

MAPPING LAND USE AND LAND COVER CHANGES BETWEEN 2004-2015 IN SELECT SEA TURTLE NESTING BEACHES OF PUDUCHERRY, INDIA

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ABSTRACT-Puducherry, is a small Union Territory of India, located along the southern east coast of India with coastline of 45 km. This coastline is being used for nesting of sea turtles, especially Olive Ridley and Green Sea turtles, but the coastline was observed as highly dynamic and rapidly changing probably due to anthropogenic pressures in the recent past. Therefore, this study aimed to detect the land use and land cover change in the recent past and its impact on the nesting beaches of sea turtles. Land use/land cover patterns between 2004 and 2015 were visually interpreted and assessed for its changes. High sporadic nesting of sea turtles was reported on the beaches of Nallavadu village before 2004 but due to significant changes in the land use of adjoining areas of the beach that resulted in decline of nesting of sea turtles. Larger portion of agricultural land adjoining to nesting beach was converted into aquaculture and built up areas that deterred more sea turtles use the beaches for nesting. Similarly, another fishing village Vanjiur where 116 hectares of agriculture land along nesting beach was converted to aquaculture and built up has resulted in decline of nesting of sea turtles. It was found that arable lands along turtle nesting beaches were shrunk due to demand from other developing sectors such as aquaculture, tourism and real estate. Therefore, we propose to declare remaining critical sea turtle nesting beaches of Puducherry such as beaches between Nallavadu and Moorthikuppam villages, and beaches around Arasalar River, Karaikal as 'Community or Conservation Reserves'. These community or conservation reserves should be managed with active participation of local communities for the long term conservation of sea turtles in Puducherry.

Keywords: Land use land cover, Puducherry, Coastal, Arable, Sporadic

1. INTRODUCTION

Puducherry is one of the most densely populated Union Territory in India. Along with 45 km long coastline, it has a very wide range of coastal ecosystems such as estuaries, lagoons, mangroves, backwaters and sandy beaches. Puducherry is well known for its sea turtles nesting beaches¹. Sporadic or solitary nesting of Olive ridley (*Lepidochelys olivacea*) is common here from November to February¹. Anthropogenic activities are known to alter sensitive coastal ecosystems and Puducherry is not exception to this. The beaches of Puducherry have been facing threats of erosion owing to natural disasters, pollution, exploitation and anthropogenic activities². The Nallavadu beach of Puducherry had reported an average of 100 nests of Olive Ridley every year before 2004 but this nesting number has now reduced to 30 to 40³. Local communities believe that the land use changes along the coast are not conducive for more nesting. Agriculture was one of the most important occupations for Puducherry's population and about 45% of the total population of the Union Territory directly or indirectly depends on agriculture, largely paddy (*Oryza sativa*) cultivation. Coastal areas are highly dynamic and very important for human beings. Landforms evolve in response to a combination of natural and anthropogenic processes. Land is the most important natural resources since all life and developmental process are dependent. Land cover is the assemblage of biotic and abiotic component on earth⁴. Land cover reflects the biophysical state of the earth's surface such as land, vegetation cover and water. Land use refers to man's activities on land which are directly related to the land. Beaches and shorelines are indicator for the healthy quality of life along the coast and also provide buffers for storms and critical habitats for many species of plants and animals⁵. Hence for maintaining natural resources it is necessary to monitor land use and land cover changes.

The land loss and anthropogenic impact alter sensitive coastal ecosystems and natural coastal processes such as tides and currents. The beaches of Puducherry are under immense pressure due to various developmental

activities which are in operation in close proximity to the coastline, including the Puducherry port. Complex and diverse types of natural disasters that occur along coastal zone bring in physical, chemical and biological changes in fragile coastline. The main objective of the present paper is to analyze land use/land cover changes in Vanjiur and Nallavadu beaches in Puducherry, India in the past eleven years and to identify the main factors of change.

2. RESEARCH ELABORATION

Puducherry is located on the Coromandel coast between 11°52'56" N and 79°45'00" E and 11°59'53" N 79°52'43" E. It is bounded by the Bay of Bengal on the East and on the other three sides by the Cuddalore and Villupuram district of Tamil Nadu State ⁷. The coastal zone of Puducherry comprises newer and older dunes including saline areas of clayey texture ⁷. There are no hills or forests in this district. Vanjiur is a village located in the Karaikal district of Puducherry (10°51'48.69" N, 79°50'51.26" E). There are 4 beaches in and around Vanjiur mainly Mahabalipuram, Adyar, Thiruvanniyur and Golden Beach. Nallavadu village (11°51'16.37" N, 79°48'41.41" E) is coastal sand dune which is dynamic but fragile buffer zones of sand and vegetation ⁵. It is also one of the major fishing villages in Puducherry. Nallavadu is bordered by Chunnambar River. Coastal dune flora from Nallavadu consists of native species and invasive species such as *Acalypha indica*, *Casuarina equisetifolia*, *Catharanthus roseus*, *Ipomoea pes-caprae* ⁶.

3. METHODOLOGY

Landsat 8 image of 2015 and Landsat 4 image of 2004 was used for preparing land use maps of the study area. Images were selected based on two criteria – dry season (to ensure cloud free images) and low tide time during satellite pass (to delineate the coastline appropriately). Since the area considered for this study was small, it was possible to use the visual interpretation technique in the GIS domain. The study area was classified into 5 land use types – beach, agriculture, aquaculture, built up area and water body. Post classification, 'matrix' function in ERDAS Imagine 2014 was used to generate a change map for both villages between 2004 and 2015 and areas with changes in land use/cover were identified. Area of each category was calculated.

The satellite images were analyzed based on visual interpretation keys to prepare land use and land cover maps of year 2004 and 2015. During the last eleven years the prominent changes have occurred in land use and land cover of the study area. The different categories of land use and land cover in 2004 and 2015 are compared as shown in Table 1 and 2. In both the study areas agriculture dominated the land use cover. It was found that the main driving factors for change in the region are aquaculture and built up areas, which primarily use the agricultural land for conversion.

4. RESULTS AND DISCUSSION

In the year 2004, majority of coastal lands along Nallavadu village (Fig. 1.2) of Puducherry i.e. 62.75% were used for agriculture, followed by 18.67% of land for built up, 13.28% as water bodies, 4.80% as beach and 0.47% for aquaculture. Similarly, 82.58% of land used for agriculture, 9.80% for built up, 3.31% as beach, 3.16% as water bodies and 1.13% as open land in Vanjiur coastal village (Fig. 1.4). It was observed that built up and aquaculture area expanded significantly from 2004 to 2015 in both the villages (Tables 1 and 2). In the year 2015, agriculture dominated 33.37%, followed by built up 10.36%, water body 9.39%, beach 3.39%, aquaculture 0.24% in Nallavadu whereas in Vanjiur, agriculture dominated 60.9%, followed by built up 15.46% and aquaculture 12.65%, beach 3.93%, water body 3.28% and open land 1.45% respectively.

A considerable increase in built-up land and aquaculture has taken place as well as a huge decrease in agricultural land during the study period. Agricultural land and beaches were converted into built up and aquaculture areas. 24% of agricultural area in Nallavadu and 27.4% in Vanjiur were compromised for aquaculture and built up areas. Built up areas rose by 78% in Vanjiur and 34% in Nallavadu. Percent rise for aquaculture in Vanjiur could not be calculated as there was no land under aquaculture in 2004, while in Nallavadu, percent rise of aquaculture was 500%. As the coastal population continues to grow, there is remarkable increase in built up land and decrease in agricultural land.

Complex and diverse types of natural disasters processes that occur along coastal zone bring in physical, chemical and biological changes in fragile coastlines. Managing coastal land loss is even more critical as coastal population increases ⁷. Pollution of sea front due to municipal and industrial wastes is increasing intense conflict between development pressure and health of the coastal environment. Beach erosion and destruction of mangroves are primary issues along Puducherry coastline ⁸. The erosion of this coast has resulted in the loss of beaches including 200 acres of coastal land ⁹. Construction of sea walls and harbor had also caused loss of about

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9 million cubic meter sand¹⁰. It was found that arable lands along turtle nesting beaches were shrunk due to demand from other developing sectors such as aquaculture, tourism and real estate. Therefore, we propose to declare remaining critical sea turtle nesting beaches of Pudcherry such as beaches between Nallavadu and Moorthikuppam villages, and beaches around Arasalar River, Karaikal as 'Community or Conservation Reserves'. These community or conservation reserves should be managed with active participation of local communities for the long term conservation of sea turtles in Puducherry.

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