	15.09482
Cultivation	3.954206
Estuary	22.80212
Mangroves	13.84603
Mudflats	1.412003
Planned City	5.136724
Rockcut Platform	4.575026
Salt Pan	1.114168
Swamp	8.077924
Vegetation on Low lands	2.602202
Vegetation on Stony Waste Land	21.38477

Table 1: Classification of Sindhudurg Coast
Source: Computed by author in ArcGIS10 based on Map

Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

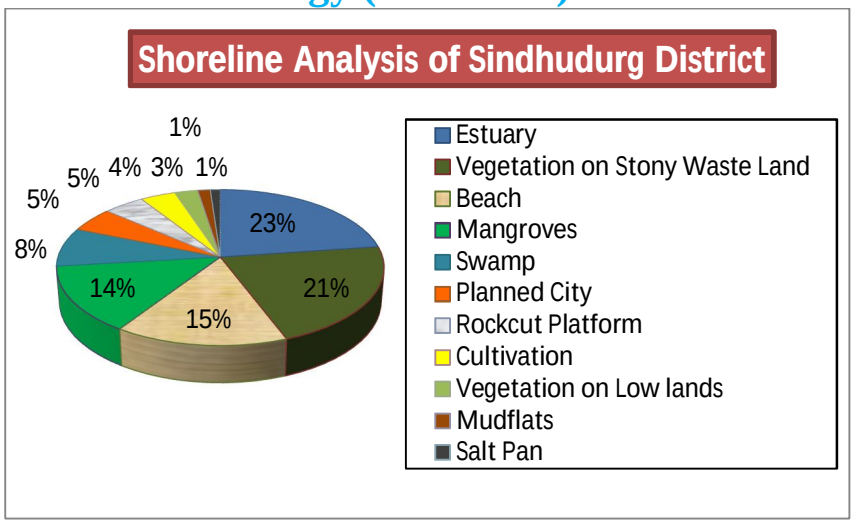
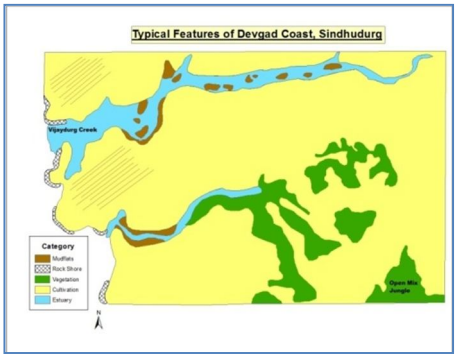


Fig 1: Shoreline Analysis of Sindhudurg Coast



Map 2: Typical Features of Devgad coast, Sindhudurg

The following features are seen in the shoreline analysis map (Map 4) and its classification (Table 1). Estuary (22.8 percent), beaches (15.1 percent), rock cut platform (4.57 percent), and mud flats (1.41 percent), Swamp (8.07 percent) and saltpan (1.11 percent) are present along the shoreline. These are the main characteristics of the coast, which provide the opportunity for the biodiversity element to survive. Coastal vegetation is equally important in this area. Vegetation on stony waste cover 21.38 percent of the total area, vegetation on low land is 2.6 percent and mangrove is 13.84 percent. Therefore, the total area under coastal vegetation is 37.83 percent of the total area. The rural settlements in the coastal area are encircled by the vegetation; and most of the settlements are within or close to the cultivable area. Vegetation of low land, mangroves and swamp are bearing the characteristics of low land with many places submerged under salt. The coast soils are saline. It does not provide opportunity for successful cultivation. Some of the areas are upland, which are good for horticulture. Successful economic activity on this shore depends on the use of biodiversity element and converting the beauty of the coast or development of tourism and associated service activity.

C. Geomorphologic Features of Sindhudurg Coast

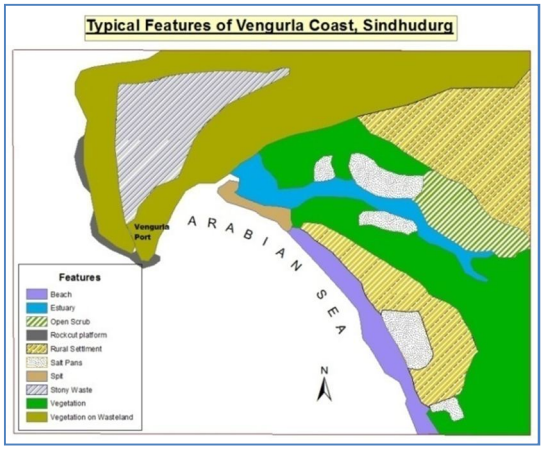
The coast has distinct geomorphologic features from rest of the Indian coast. The ecosystem is distinctive, owing to the diverse geological process, which have acted in varying degrees and duration, during the quaternary period and have left their imprint in the form of various geomorphic features along the coast.

1) *Devgad:* The coastline from Vijaydurg to Devgad and from Devgad to the Achra River, the southern boundary is comparatively regular though cut into the numerous small river creeks. The cliffs are steep. Above the cliffs are flat tablelands and jagged hills of bare lateritic with little or no vegetation cover in the rainy months. The principal ports are Vijaydurg, Vagothan and Devgad. The north part of Devgad is bounded by rivers in the coastal area. It is characterized by Vijaydurg creek, estuary and stony waste.

Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

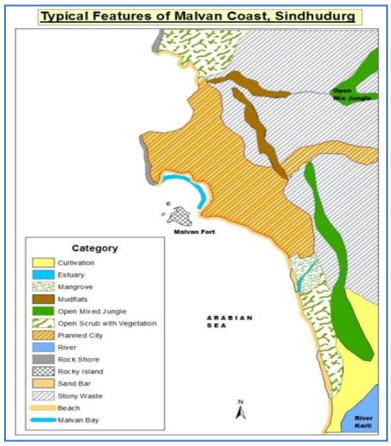
2) *Malvan:* Malvan is located between the mouth of the Achra in the North and the mouth of the Karli in the south consist mainly an open sandy roadstead intersected by Kolam and Kalavali creek. Malvan is broken and irregular; a series of rugged hill and rich valleys. Long sand bar is present in the coast. This rich, ecologically important area of Malvan coastal water was designated as Malvan Marine Sanctuary (MMS) in 1987. One of the most important features of Sindhudurg coast (Malvan) is the coral reef that has been recorded at Vengurla Rocks Island, Malvan and Angria bank. The occurrences of coral reef off the West Coast have been reported by Scientists from NIO (National Institute of Oceanography) and the Central Marine Fisheries Research Institute. The corals are very vibrant in this area and extending beyond Sindhudurg.

Map 3: Typical Features of Malvan coast, Sindhudurg



3) *Vengurla:* Vengurla about twenty-two miles long and nowhere more than five broad has in the north a succession of high bare rocky plains and narrow valley. The hillsides have their upper slopes well clothed with brush wood and lower slaps covered with coconut and bettlenut palms. Much of the south consists of low open belts of sand. Nine miles to the north west of Vengurla lay the Vengurla rock of burnt island a group of rocky islets stretching about three miles from North to south and one mile from east to west.

Map 4: Typical Features of Vengurla coast, Sindhudurg

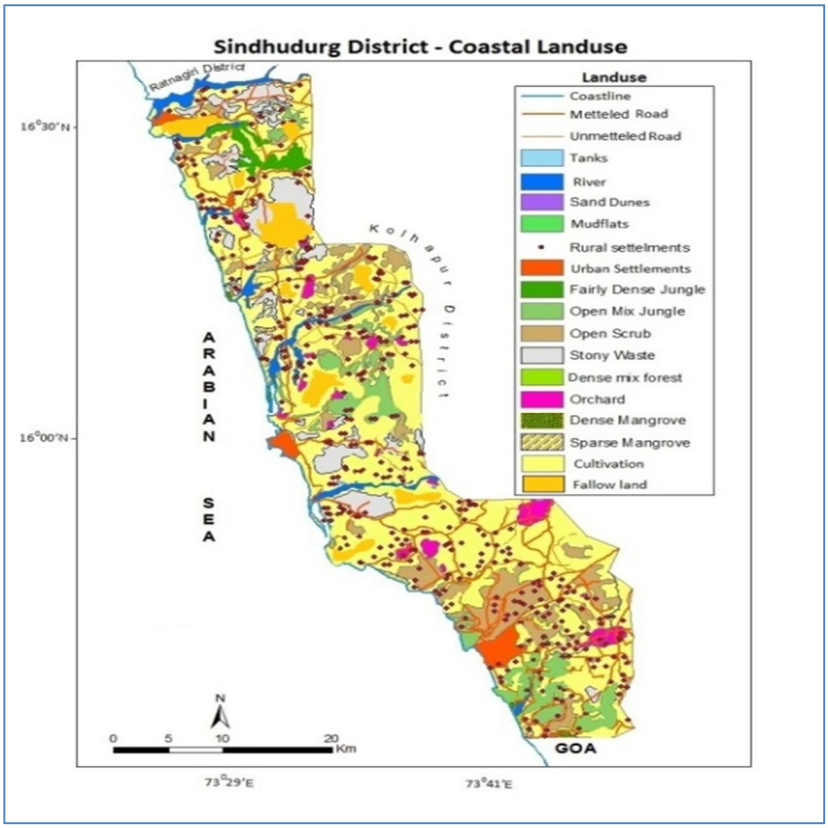


D. Landuse Analysis of Sindhudurg Coast

An attempt is taken to prepare a Land Use Map based on remotely sensed data and imageries with the help of GIS after analyzing the geomorphic features of the Sindhudurg coast. Essentially, it seeks to integrate a large range of spatial information including - urban services, infrastructure, land uses and other socio economic services. With the help of satellite imageries and digital techniques, all the required information are integrated and land use map has been prepared. Along with satellite imageries, toposheet of 1:50,000 scale are used. For the preparation of the landuse map for coastal area, taking administrative unit (Taluka boundary) was

Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

not considered, as the area is extension of vast geomorphologic features. Thus, coastal landuse is map is prepared by taking on an average a zone extending upto 15 km from the coastline towards interior. Fourteen classes have been derived as follows which is presented in the map (Map 5)



Map 5: Coastal Landuse of Sindhudurg Coast

Table 2: Classification of landuse categories of Sindhudurg coast.

Category	Percentage
Cultivation & Rural Settlement	36.3
Open Scrub	15.3
Fallow	11.8
Stony Waste	11.6
Open Mix Jungle	5.2
River	5
Fairly Dense Mix Jungle	3.8
Orchard	3
Dense Mangrove	2.8
Urban Settlements	2.2
Sparse Mangrove	1
Sand dunes	1
Mudflats	1

Source: Computed by Author in ArcGIS based on Map 5

Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

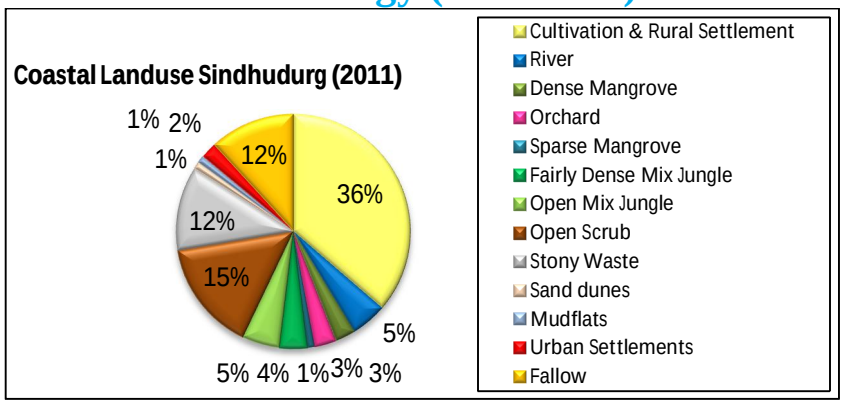
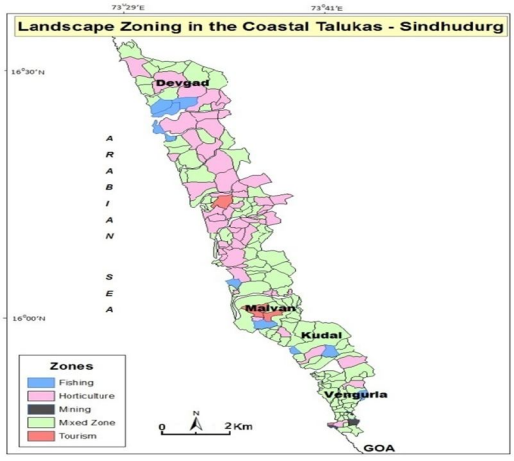


Fig 2: Category wise distribution of landuses in Coastal Sindhudurg

It is seen from the above Table 2 and Map 5, that nearly 37 percent of the area is occupied by cultivation and rural settlements. Here rural settlements are intermixed with the cultivable area, thus both of them need to be considered together. Open scrub occupy nearly 15 percent of the area, which are nearly concentrated in the southern part of the district in Vengurla taluka. Fallow land, which occupies nearly 12 percent of the total area, is distributed unevenly over the entire district. Stony waste comprises of 12 percent of the area, spreading mostly in Devgad and Malvan talukas. Different categories of forest are seen occupied in the central and southern part of the district. Fairly mix jungle occupies 4 percent of the area of the district and open mix forest occupies 5 percent. Vegetation is also classified into the coastal forest in form of Dense Mangrove (3 percent) and Sparse Mangrove (1 percent). Orchards (3 percent) are noted in Malvan and Vengurla taluka. Other landuses such as sand dunes, mudflats, beaches and tanks occupy insignificant area.

E. Landscape Zoning of Sindhudurg Coast

Landscape level zoning of Sindhudurg district is carried out with the help of occupational data available for villages from Devgad and Malvan taluka from Bio-diversity Action Plan for Maharashtra. For the landscape zoning of the coastal area 200 coastal villages were demarcated within 10 km from the coast based on their affinity to the seashore. (Devgad - 47, Kudal - 09, Malvan - 73 and Vengurla - 71). The occupational characteristics for talukas of Vengurla and Kudal are identified from Census Record (2011). Based upon core occupational pattern, the villages are classified under zones - Fishing, Horticulture, Mining, Tourism and those villages having mixed functions were classified under mixed zone.



Map 6: Landscape zoning in the coastal talukas -Sindhudurg district

The most important zones identified, according to the occupational pattern and resource availability fishing, agro-horticulture, mining and tourism. Due to diversification of agriculture, the prime food crops are replaced by horticulture in the coastal uplands of Sindhudurg district. Horticulture is introduced in coastal villages because the land is mostly wasteland where food crop cultivation

is not effective. Orchards, particularly of Mangoes are increasing in Devgad and Malvan talukas.

Apart from these two functions fishing has been identified as the second largest activity in the region. Fishing villages are identified with the help of bio-diversity action plan. Fishing activity was divided in the category of coastal, creek and inland fishing.

Tourism is gathering momentum, particularly in the taluka of Malvan. Scuba diving, snorkeling and coral watch are major tourism activity practiced at Sindhudurg coast. Tourism zones are prominently located at Malvan. Vengurla also shows potential of this cultural resource because of its proximity to Goa (an old tourism destination). However, Vengurla taluka is also identified with few villages (Redi, Shiroda, Mhartale, Huda and Gavatale) under mining zone. Ironore mining is prominent here. This is creating ecological imbalance because of the extraction of the top soil. Environmental issues are noted because of this activity. In this zone, agriculture and horticulture is becoming a rare phenomena.

Other coastal villages of Devgad, Malvan, Kudal and Vengurla, which are not classified under these three zones, are having multiple resources and occupational activities. Specific zoning in such areas is not possible, because of the presence of mixed occupational activity. Thus, these villages are categorized into 'mixed zone'.

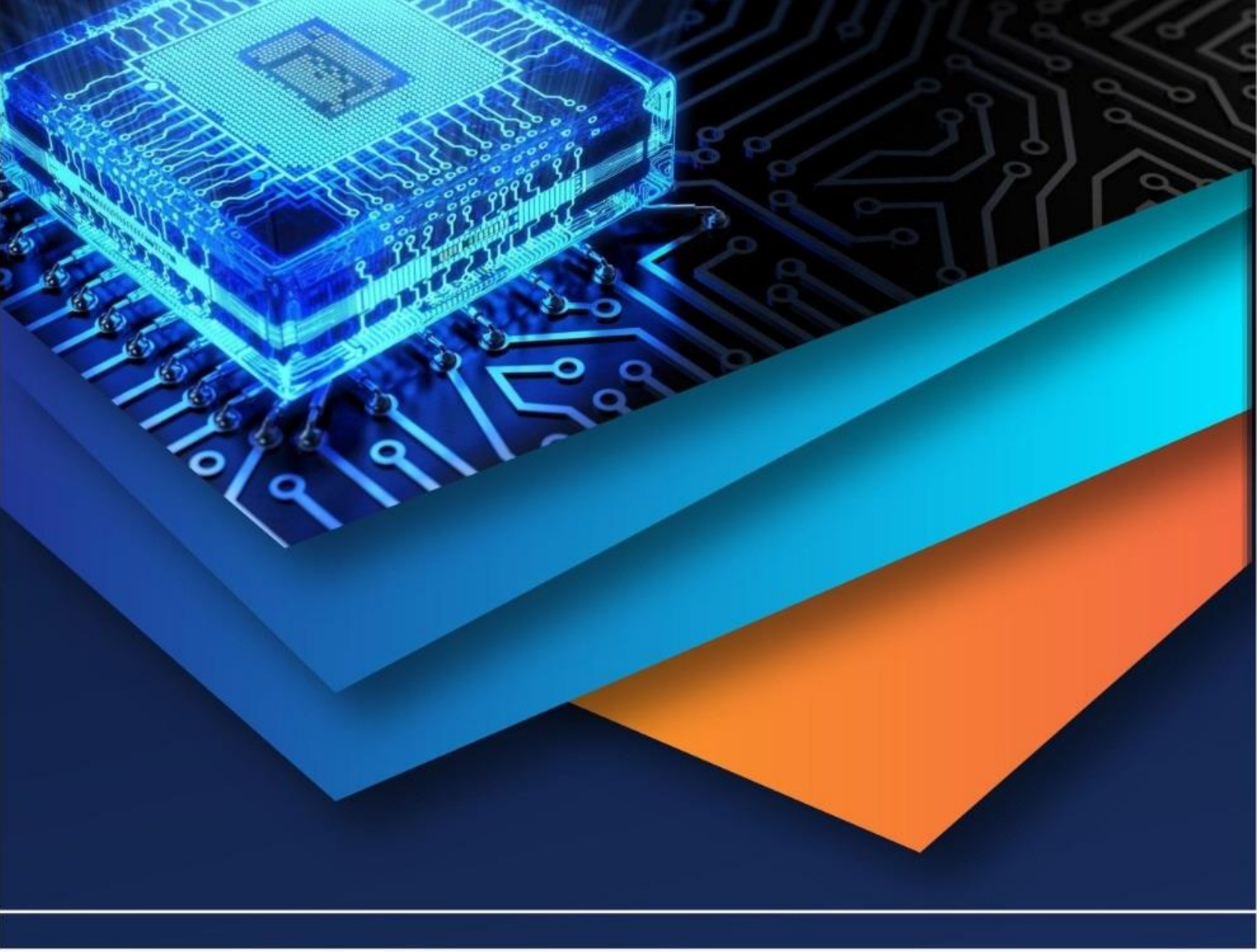
VI. CONCLUSION

The systematic analysis of the various natural resource components, available in the coastal area of South Konkan more specifically Sindhudurg district, have been integrated and brought in a composite frame for the preparation of a micro level landuse plan. This landuse plan is an essential input for land administration and management for any critical area like Sindhudurg coast.

The coastal features are unique characterize by bays, estuaries, rock cut platform, series of island mainly in Vengurla and Malvan coast, some of island are big and away from the coast namely Angria bank. These estuaries and island are the home of Biodiversity elements like fish, turtle, and migratory birds. Infact, Malvan is a well known in India and internationally acclaimed for its biodiversity. Vengurla Malvan along with Angria bank is the rich ground for coral breeding. It provides a very rich ground for fish breeding. Fish is one of the most important natural resource in this region. However, there is a general decline in fish production in Maharashtra but Sindhudurg is steady and its growth rate is positive. In 2009-10, the fish production was 20136 metric tons and 2011-12 it became 24,563 metric tons. Observation shows that outside the coastal area, horticulture is the principal economic activity for the resident population. The Land is infertile composed of lateritic. This is a natural resistance can be gainfully used as horticulture. Mango is the predominant fruits products.

REFERENCES

[1] Mukhopadhyay, T. (2015), "Land Administration And Management Through Landuse Planning (Case Study Of Coastal Talukas Of Sindhudurg District)", Emeritus Fellowship Project, Sponsored by University Grants Commission, New Delhi
[2] Malvan, Konkan: Evidence for higher sea level during the Late Tertiary (Neocene) along the west coast of India: Curr. Sci.:86(2); 2004; 335-340.
[3] National Biodiversity Action Plan (2008), pages 56-61
[4] Sahstrabuddhe Y.S., Geography Section ‘Ratnagiri District Gazetteer, Govt. of Maharashtra, Bombay, 1962, p. 13-16.
[5] Nayak, S. et al. 1996. IRS-1C applications for coastal zone management. Current Science, 70 (7): pp. 614-617.
[6] Nayak, S. and Bahugunam A. 2001. Application of remote sensing data to monitor mangroves and other coastal vegetation of India. Ind. Jour. Of Marine Science, 30 (4): pp.195-213.
[7] United Nations Development Programme: India, (2012), "Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in the Sindhudurg Coast, Maharashtra, India".
[8] Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in Sindhudurg Coast in Maharashtra (January 2011 - December 2016), UNDP, India.
[9] Tourism Survey for the State of Maharashtra April 2014 to March 2015, submitted to Maharashtra Tourism Development Corporation Limited. (MTDC), Mumbai by Datamation Consultants Pvt. Ltd. New Delhi



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY