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Gitanjali Bharali

THESIS ABSTRACT

The aim of this thesis is to examine and understand the coastal landscape of Murud Taluka in a regional scale and Murud–Janjira in detail and the relationship between natural resources, the historic precinct and the tourism of the place.

This research examines the historical background of the konkan coast from Chaul to Rajapuri creek, its value, the diversity of ecological habitats and the important tourist destinations of the entire stretch. Murud – Janjira is a small tourist town in the Raigad district of Maharashtra . An analysis is made regarding the history of the Murud Janjira region and its valuable resources and why it has became a tourist destination over an era.

The various chronological landscape layers of Murud taluka are analyzed and the problems and threat of the region are being indentified. There is a remarkable diversity of coastal landscapes in Murud , ranging through rocky cliffed coasts, sandy beach , wadi lands, sandflats and mangrove , woodlands, scrub lands, forest and the coastal plain , Highlighting past changes at the coastline such as erosion, siltation, land movements and fluctuations in sea level and also the ecological changes like the threatren species of plants and animals in the entire coast.

some features of the Murud coast have national and global research significance. Some for understanding sea level changes, coastal evolution and management by providing present analogues of past landforms.

Thus the paper tends to give a solution how to conserve the natural resources of the place together with the historic precinct and make a linkage between them. This program has contributed to preserving valuable habitat for native plants and animals while creating some unique nature based recreational opportunities for residents and visitors. This plan seeks to encourage sustainable recreation in our natural areas and at the same time ensure that we protect our remarkable biodiversity.

Abstract

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CHAPTER NO.1

1 Introduction

1.1 Background

India has a vast coastline of about 7516 km length spanning 13 maritime mainland states and union territories, with diverse coastal and marine ecosystems, supporting nationally and globally significant biodiversity. The coastline also supports almost 30% of its human population who are dependent on the rich exploitable coastal and marine resources. (Sivakumar, 2013)

The coastline of the Bay of Bengal and Arabian Sea continues to be a rich fishing ground in the South Asian region, and India is one of the world's largest marine product exporting nations. Marine ecosystems such as estuaries, coral reefs, marshes, lagoons, sandy and rocky beaches, mangrove forests and sea grass beds are all known for their high biological productivity, and they provide a wide range of habitats for many aquatic plants and animals. They also provide important food resources and innumerable ecological services to human beings. Therefore, sustainability of these fragile ecosystems needs to be our primary concern. Moreover, human activities such as destructive fishing, shipping, coastal development and discharge of untreated effluent from industries have caused considerable damage and pose a severe threat to coastal and marine biodiversity. In addition to these, global warming due to climate change also poses a major challenge to the marine biodiversity of India. It is known that there is a mosaic of habitats such as coral reefs, estuaries, intertidal mudflats, mangroves, backwaters, sand dunes, rocky shorelines, sea grass meadows and lagoons. (Sivakumar K. R., 2014)

But detailed studies on the coastal, its natural resources and its ecological prospective of the Indian mainland are lacking. It is obvious that every sensitive zone have its own ecological values which we have to retain. Restore and revitalized of some of the coastal areas are required where the human interventions are increasing rapidly, by

conserving the cultural values of the place and the entire ecology for developing a sustainable future.

The dissimilarities between the west and east coasts of India are remarkable. The west coast is generally exposed, with heavy surf and rocky shores and headlands, whereas the east coast is generally shelving, with beaches, lagoons, deltas and marshes. The west coast is a region of intense upwelling, associated with the southwest monsoon (May– September). (Bose, 2013)

In this paper, an effort has been made to understand the western coastal landscape of Murud taluka, Raigad district, Maharashtra , in a regional scale and to understand in detail the Murud-Janjira region and revitalization of the coastal landscape is to bringing back to life, the city unique and diversified spaces, by conserving and protecting the natural resources and the historic precinct available of the region. It is basically enhancing the entire environment of the place and making it useable to the common people by some sustainable and local traditional means.

1.2 Problem statement

The Maharashtra coast (popularly known as Konkan), harbors has a significant diversity of natural resources. This region has endowed with number of natural and manmade assets that have attracted attention of scientists and communities. Konkan constitute a narrow belt between the western mountain range (regionally known as Western Ghats) and Arabian Sea. (Mhatre, 2001)

Among natural threats, storms, waves and tsunami particularly cyclones are major stresses on marine ecosystems. Varied human activities which are a cause for concern over and above the natural disturbances include: runoff and sedimentation from developmental activities (projects), eutrophication from sewage and agriculture, physical impact of maritime activities, dredging, destructive fishing practices, pollution from industrial sources and oil refineries of anthropogenic disturbances. (Delong, 1996)

Maharashtra has a coastline of 720 km, of which about 320 km (about 44%) is subject to erosion. Coastal urban areas have been severely affected by erosion, partly due to clearance of mangroves and associated vegetation along the shoreline and also due to

construction of offshore and coastal infrastructure. Rural coastal regions are hence adversely affected by erosion. This has increased the vulnerability of resident coastal communities to natural disasters (such as cyclones) since their dwellings are along the fringes of the shoreline. (Verma et. al. 2004)

1.2.1The main threats of Konkan coast are

1.2.1 (a) Tourism : Tourism is an threaten to the coastal area. In many areas, massive new tourist developments have been built and developed in the coastal areas – like resorts, water font development , Overdevelopment for tourism has the same problems as other coastal developments, but often has a greater impact as the tourist developments are located at or near fragile marine ecosystems. (Lal Mukherjee, 2013)

For example:

1) Mangrove forests and sea grass meadows have been removed to create open beaches
2) Tourist developments such as piers and other structures have been built directly on top of coral reefs
3) Nesting sites for endangered marine turtles have been destroyed and disturbed by large numbers of tourists on the beaches

1.2.1 (b) Fishing : Fishing is a major activity in the fishing villages situated along the 8,000 km coastline of India. About one million people are occupied full time in marine capture fisheries. Commercial and unsustainable fishing activities pose a threat to marine biodiversity. (Lal Mukherjee, 2013)

1.3 Site Area

The proposed study incorporates the Murud – Janjira area of Raigad district , Maharashtra as the study area. The hills and forests within this boundary have been taken into consideration for the present study. The area covers an area of 100 km² and and covered 1 municipal ward . Murud is a taluka city and a municipal council in Raigad district in the Indian state of Maharashtra. Situated at a distance of 42 km (26 mi)

from Alibag, Murud is a tourist destination. The urban area is around 6 sq.km and has a population of about 12,551 (Census of India, 2011).

The city enjoys a tropical climate. Murud is located at 17.77°N 73.12°. It has an average elevation of 159 metres (521 feet).The annual rainfall ranges from 16,387 mm. to 26,219 mm. The average temperature in Murud is 25.7 °C. The rainfall here averages 850 mm. Murud Janjira enjoys a salubrious climate. It is very pleasant all through the year with cool breeze blowing all day long. During summers (March to June) the temperature never rises beyond 32°C. Winters (November to February) are cool and the temperature is around 15°C on an average. Monsoons are accompanied with medium rainfall. (climate data)

Map 1: Google Map showing the location of the study region

1.4 Aim

To revitalize the coastal area of Murud by conserving the natural resources and connecting the natural ecosystem with the historic structures and the city tourism.

1.5 Objectives

- Study the entire region, and to understand the landscape character of Murud region.
- Identifying the main potential areas in the study region that need to be revitalized.
- To map the existing tourism pattern to identify tourist sites
  Overlay of existing tourism pattern on the physiography of the region.
- Identifying the main issues and the eco sensitive area that needs to be conserved.
- To give proposals for the protection of the natural ecological of the coastal landscape , and strategies for beach improvement and improve the existing tourist and enhance new destinations.

1.6 Methodology

FIRST STAGE

COLLECTION OF DATA

- **Information from, books, articles ,maps district gazetteer.**
- **Information from site survey and inventories**
- **Collection/ generation of various Topography maps like geology, geomorphology, soil , geohydrology, hydrology , slope, and the vegetation, landcover understanding the landscape character of the region.**
- **Creating a base map for the entire study region. Calculating the area**

SECOND STAGE
MAPPING

- **Site visit and mapping the area to identify the main potential areas of the site**

THIRD STAGE
UNDERSTANDING THE TOURISM PATTERN

- **Data collection from various departments regarding site survey and questionnaire from 100 people regarding the region. To understand the tourism potential of Murud and its impact on the entire region**

FORTH STAGE
ISSUES

- **Overlying and Comparison of the chronological layers – thought map**
- **Pointing out the issues through site visit and photographs.**

FIFTH STAGE
PROPOSAL

- **Proposal for the conservation and protection of the coastal area**
- **Like erosion, mangroves depreciation, protection of the coastal area, special concern on the Murud beach , its development.**

1.7 Need of the Study

Sited on the Konkan strip, bordered by the Sahyadri mountain range. The varied typology of the built and natural heritage and its historical, cultural, ecological significance within this region is the consequence of human interventions. Due to its rich Maritime Tradition, trade and commerce flourished from ancient times, there need to preserve the biodiversity and natural resources of the region on which the local inhabitants live on, agriculture farmers.

1.8 Outcome of the study

This study provides understanding of a coastal landscape together with the cultural values and the tourism of a region. The study also helps to understand the geology , hydrology, soil and vegetation of the region. Analyze and access the nature and severity of threats of coastal, ecological, environment. Provide appropriate conservation measures to the natural resources and developed a sustainable tourism of that region which not only will protect the natural and the historic precinct but also make a linkage between them and will help in developing the economy of the region. ESA/ CRZ violations, excess tourism, haphazard development is changing the character of the area, most important biodiversity and ecology of the area is in danger, which is requiring a sustainable management plan.

1.9 Scope and Limitations

The geographical extent of the area surveyed includes the 51 km long stretch from Chaul to Rajapuri Creek and comprises of sites of historical, architectural, cultural and natural importance which form a part of the coastal landscape .Due to the limitation of timing the area of study has been restricted to the coastline / coastal front settlements with their significant cultural and natural resource components. The Extensive primary surveys has been undertaken on the focus area of Murud-Janjira , which is 10 km stretch and analysis of the area has been done on the basis of secondary data and primary surveys. Major limitation is that, survey maps of this area are not available, as the entire stretch comes under Coastal Restricted Zone. The topography of the area has been analyzed on the basis of the Google maps.

CHAPTER NO.2

2. Literature study

2.1 Coastal Landscape

Figure 1: A pictorial representation of a coastal landscape

The coast is a strip of soil between the mainland and the sea. And coastal landscape is characterised by low, wind-swept, sand dunes, the bays, creeks, the beach, the mangroves, fort and the wadis .It is this diversity and splendour of the coastal landscape that makes it an asset to be conserved and appreciate the beauty as well. (Eniscuola , 2011)

2.2 Revilalization of a Coastal Landscape

Revitalized of a coastal landscape is to bring back to life the entire region, by identifying the issues and finding out method to conserve and protect it and at the same time understanding the importance of the region , the culture, the people and even improve the economic condition of the people by some traditional means. (Kushwaha et. al. 2013)

2.3 Coastal landform

Coastal landforms created by erosion include headlands, bays and cliffs. Landforms created by deposition include spits, salt marshes and beaches. (Verma et. al. 2004)

2.4 Types of Coast

Although every coastline is a unique creation of ocean waves acting on distinctive land masses, we can identify seven important types of coasts. (Blair 1999)

2.4.1 Coastlines of submergence

Coastlines of submergence are formed when the rising sea level partially drowns a coast or when part of the crust sinks. This group includes Ria coasts and fiord coasts. (jea, 2016)

2.4.1.1 Ria coast

Coastlines of submergence include Ria coasts and fiord coasts. A Ria coast is formed when a rise of sea level or a crustal sinking (or both) brings the shoreline to rest against the sides of river valleys previously carved by streams. Because the new embayment's are fed fresh water from the streams the valleys formerly contained, they become estuaries. (Types of Coastlines)

2.4.1.2 Fiord Coast

The fiord coast is similar to the Ria coast. Steep-walled fiords are created from submerged glacial troughs rather than from submerged stream valleys, as in the case of Ria coasts. (Types of Coastlines)

Figure 2: Ria Coast

Figure 3: Fiord Coast

2.4.1.3 Dalmatian coast

Where mountains run parallel to the longitudinal coast. the submergence produces long narrow inlets with a chain of islands parallel to the coast, The elongated islands are the crest and the narrow sounds are the former ranges. (Types of Coastlines)

2.4.1.4 Estuarine coast

An estuary is a partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it, and with a free connection to the open sea. Mouths of the river are drowned so that funnel shaped estuaries are formed.

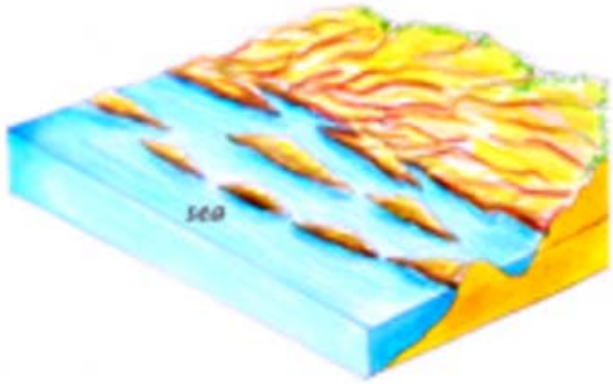


Figure 4: Dalmation Coast

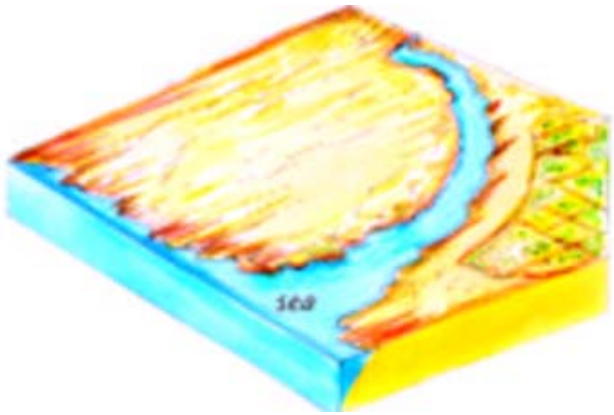


Figure 5: Estuarine Coast

2.4.2 Coastlines of emergence

Another group of coastlines are formed by the process of emergence, when submarine landforms are exposed by a falling of sea level or a rising of the crust. This group includes barrier-island coasts, volcano coasts, delta coasts, fault coasts, and coral-reef coasts. (Types of Coastlines)

2.4.2.1.Barrier - island coast

The barrier-island coast is associated with a recently emerged coastal plain. A barrier island is a low ridge of sand, lying a short distance from the coast, that is created by wave action and increases in height as coastal winds fortify the island with dunes. Behind the barrier island is a lagoon—a broad expanse of shallow water in places

largely filled with tidal deposits. Characteristic gaps, known as tidal inlets, along the barrier island connect the lagoon with the ocean.

Strong currents flow back and forth through these gaps as the tide rises and falls. New inlets are formed in severe storms and are then kept open by the tidal currents. In many cases, these inlets are later closed by littoral drift. (Types of Coastlines)

2.4.2.2 Delta coasts

The deposit of clay, silt, and sand made by a stream or river where it flows into a body of standing water is known as a delta .The sediment is deposited because the current is rapidly slowed as it pushes out into the standing water. The river channel divides and subdivides into lesser channels called distributaries. The coarser sand and silt particles settle out first, while the fine clays continue out farthest and eventually come to rest in fairly deep water. When the fine clay particles in fresh water come into contact with salt water, they clot together into larger particles that settle to the seafloor.

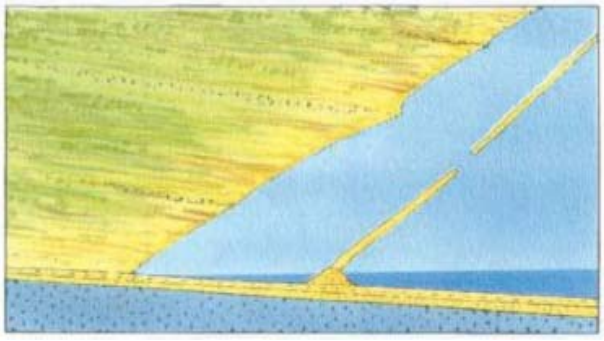


Figure 6: Barrier – Island Coast

Figure 7: Delta Coast

2.4.2.3 Volcano and coral-reef coasts

Volcano coasts arise where volcanic deposits—lava and ash—flow from active volcanoes into the ocean. Wave action erodes the fresh deposits, creating low cliffs. Beaches are typically narrow, steep, and composed of fine particles of the extrusive rock. Coral-reef coasts are unique because the new land is made by organisms—corals and algae. Growing together, these organisms secrete rock-like deposits of

carbonate minerals, called coral reefs. As coral colonies die, new ones are built on them, accumulating as limestone

2.4.2.4 Fault coasts

The final type of coastline is a fault coast. Faulting of the coastal margin of a continent can leave the shoreline resting against a fault scarp. A classic example occurs on the northern coast of Chile, where the Andes Mountains rise from the Peru–Chile trench. In central California, near the coastal town of Lucia, the continental shelf is very narrow, suggesting that the marine cliffs there are the result of faulting. (Types of Coastlines)

Figure 8 : Volcano and coral reef Coast

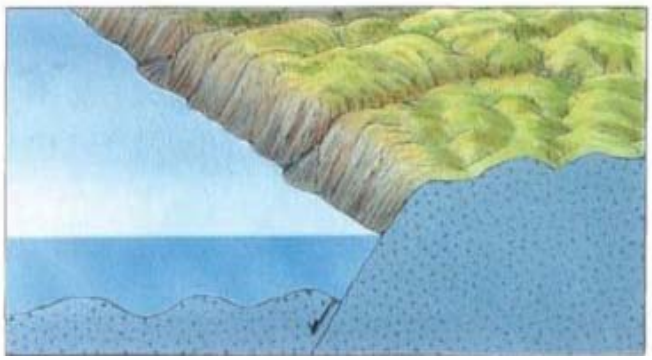


Figure 9: Fault Coast

2.5 Coast of India

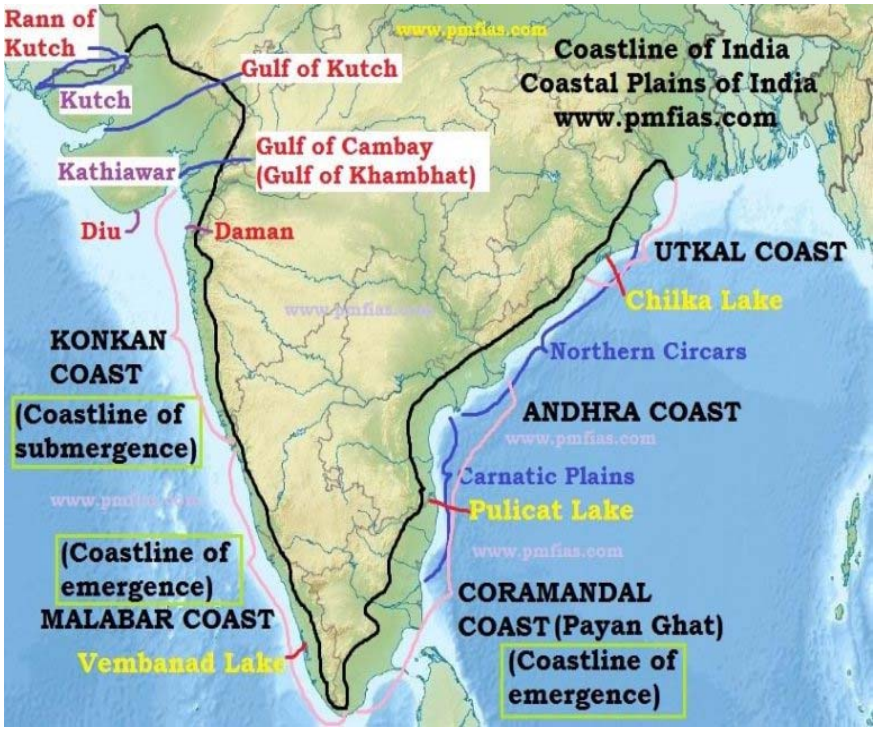
India has a coastline of 7516.6 Km [6100 km of mainland coastline + coastline of 1197 Indian islands] touching 13 States and Union Territories (UTs).The straight and regular coastline of India is the result of faulting of the Gondwanaland during the Cretaceous period. As such the coast of India does not offer many sites for good natural harbors.

2.5.1 East coast of India

Lies between the Eastern Ghats and the Bay of Bengal.It extends from the Ganga delta to Kanniyakumari. It is marked by deltas of rivers like the Mahanadi, the Godavari, the Krishna and the Cauvery. **Chilka lake** and the **Pulicat lake (lagoon)** are the important geographical features of east coast. (Manjunath and Bhaskar Joshi 2012).

2.5.2 West coast of India

- The west coast strip extends from the Gulf of Cambay (Gulf of Khambhat) in the north to Cape Comorin (Kanniyakumari).
- Starting from north to south, it is divided into (i) The Konkan coast, (ii) The Karnataka coast and (iii) The Kerala cost.
- It is made up of alluvium brought down by the short streams originating from the Western Ghats.
- It is dotted with a large number of coves (a very small bay), creeks (a narrow, sheltered waterway such as an inlet in a shoreline or channel in a marsh) and a few estuaries. {Marine Landforms}
- The estuaries, of the Narmada and the Tapi are the major ones.
- The Kerala coast (Malabar Coast) has some lakes, lagoons and backwaters, the largest being the Vembanad Lake. (Manjunath and Bhaskar Joshi 2012).



The east coast of India, especially its south-eastern part (Tamil Nadu coast), appears to be a coast of emergence.

The west coast of India, on the other hand, is both emergent and submergent.

The northern portion of the coast is submerged as a result of faulting and the southern portion, that is the Kerala coast, is an example of an emergent coast.

Map 2: Map showing the Coastland of Submergence and coastland of Emergence

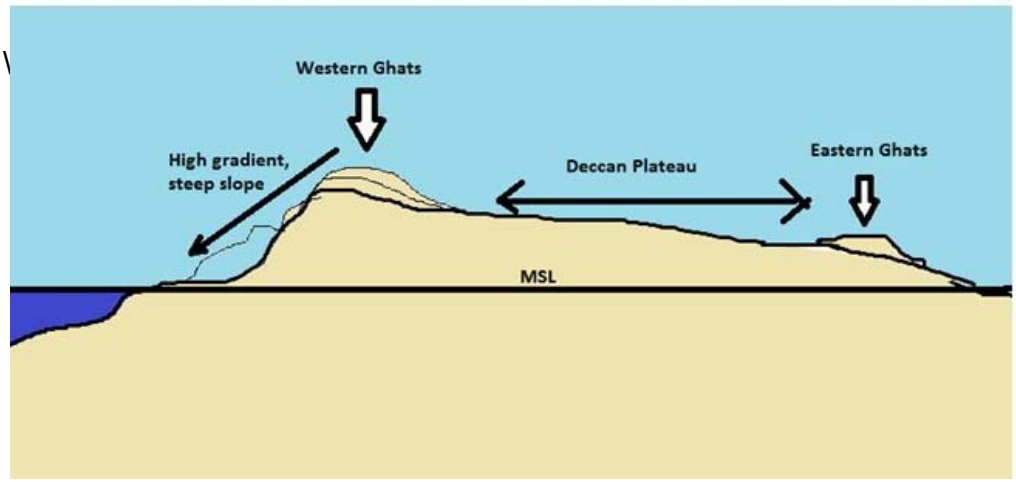


Figure 10: Figure showing the reason of Western Ghats river doesn't form a delta

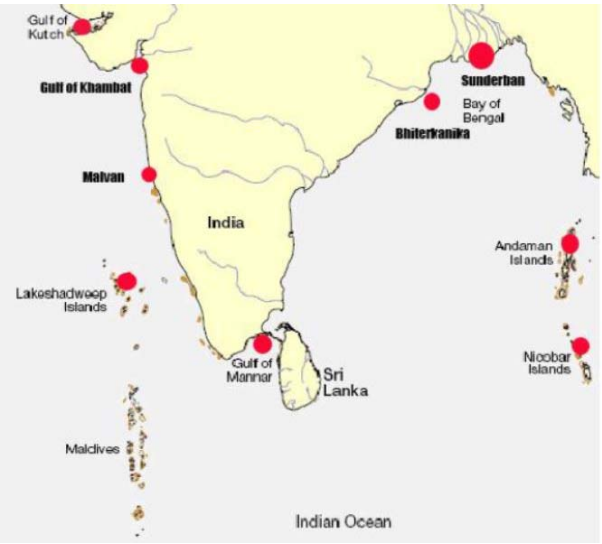
2.5.3 Significance of the Coastal Plains

- Large parts of the coastal plains of India are covered by fertile soils on which different crops are grown. Rice is the main crop of these areas.
- Coconut trees grow all along the coast.
- The entire length of the coast is dotted with big and small ports which help in carrying out trade.
- The sedimentary rocks of these plains are said to contain large deposits of mineral oil (KG Basin).
- The sands of Kerala coast have large quantity of MONAZITE which is used for nuclear power.
- Fishing is an important occupation of the people living in the coastal areas.
- Low lying areas of Gujarat are famous for producing salt.
- Kerala backwaters are important tourist destinations.
- Goa provides good beaches. This is also an important tourist destination

2.6 Critical habitat of the Indian Coast

There are 9 critical habitat having identified along Indian Coast

1) Andaman and Nicobar
2) Lakshadweep
3) Gulf of khambhat
4) Gulf of Mannar
5) Bhiterkanika
7) Sunderban
8) Gulf of Malvan
9) Gulf of karvar



Map 3: Indian Map showing critical habitat along the Indian Coast

2.7 Coastal biodiversity of India

India's coastline holds many biological treasures. Mangrove forests of Sundarbans, the world's largest congregations of nesting turtles in Odisha, beautiful sea grass beds in Palk Bay, enigmatic sea cows in the Gulf of Mannar, majestic yet gentle whale sharks in the Gulf of Kachchh and some of the world's most beautiful and striking coral reefs are examples of the some of the biological treasures of India's coastal and marine biodiversity. Besides being store houses of biological diversity, coastal regions are also home to a large human population. However, due to industrialization and urbanization, these ecosystems are under pressure. Global climate change is likely to put them under additional stress. Sustainable development of coastal and marine ecosystems may reduce the pressure on them and also help in preserving biological diversity. Indian coastal ecosystems comprising mudflats, sandy and rocky beaches, estuaries, creeks, mangroves, coral reefs, marshes, lagoon and sea grass beds extend to approximately 42,808 km2. They are known for their high biological productivity, which provide a wide range of habitat for many aquatic flora and fauna. The Indian coasts support about 30% of the total 1.2 billion human population. Several major cities, including some of the largest and most densely populated urban mega-agglomerations (eg. Mumbai, Kolkata,

Chennai, Kochi and Visakhapattanam) are located on the coast. Activities such as fishing, ports, agriculture, oil and mineral exploitation contribute significantly to India's economy. Major anthropogenic direct drivers of ecosystem degradation and destruction include habitat conversion to other forms of land use, overexploitation of species and associated destructive harvesting practices, spread of invasive alien species, and the impacts of pollution from agricultural, domestic and industrial effluents. (Vivekanandan, 2013)

2.8 Most sensitive zone in the coastal areas are

2.8.1 Coral reefs

A ridge of rock in the sea formed by the growth and deposit of coral. Approx 3500 sq.km confined to four states and two union territory. (Gujarat, Maharashtra, Karnataka, Tamil Nadu , Lakshadweep and Andaman and Nicobar) 400 species of corals. Three types- Fringing , Barrier and Atoll.

Figure 11: Coral Reefs

2.8.2 Mangrove

Mangroves are shrubs or small trees that grow in coastal saline or brackish water. Mangroves are remarkably tough. Most live on muddy soil, but some also grow on sand, peat, and coral rock. They live in water up to 100 times saltier than most other plants can tolerate. They thrive despite twice-daily flooding by ocean tides, even if this water were fresh, the flooding alone would drown most trees. Growing where land and water meet, mangroves bear the brunt of ocean-borne storms and hurricanes.

Figure 12: Mangroves

2.8.3 Sea grass bed

Figure 13: Sea Grass Bed

Sea grass is an important but under rated resource. Physically they are protected coastlines from impact of waves and tides, chemically they play a key role in nutrient cycle for fisheries and biologically they provide habitat , shellfish and priority icons like dugong, manatee and green turtles.

2.8.4 Mud flats: Mudflats or mud flats

Figure 14: Mud Flats

Also known astidal flats, are coastal wetlands that form when mud is deposited by tides or rivers. They are found in sheltered areas such as bays, bayous,lagoons, and estuaries. Mud flat coastlines only occur where the shore is protected from waves. This may be found where a river meets the ocean and a sandspit has formed across the entrance. The entire area is called an estuary if the fresh water flow is slow and the ocean flows into the river mouth in with each high tide and out at low tide.

2.8.5 Sandy shore

Figure 15: Sandy Shore

Sandy shores or beaches are loose deposits of sand, gravel or shells that cover the shoreline in many places. They make up two-thirds of the world's ice-free coastlines. Beaches serve as buffer zones or shock absorbers that protect the coastline, sea cliffs or dunes from direct wave attack. It is an extremely dynamic environment

where sand, water and air are always in motion. Beaches also provide important coastal recreational areas for a many people.

Fine-grained sand beaches tend to be quite flat.

2.8.6 Sand dunes

A dune is a hill of loose sand built by wind or the flow of water. Dunes occur in different shapes and sizes, formed by interaction with the flow of air or water. Dunes form where the beach is wide enough to allow for the accumulation of wind-blown sand, and where prevailing onshore winds tend to blow sand inland.

Figure 16: Sand Dunes

2.8.7 Inter tidal area

The intertidal zone, also known as the foreshore and seashore and sometimes referred to as the littoral zone, is the area that is above water at low tide and under water at high tide . This area can include many different types of habitats, with many types of animals, such as starfish, sea urchins, and numerous species of coral.

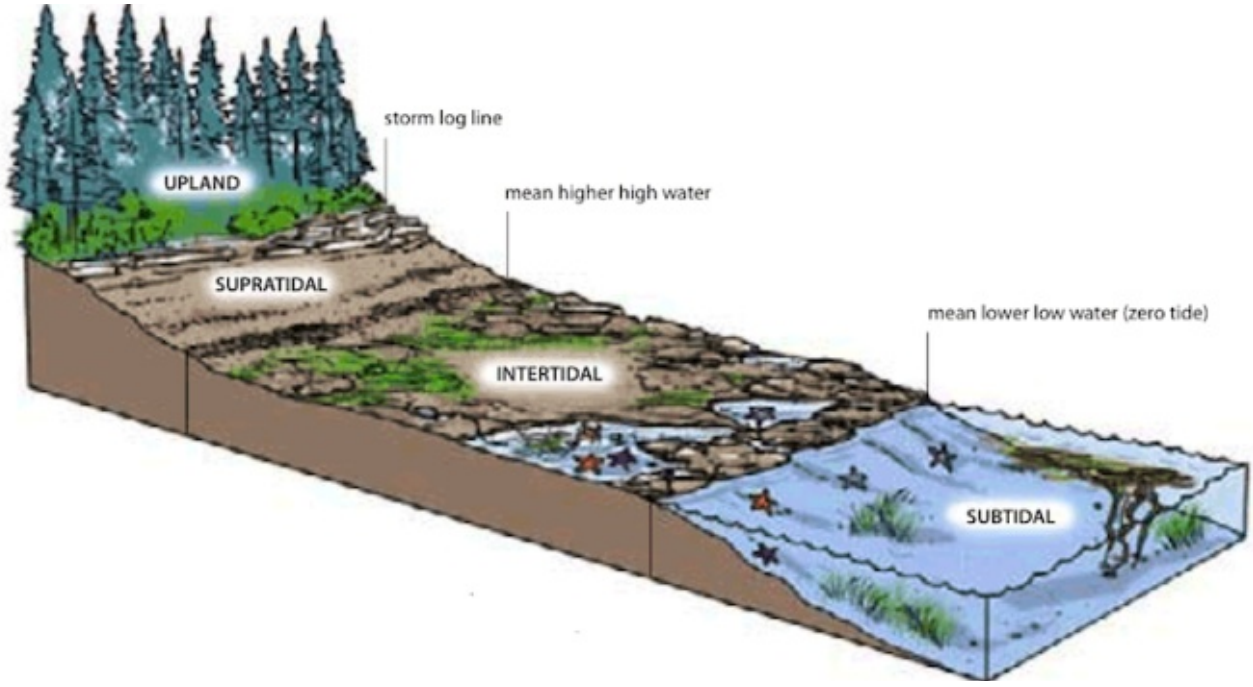


Figure 17: Inter tidal Area

2.8.8 Coastal lagoons

A lagoon is a shallow body of water separated from a larger body of water by barrier islands or reefs. Lagoons are commonly divided into coastal lagoons and atoll lagoons.

Figure 18: Coastal Lagoons

2.8.9 Atoll

An atoll is a ring-shaped coral reef, island, or series of islets. An atoll surrounds a body of water called a lagoon. (Kushwaha et. al. 2013)

Figure 19: Atoll

2.8.10 Islands

An island or isle is any piece of sub-continental land that is surrounded by water. An island in a river or a lake island may be called an eyot or ait, and a small island off the coast may be called a holm**.**

Figure 20: Islands

2.9 Types of Rocky shores

2.9.1 Vertical cliffs : During monsoon the rocky platforms are full of sedimentation and thus opportunistic species such as mytillids occupies the whole platform.

2.9.2 Boulder fields: Spaces between the randomly arranged boulders are best niches for the crustaceans like Crabs, Lobsters etc. Spaces between the randomly arranged boulders are best niches for the crustaceans like Crabs, Lobsters etc

2.9.3 Platforms: Formed by rocky outcrops of the coastal plateaus

Figure 21: Vertical cliff

Figure 22: Boulder Fields

2.9.4 Rock pools: In the winters rock pools found covered with Red, Brown and green algal whereas in summer with temperature tolerant species

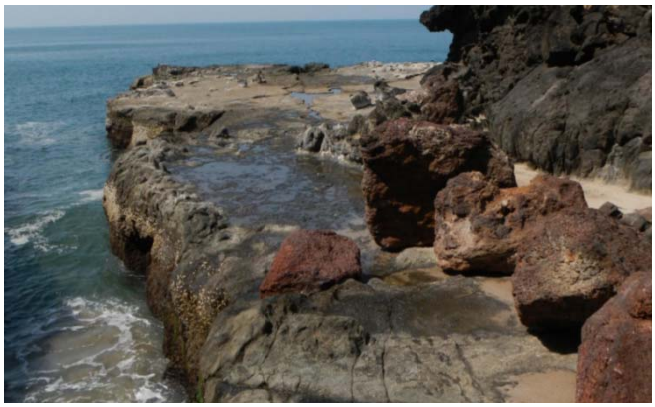


Figure 23: Platforms

Figure 24: Rock Pools

2.10 Most endangered species in the coastal areas are

Figure 25: Sea turtles

Figure 26: Fishes

Figure 27: Echinoderms

Figure 28: Sea shells

Figure 29: Sea Slugs

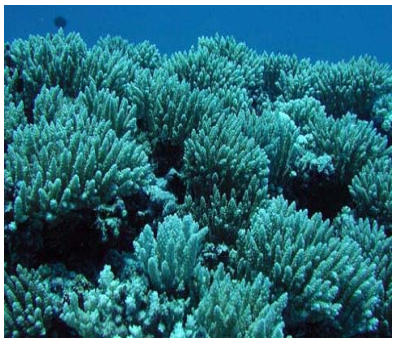


Figure 30: Corals

Figure 31: Sea Anemones

Figure 32: Symbiosis

Figure 33: Camouflage

Figure 34 : Tracks And Signs

Figure 35: Stingers And Biters

Figure 36: Marine Communities

2.11 Main issues of the Coastal India

2.11.1 Erosion

Erosion is caused by the sea waves and destructive tidal currents, which have produced erosive transgression over the sub-aerial part of the sub-delta. Frequent embankment failures, submergence and flooding, beach erosion and siltation at jetties and

navigational channels, cyclones and storm surges are all making this area increasingly vulnerable. (Senapati, 2014)

2.11.2 Threats to the mangroves

2.11.2.1 Biotic threats

- **Moth infestation:** A common teak defoliator Hyblaea puera (Lepidoptera Hyblaeidae) was found to infest Avicennia marina in . In 2002, more than 4000 ha and in 2008, about 6000 of mangroves were affected by this moth infestation.
- **Barnacles infestation** The aerial roots of Rhizophora, Bruguiera and pneumatophores of Sonneratia were found to be colonized by the barnacles especially near rocky habitats.
- **Grazing:** The natural regeneration and plantations of mangroves are subject to grazing. Being a part of common property lands, the cattle graze freely on mangrove swamps. Avicennia marina is the most preferred plant species by grazing animals. (Senapati, 2014)

2.11.2.2 Anthropogenic pressure

The natural ecosystem like mangrove wetlands is under threat due to anthropogenic activities.

- **Wood felling**: Clearing of mangrove trees from swamps renders it an irreversible change to the landform.
- **Agriculture:** Leaves of Avicennia and Aegiceras sp. are commonly used for the slash and burn technique. In this method, the leafy branches are chopped out from the healthy plants and used for burning in the agricultural fields in order to enrich the nutrient content of the soil.
- **Dumping of non-biodegradable solid wastes**: Different types of plastic material cover most of the mud flats and mangrove areas. This situation is

common along the coastal Ratnagiri District where industrial estates are located (e.g., Chiplun, Ratnagiri, etc.)

- **Water pollution:** Pollution of the brackish water due to the industrial and sewerage discharge is serious along the coastal belt of Maharashtra.
- **Conversion of mangrove swamps:** Mangrove swamps are often transformed for various purposes like aquaculture, agriculture, extension of residential, industrial or related developmental campuses.
- **Conversion into saltpans:** The temperatures and wind conditions prevailing along the northern coastline of Maharashtra are congenial for several saltpan activities.
- **Conversion into aquaculture plots:** Worldwide, the conversion of mangrove land into aquaculture appears to be a serious threat.
- **Conversion into agricultural plots:** Mangrove swamps are generally marginal for agriculture, yet conversion of mangrove land for agriculture is widespread.

Conversion into residential / industrial plots: Conversion of mangrove swamps into residential plots is observed in vicinity of fast growing cities. (Senapati, 2014)

Figure 37: Coastal Erosion

Figure 38: Mangrove removal

2.11.3 Tourism

Massive influxes of tourists, often to a relatively small area, have a huge impact. They add to the pollution, waste, and water needs of the local population, putting local infrastructure and habitats under enormous pressure.

2.11.4 Salinity

Salinity ingress is another serious environmental problem of the state. The saline area in the state increased more than 8 times during 1975-1993. This was primarily because

of (a) the destruction of mangroves on the sea coast, (b) over drafting of (sweet) ground water in the coastal regions and (c) over drafting of ground water in other regions.

2.11.5 Ports and Jetties

There are many environmental problems associated with increased port development and maritime activity, including tanker spills and accidents, as well as sediment deposition on corals due to deep-sea dredging activities. The accelerated development of ports and harbors will also greatly increase the problems that fishing communities face, further restricting their fishing grounds and depleting the availability of fish.

2.11.6 Industrial Development

Industrial development has altered, disturbed, and destroyed costal ecosystems, including sensitive habitats. Many important industrial centres are situated on estuaries and in the vicinity of urban areas and ports. Main industrial activities affecting coastal areas include metal smelting and processing, chemical, petrochemical (oil and gas storage and refining), paper mills, vehicle factories, ship building, power plants (coal, oil gas, nuclear energy), and food processing (including fish). (Senapati, 2014)

2.11.7 Sand Mining

Sand mining has led to affecting the water table in coastal areas as well as triggered salinity intrusion.

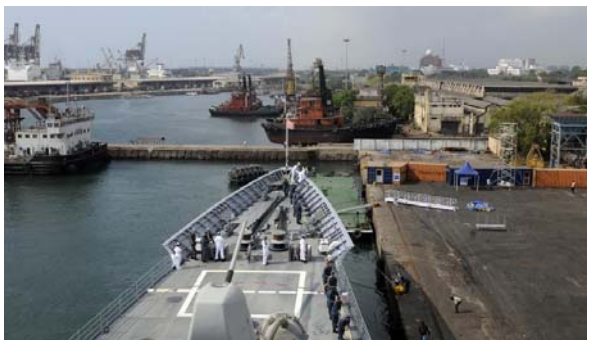


Figure 39: Development of Port Deck

Figure 40: Industrial Development

CHAPTER NO. 3

3.1 Case study

Coastal town of Sunar, Bali , Indonesia Coastal Management Plan

3.1.1 Introduction

Bali is an Indonesian island located in the western most end of lesser Sunda islands, lying between java to the west and Lombok to the east. It is one of the country's 33 provinces capital at Denpasar towards the south of the island. The province covers a few small neighboring islands as well as the Isie of Bali. (Fulazzaky, 2000)

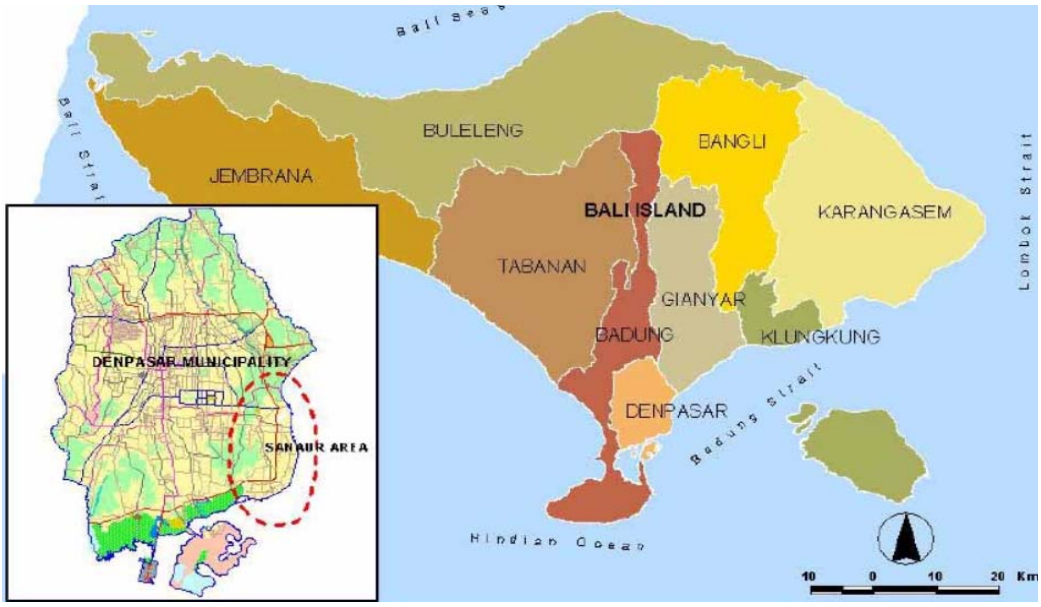
Co-ordinates: 8 .3405° S - 115.0920° E
Population: 3,891,428 (census 2011)
Area: 5780 sq.km(East to West and 112 km north to south)
Density: 670 person per sq km
Tourist influx: Foreign:13,06,316
Domestic: 7,00,000

Map 4: Location of Bali w.r.t world map

3.1.2 Potential of Bali Island

Bali is a small island has no enough natural resources for economy development support. Bali' economy development is built base on cultural values and environmental services through the comparative advantage of tourism sector. The most parts of the famous tourism destination in Bali locate in coastal zone. The coastal zone is extremely important to Bali's society, not only economically but more to socio-cultural aspect. In Bali, majority of Balinese are Hindu. The Balinese believe that marine and coastal area is sacred area, where many religious activities take place. On the other hand, the facts showed that development along coastal area increased environmental problem (include

social problem) that threaten the sustainability of coastal development. Most of natural resources degradation may be resulted by not optimal, unsustainable and sectoral management. Considering existing potential resources, prospective, challenges and problems, the coastal management is being important and strategic in the future.



Map 5: Location of Sunar w.r.t Bali Island

3.1.3 Climate

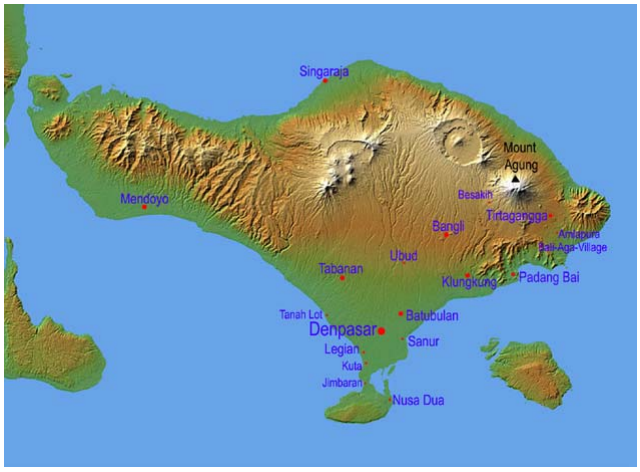
Rainfall in the coastal plain is 1400 mm and in the mountains is 3000 mm. **Bali's** is located very near to the equator, therefore its warm, tropical **climate** makes it a huge draw for tourists. Average year-round temperature stands at around 26-27°C with a humidity level of about 85-90%.

3.1.4 Location of Sunar and Benoa Bya

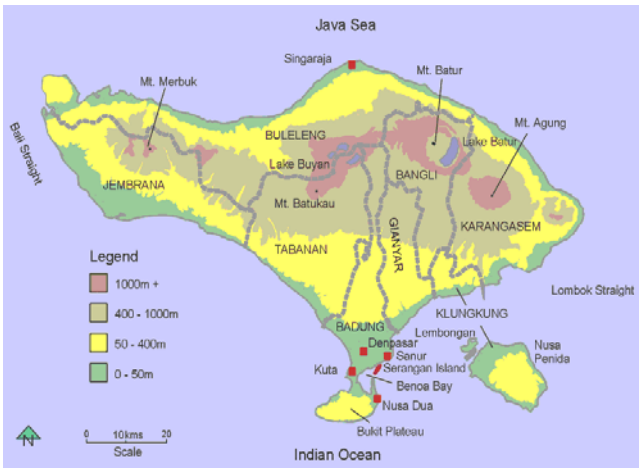
Sunar and Benoa bay is located at the furthest south eastern part of the island benoa bay is a tidal estuary on the south east coast of bali , protected by narrow sandy peninsula and sunar is the adjacent northern white sandy beach.

3.1.5 Geology

- These islands are younger than the asian mainlands, bali got exposed during last ice age when sea levels receded by 200 mts.
- These islands are still forming with coastal plains expanding as alluvial deposits
- Geologically bali has active with two volcanic centers.



Map 6: Geological formation of Bali Island



Map 7: Elevation map of Bali Island

3.1.6 Natural landscape character

- Island is surrounded with Coral reefs
- Beaches in southern part of island have white sand and northern are black
- Ball is a mountainous island with several peaks over 3000 mts. elevation. The highest is Mount Agung which is an active volcano. Volcanic nature of Bali has contributed to exceptional fertility and its tall mountain ranges provide high rainfall which supports highly productive agricultural sector
- Bali's second most significant landscape is the coastal plains which are generally deeply dissected by the numerous perennial rivers. Two subdivisions of the coastal plain can be identified: The Elevated Coastal Plain which is found in southern central Bali and the low-lying coastal plain which occurs throughout.

Figure 41: South Sea Beach

Figure 42: Sandy Beach

3.1.7 Detail of Benoa Bay and Sanur and related environmental conflicts

Figure 43: Rocky Coastal Temple

Figure 44: Agriculture on hills

Figure 45: Volcanic mountain

Figure 46: Temple of Bali

Figure 47: Rocky beach

Figure 48: Coastal plains

3.1.8 Environmental problems

1. Severe Beach erosion occurred 7 mts land lost per year
    a. Due to breaches in planning setback regulation
    b. Extension of Airport runway 2 kms into the Ocean
2. The Beona port and 3 km Long Causeway obstruct the tidal flashing of bay
3. 50% Mangrove forest got depleted-development and land reclamation
4. Loss of offshore coral reefs due to mining and pollution
5. Shortage of water due to over exploitation by the tourism industries
6. Pollution of the bay is due to
    a. Biological pollution from Untreated sewage disposal
    b. Agricultural runoff of chemicals and fertilizers
    c. Urban runoff
7. Land filling by urban waste dumping
8. Benoa fresh water dam project- for tapping excess fresh water to augment the enormous need of growing tourism. This resulted in
    a. Depletion of Mangrove forest
    b. Stoppage of freshwater supply to Estuary destabilizing the fresh water salt water balance
    c. Shortage in sediment supply to the Coast leading to severe erosion problem

Figure 49: Soil erosion at the beach

Figure 50: The effects of reef bombing

3.1.9 Management strategies and mitigation measures

- Formation of General Development Plan (1989-2010) saying.

- Promotion of decentralization of tourism in all over the island instead of concentration model which assisted the economy to spread out while reducing stress on the environment
- 21 new tourism zones were outlined for development
- setback regulations were made to control development in coastal zones
- Beach line protection measures and engineering methods undertaken to control the problem of erosion-Offshore Breakwater, artificial headlands, groins and beach nourishment, coconut plantations on nourished beaches.

Figure 52: Artificial Groins

Figure 51: Artificial Headlands

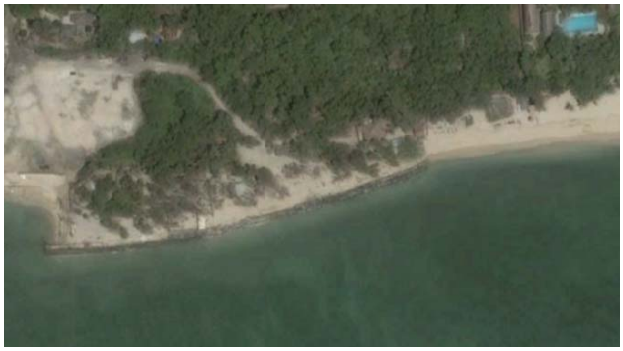


Figure 53: Bali beach in 2002 (a)

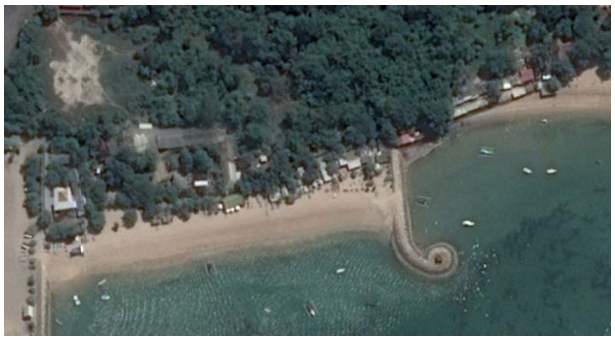


Figure 54: Bali beach in 2010(a)

Figure 55: Bali beach in 2002 (b)

Figure 56: Bali beach in 2010 (b)

3.2 Case study 2

Gold Coast , Queensland, Australia

3.2.1 Introduction

Gold Coast is a coastal city located in the South East of the state of Queensland, Australia. It is the sixth most populated city in the Continent. (Tate)

Population: 5,91,473 in the 2010 census

Area: 414.3 sq km

Density: 972 persons per sq km

Temperature: Mean Maximum is 25.1 Feb

Mean Minimum is 17.2 July

Annual Rainfall: 1218 mm Nov-Feb

Map 8: Location of Gold Coast

3.2.2 Types of Flood Occurring in Gold Coast Region

River/creek Flood (Regional Flood)

Local/Stormwater Flooding (Local Flood)

Storm Surge (Due to cyclonic activities)

Tidal (From High Tides)

Figure 57: Flood condition of Gold coast (a)

Figure 58: Flood condition of Gold coast (b)

Figure 59: Flood condition of Gold coast (c) Figure 60: Flood condition of Gold coast (d)

3.2.3 Management Strategies and Mitigation measures

Planning measure: Land use Planning

Physical measure: Engineering Techniques

Risk reduction: Post Flood Management

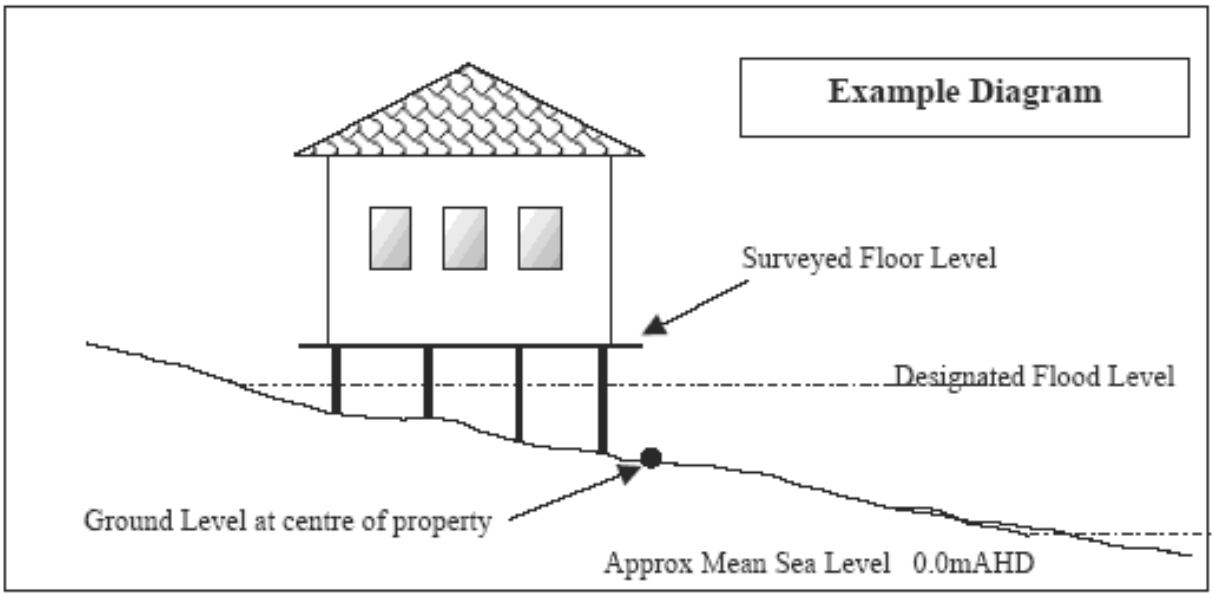


Figure 61: Designated flood level and flood level regulations free passage of storm water through swales, permeable paving , trench drains

Landuse planning of low area integrated with network of seasonal lake acting flood retention pond during heavy rain

Figure 62: Land use planning of Gold Coast

Coastal wetlands and mangrove to act as flood detention areas in tidal flooding and storm surge.

shoreline vegetations buffer and dune belt- dissipate the energy of storm surge and high waves.

Figure 63: Vegetations in the coast

Hinze dam capacity was increase on the Nerange River valley

Lock gates in canal to stop tidal flooding in internal residential districts

Figure 64: Lock gate at Hinze Dam

3.2.4 Summary of case study

Case Study	Landscape Character	Tourism Type/Economy	Issues	Measure	Aftereffect(Good)	Aftereffect (Bad)
Sunar and Benca bay, Bali	Mountainous island Coastal Plain Lands Coral Reefs Beautiful Sea Beaches	Sea Recreation and Leisure Heritage and Culture Nature appreciation Pilgrimage Agriculture	1.Beach Erosion 2.Estuarine habitat depletion 3.Mangrove reduction 4.Coral reef mining 5.Marine Pollution 6.Fresh water shortage 7.Over exploitation and concentrate of tourism pressure	1.Enginnering techniques to stop erosion 3.Mangrove restoration in parts 4.Legal action against coral mining 5.Sewage treatment and alternative solid waste dumping location 6.Construction of dam near river mouth 7.Integarted tourism planning to decentralize the pressure to the whole island	1. Beach restored upto 75 mts 6. Adequate Fresh water 7. Distribution of Economic growth in whole country	1. Erosion shifted to adjacent beach 6. Misbalance in Estuarine salt concentration 7. Social dependence on tourism sector, Commercialization of native culture and heritage
Gold oast, Queensland, Australia	Mountainous Coastal plan with numerous rivers and drainage channels Alluvial terraces Sea Beaches Ricky Headlands	Sea Recreation and Leisure Agriculture Fisheries	Severe Flooding 1.River/Creek Flood 2. Storm water Flood 3. Storm Surge 4. Tidal Flood	1. Conservation of Coastal Wetlands for buffer 2. Land usePlanning for the future development of city, dam capacity Increase: Building Plinth height regulation, retention lakes and channels 3.Conservation of Dune 4.Lacks controlling the water level at the lake districts	1.Good detention areas for excess water 2.Local highlands for construction, very rare loss of property of life, retention channels provide waterway evacuation routes during flood 4.Adequate time gap between catastrophe and its impact	2.Extensive economic expense in Dam construction, downstream impacts in the plains 4.Expensive

Table 1: The Summary of the case study

3.2.5 Inference

	Methodology of Action
1	Preparation of Regional Master Plan- through thorough analysis of natural resources and processes
2	Categorization of different areas according to suitability of different action like
3	conservation, recreation or development
4	Division of land into suitable land uses with detailed description of allowable activities –prohibition and exemption
5	Management procedure to be proposed for future development
6	Restoration procedures for depleted ecological processes
7	Mitigation measures for endangered areas
8	Evaluation of the proposes measures as per their probable short term and long term impacts on ecology, social life and economy

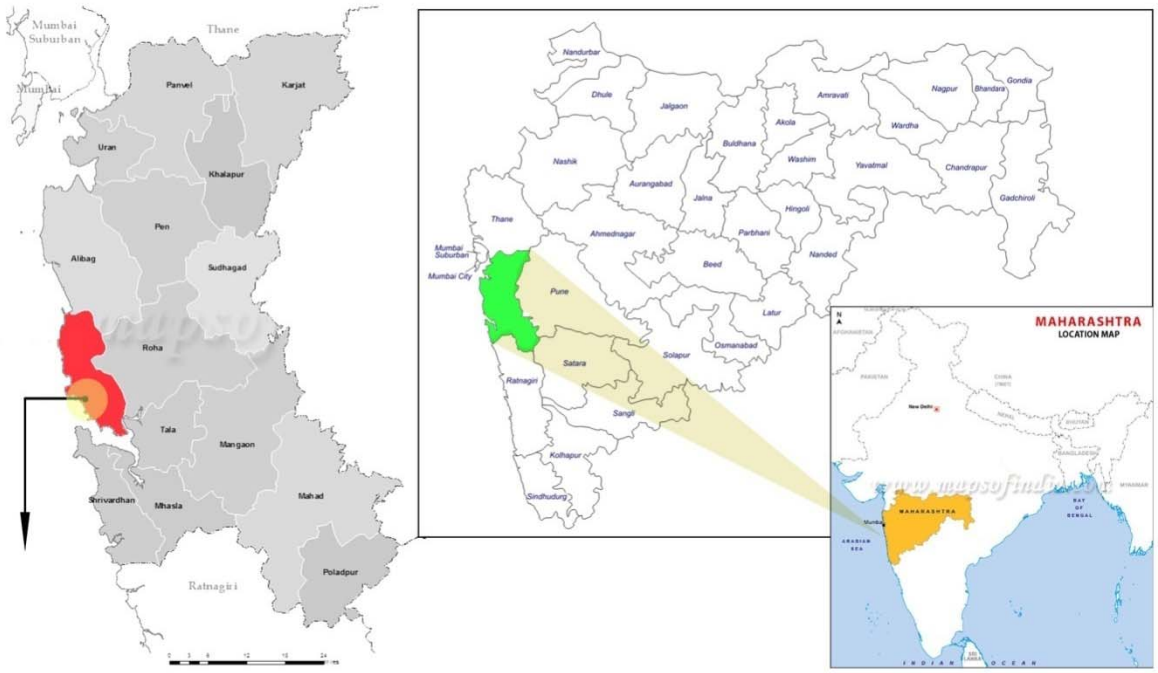
Table 2: Methodology of action considered in the case study

CHAPTER NO.4

4 Site Introduction

4.1 Background

The district Raigad is a part of Maharashtra state situated on the west coast of Arabian coast. It has approximately 240 km coast in the west. The coastline is indented by numerous river mouths, creeks, small bays, headlands, sandy and rocky beaches, promontories , cliffs etc. Murud is a coastal town and is fast becoming a tourist destination, it has a scenic coastline and Janjira fort , which add to the tourist attraction , it is a fishing village and has experienced urbanization over time.

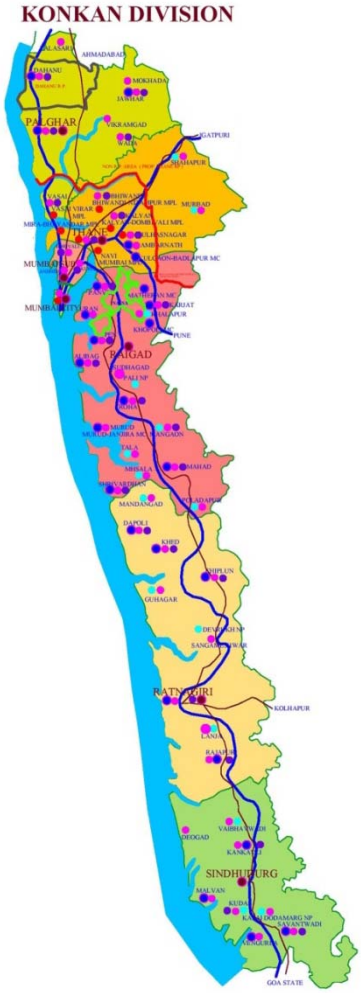


Map 9:Location Murud in Raigad **Map 10: India map representing Raigad**

4.2 The speciality of the entire region

The Konkan is a narrow strip of land between the Arabian Sea and the Sahyadri Range.The spurs of the Sahyadries gradually lose height as they approach the coast,

and far in the sea they create islands, a distinctive feature of the coastline and to site significant Cultural Sites, forts , beach.



Map 11: Konkan coast in Maharashtra map

The Konkan is a narrow strip of land between the Arabian Sea and the Sahyadri Range.The spurs of the Sahyadries gradually lose height as they approach the coast, and far in the sea they create islands, a distinctive feature of the coastline and to site significant Cultural Sites, forts , beach.

Map 12: Konkan Coast

Figure 65: The Beach of Murud

Figure 66: The scenic beauty of the coastal road

Figure 67: The facilities of boating

Figure 68: The entire region is famous for fishing

Figure 69: The coastal road is used as cycle track from Mumbai to Alibug

COAST OF MAHARASHTRA-KONKAN			
DELINEATION	UPPER KONKAN DAHANU-VASAI	CENTRAL KONKAN KHANDERI/UNDERI-DABHOL	LOWER KONKAN GUHAGAR-TAREKHOL/VENGURLA
COAST	The coast here is shallower and wider with very few hills	The coast is rocky with few beaches, mountain range is closer to the coast	The coast is mostly rocky and even more isolated than central or upper Konkan
	The plains are more fertile but more accessible ti invasions and migrations from North	Creeks at the mouths of the rivers provided protection to small craft with shallow fraft	Moderately high hills affords some protection to shipping during monsoons
RIVERS	Vaitaran and Ulhas	Amba, jundalika and Savitri	Vasishthi, shastri, muchjundi, vaghotan, kharepatan
TRIBUTERIES	Kalu, Patalganga	Mhasala	
CREEKS	Agashi, Bassain, Minor Creeksat-Dahanu, Shrigaum, Tarapur, Chinchani, Kelve, Danda	Rajpuri or Janjira Creek, Mhasala	Ratnagiri or Bhatya Creek, Jaytapur, Minor creeks-Kelshi, Ada, Bonya, Ganpatipule, Nevare, Pavas
IMPORTANT PLACES	Agashi-Once a Important ship building center	Chaul-once a important trading centre, Ravdanda, Rajpuri, Murud, Janjira	Dabhol-fam,ous port of medieval times, vijayadurg-harbour here is pritected from southwest monsoons
FORESTS	Manor	Phansad	
ISLAND	Arnala	Khanderi-Underi, Janjira, Suvanmadurg	

Table 3: Different character of the Konkan coast

4.3 Historical background of the region

The early history of Konkan starts from Mauryan Empire and Ashok the Great. Buddhism reached the coast as seen by the caves at Chaul and Manded. After the Mauryan period the Satavahanas, Shakas, Chalukyan's, Kadamba and yadava ruled over this land from 3rd century BC to 14th century AD. (Archana)

The coast of Maharashtra was known from very ancient times for its ports from where extensive trade was carried on to places as far west as Rome and as far East as Java and Sumatra. This place was well known and is mentioned by Ptolemy and in the Periplus. Commercial relations with Egypt and Babylon existed as far back as BC 2500. Arabs, Greeks, Chinese, Jews, Parsis, and Portuguese had traded at Konkan ports in perfect safety. Trade and commerce with the Middle East and Europe, had been going on from ancient times. The European powers arrived on the western coast and the ports and the coastal forts of the Maharashtra became an intrinsic part of their activities and political aspirations. (Archana)

Originally the fort was small wooden structure built by a Koli chief in the late 15th century. It was captured by Pir Khan, a general of Nizamshah of Ahmednagar. Later the fort was strengthened by Malik Ambar, the Abyssinian Siddi regent of Ahmednagar kings. From then onward Siddis became independent, owing allegiance to Adilshah and the Mughals as dictated by the times. Despite their repeated attempts, the Portuguese, the British and the Marathas failed to subdue the Siddi power. Shivaji's all attempts to capture Janjira fort failed due to one reason or the other. When Sambhaji also failed, he built another island fort, known as Kansa or Padmadurg, just 9kms north of Janjira. The Janjira state came to an end after 1947.

Thus settlement began from 15th century, and in course of times due to the fort and the coastal environment, the valley was occupied by the people due to the rich natural resources and finally the tourism became. Thus Murud – Janjira region came into known and it became renowned as a tourist town due to the present of the historic background with the natural resources. (Archana)

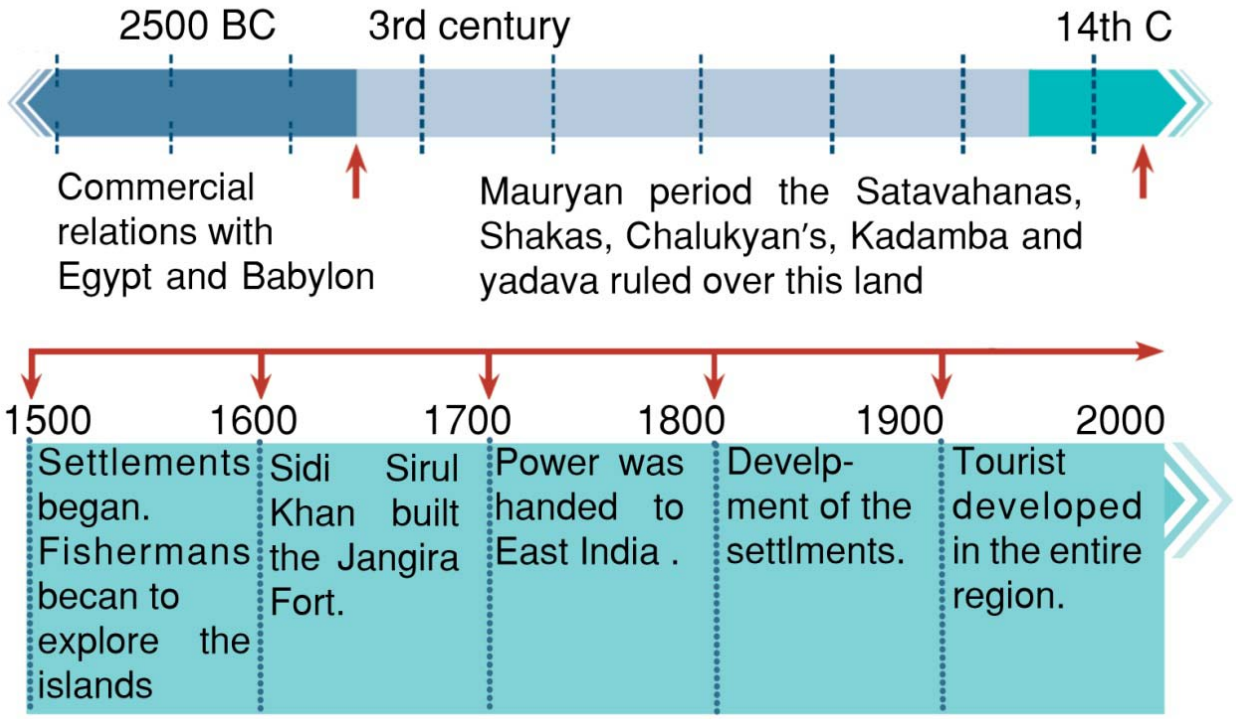


Figure 70: Graphically represents the history of Murud – Janjira region

4.4 Landscape values

There is beautiful landscape on the west due to open sea beach, due to existence of large tracts of wadis lands in and around, hills on the north and sea on the west , the town has a very beautiful landscape and attracts people from outside for picnic. There are paddy fields on east and north which are smaller in extent as compared to wadis . Due to hill ranges on north and due to sea and creek on the other side , the town slopes from north towards south and west.

Figure 71: Section showing the diversity of coastal habitat

4.5 Landscape character of MURUD –JANGIRA

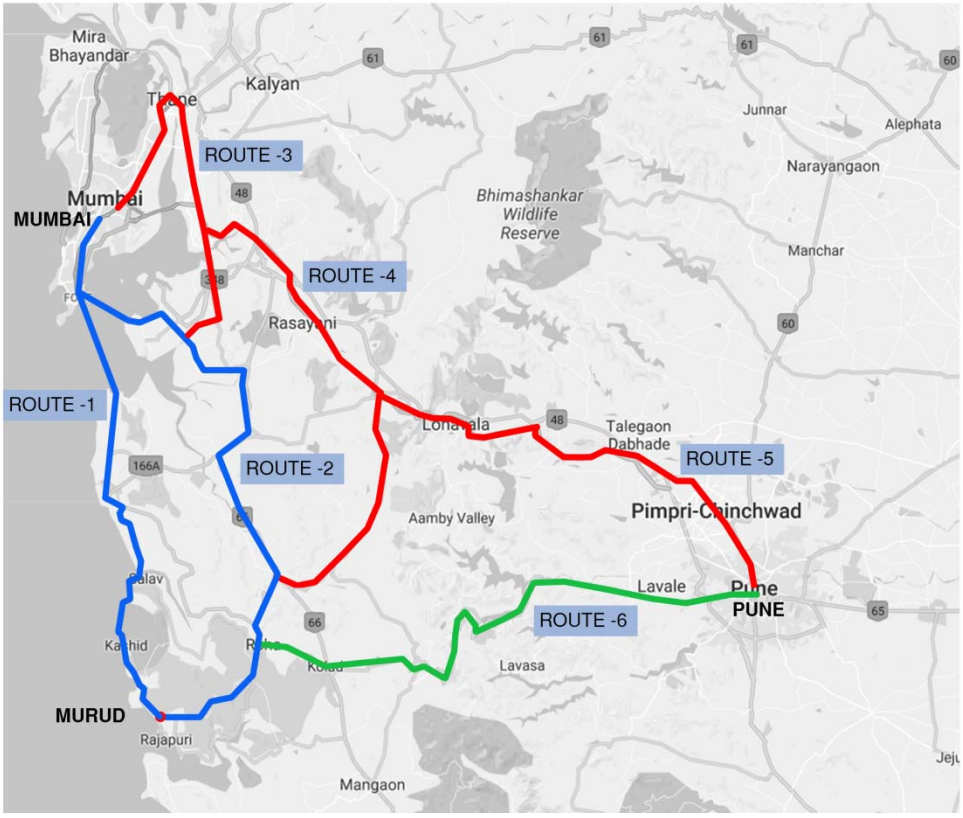
The distinctive character of the Murud landscape is based on a fusion of natural and cultural elements. Forts, Haveli, temple, masid, the coastline , the beach, the wadis, settlements, field boundaries and field patterns, buildings and , roads, the vegetations, mangrooves, creek, scrub land all attest to the imprint of people on the landscape. These cultural elements, combined with the natural landscape, give distinctive character to different place.

4.5 Connectivity

Murud is Nearby airpot is Chhatrapati Shivaji International Airport: 165 kms. Nearby railway station is at Roha: 40 kms away.

Murud is 42 km from alibag and 150 km from main cities like Mumbai and Pune.

Route 1 and 6 are more preferably used



ROUTE 1	MUMBAI TO MURUD **VIA FERRY** -102 KM 4 HRS 30 MIN
ROUTE 2	**VIA FERRY** 143 KM 4 HRS 48 MIN
ROUTE 3	EASTERN EXP HIGHWAY/MUMBAI AGRA NATIONAL HWY AND NH66 167 KM 5 HRS 10 MIN
ROUTE 4	BANGLORE- MUBAI HWY AND SH92 157 KM**(HAVE TROLLS)** 3 HRS 34 MIN
ROUTE 5	PUNE TO MURUD BANGLORE- MUBAI HWY 179 KM 4 HRS **(HAVE TROLLS)**
ROUTE 6	TAMHINI GHANT ROAD 157 KM 4 HRS 13 MIN

Map 13: Map showing various routes to reach Murud-Janjira

Map 14: Various tourist destinations along the coast from Chaul to Rajapuri

4.5 The pictorial representation of the important tourist destination of Murud

Figure 72: The Nawab Haveli (1)

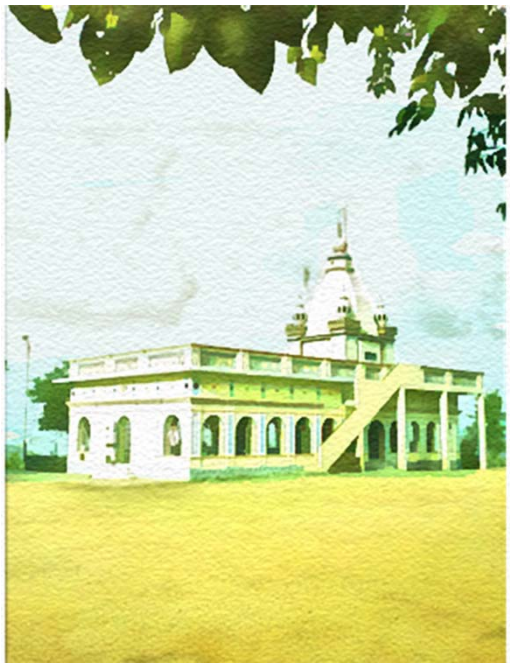


Figure 73: Datta Mandir (2)

Figure 74:Murud Beach (4)

Fig 75: Garambi water fall (9)

Figure 76: Eidga (3)

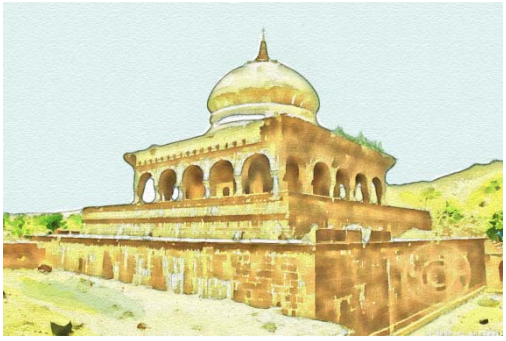


Figure 77: Siddi Ka Maqwara (7)

Figure 78:The Creek which is rich in ecological habitats like mangroves, wetlands , Wadi lands. (7)

Figure 79: The Janjira fort situated on an island. (6)

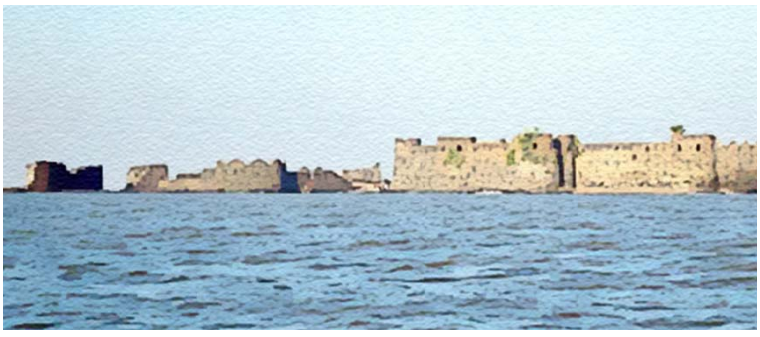
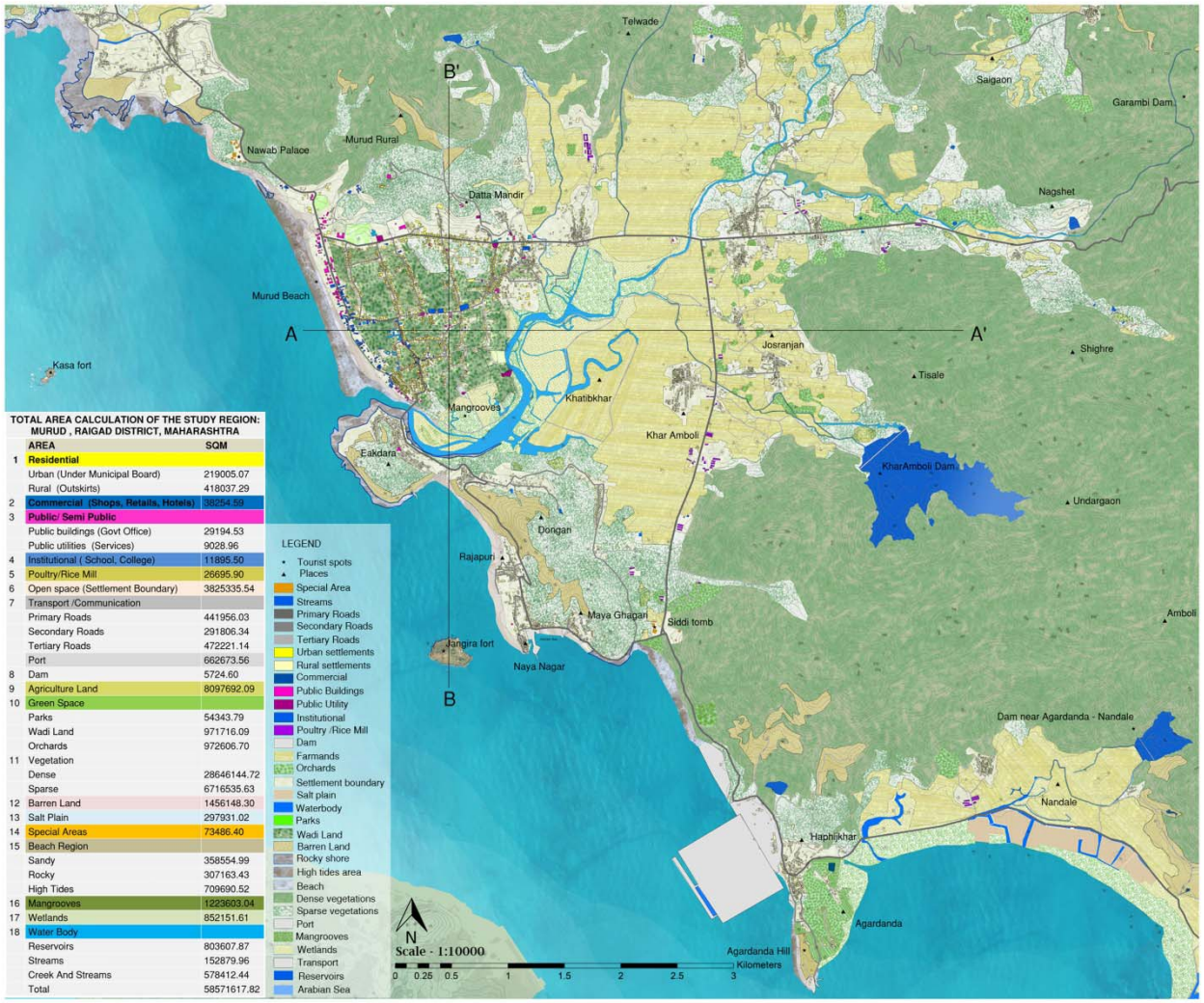


Figure 80 The Padmadurga fort (5)

Figure 81: The key map showing the location of the picture

4.6 The base map of Murud – Janjira region



TOTAL AREA CALCULATION OF THE STUDY REGION: MURUD , RAIGAD DISTRICT, MAHARASHTRA

	AREA	SQM
1	Residential	
	Urban (Under Municipal Board)	219005.07
	Rural (Outskirts)	418037.29
2	Commercial (Shops, Retails, Hotels)	38254.59
3	Public/ Semi Public	
	Public buildings (Govt Office)	29194.53
	Public utilities (Services)	9028.96
4	Institutional (School, College)	11895.50
5	Poultry/Rice Mill	26695.90
6	Open space (Settlement Boundary)	3825335.54
7	Transport /Communication	
	Primary Roads	441956.03
	Secondary Roads	291806.34
	Tertiary Roads	472221.14
	Port	662673.56
8	Dam	5724.60
9	Agriculture Land	8097692.09
10	Green Space	
	Parks	54343.79
	Wadi Land	971716.09
	Orchards	972606.70
11	Vegetation	
	Dense	28646144.72
	Sparse	6716535.63
12	Barren Land	1456148.30
13	Salt Plain	297931.02
14	Special Areas	73486.40
15	Beach Region	
	Sandy	358554.99
	Rocky	307163.43
	High Tides	709690.52
16	Mangrooves	1223603.04
17	Wetlands	852151.61
18	Water Body	
	Reservoirs	803607.87
	Streams	152879.96
	Creek And Streams	578412.44
	Total	58571617.82

Figure 82: Base Map for the region of Murud – Janjira

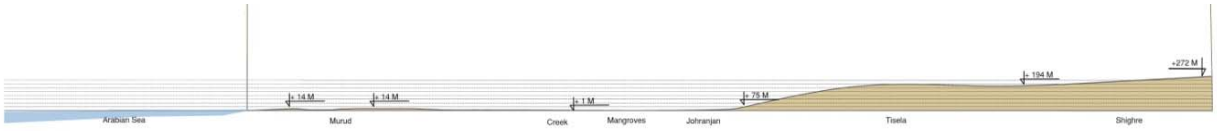


Figure 83: Section AA'

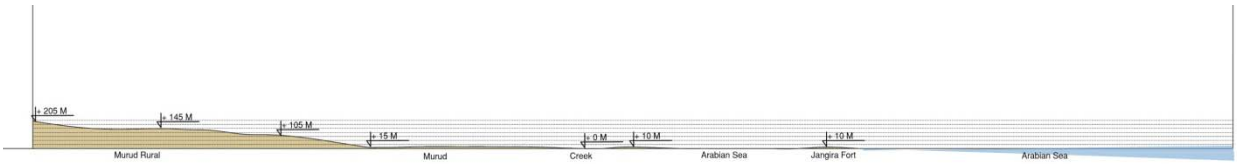


Figure 84: Section BB'

4.7 The settlement pattern of Murud

	SETTLEMENT PATTERN OF MURUD REGION
1	The settlements are generally found in the valleys and along the gradual sloping land. they are seen along the sea coast or the creek. There is no development on the plateau.
2	The settlements turn sparse as one moves towards the hilly areas.
3	The settlements are linear along the sea coast and in the form of clusters on the banks of the creek.
4	Murud is major town of the district having all the important amenities and facilities. The other settlements are small hamlets and are dependent on the natural resources of the region.
5	The occupation of the people being fishing and farming.
6	Agriculture is the second most important occupation of the region. It is done on the flat region near the coast.
7	The staple diet in the region includes sea food, rice, wheat , pulses, millet, coconut, cashewnut, amla, betelnut, vanilla and pine apple
8	The cultivated land in the lower region near the coast consists of horticulture and other tree plantations.

Table 4: Settlement pattern of Murud

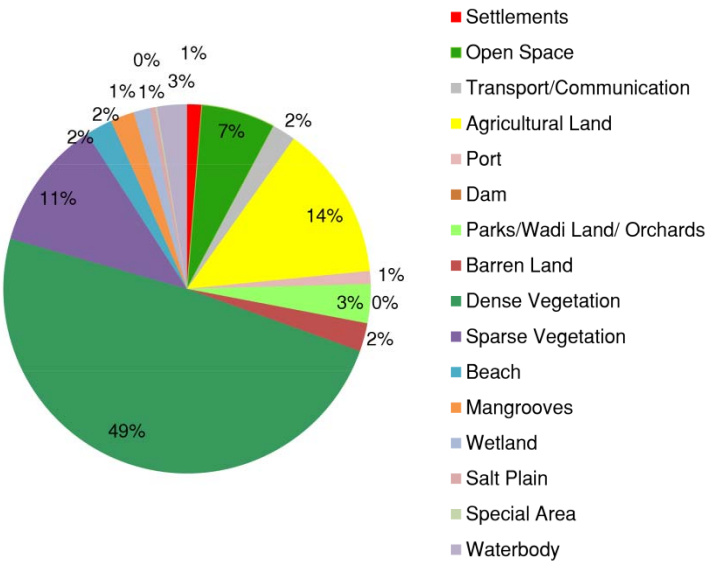


Chart 1: Percentage of Landuse

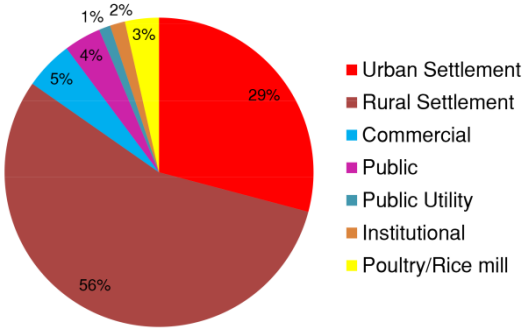


Chart 2: Percentage of built up

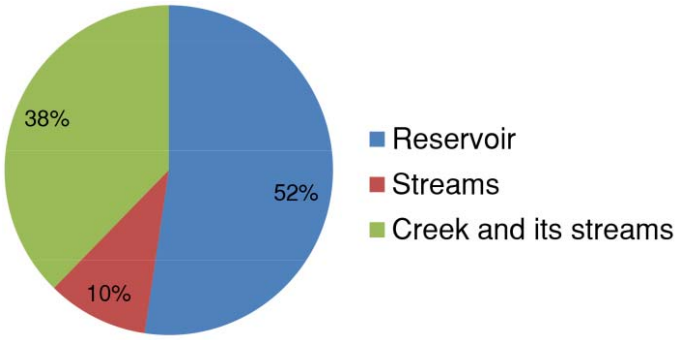


Chart 3: Percentage of Water body

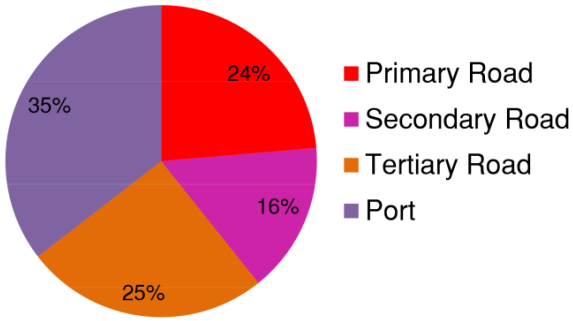


Chart 4: Percentage of transport /Communication

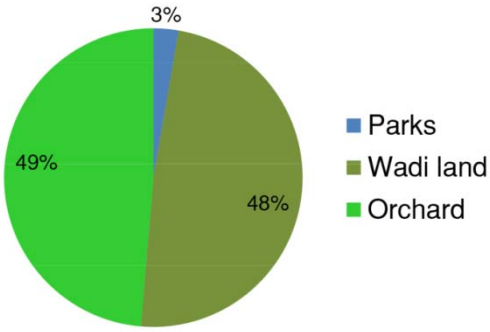


Chart 5: Percentage of Green space

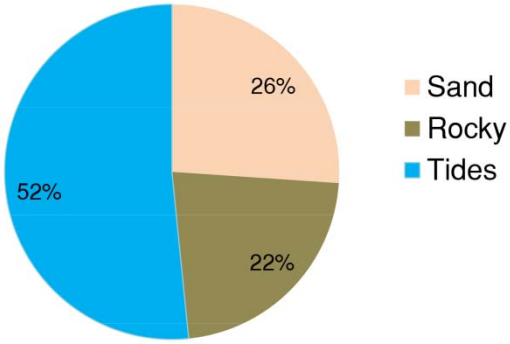


Chart 6: Percentage of Beach

CHAPTER NO.5

5 Site Analysis

5.1 The study region

The region is sparsely populated with most of the development along the coast. A few major towns of the region is Murud . Apart from these towns there are small fishing village , the coast is undulated by a number of rocky as well as sandy beach . There is a substantial growth in the tourism in this decade.

Figure 85: The Rajapuri Creek

Figure 86: The Janjira fort

Figure 87 : Murud Beach

Figure 88: The wadi land

5.2 Detail of the study region

Site taken for the region study is the entire stretch from Chaul to Rajapuri creek. It covers an area of 51km x30km. The regional scale is considered for the Landscape analysis like the layers of geology , geomorphology, soil , geo hydrology , hydrology, vegetation for the entire stretch.

These layers are overlapped and considering the inferences the zoom site is studied in detailed and some conclusions are drawn. Guidelines are given for the area of

10km x 10km and proposal for the region of 3km x 3km.

Map 15: Key map representing the Regional Site of Murud Taluka

5.3 Climatic conditions of Murud taluka

5.3.1. Rainfall

The climate of the region is hot and humid. The rainfall is abundant and regular. With an average annual rainfall varying from 16,059 mm. to 21,795 mm. The climate of this district is typical of that on the west coast of India, with plentiful and regular seasonable rainfall, oppressive weather in the hot months and high humidity throughout the year. The summer season from March to May is followed by the south-west monsoon season from June to September. October and November form the post-monsoon or the retreating monsoon season. The period from December to February is the cold season. (Meteorological Department)

Months	Rainfall in mm	No. of Rainy days	Temperature	Mean Relative Humidity

			Min	Max	Mean	Monthly Average (Morning) %	Monthly Average (Morning) %
1	2	3	4	5	6	7	8
Jan	-	-	17.7	29.1	23.4	91	49
Feb	-	-	18.4	29.5	23.9	91	56
March	-	-	21.3	31.2	26.2	91	47
April	0.40	1	23.8	31.9	27.8	88	59
May	20.00	2	26.4	33.3	29.8	83	63
June	519.80	21	26.1	32.0	29.0	95	77
July	859.04	29	25.5	30.4	27.9	96	76
Aug	453.72	26	25.2	30.2	27.7	96	83
Sep	321.96	21	24.7	30.6	27.6	97	76
Oct	100.08	7	23.7	32.5	28.1	95	63
Nov	5.00	2	21.4	33.1	27.2	87	53
Dec	14.60	1	19.0	31.2	25.1	86	52
Avg	2294.60	110	22.7	31.4	27.0	91	63

Table 5: Rainfall Data of Murud

5.3.2 Temperature

May is the hottest month with a mean daily maximum temperature at 31.7°C (89.1°F) and the mean daily minimum temperature at 26.4°C (79.5°F). Fresh breezes from the sea relieve the oppressive heat particularly in the coastal regions in the afternoons.

5.3.3 Humidity

The air is humid throughout the year. Relative humidity is on an average over 80 per cent. during the south-west monsoon season. In the rest of the year the relative humidity is between 65 per cent and 75 per cent.

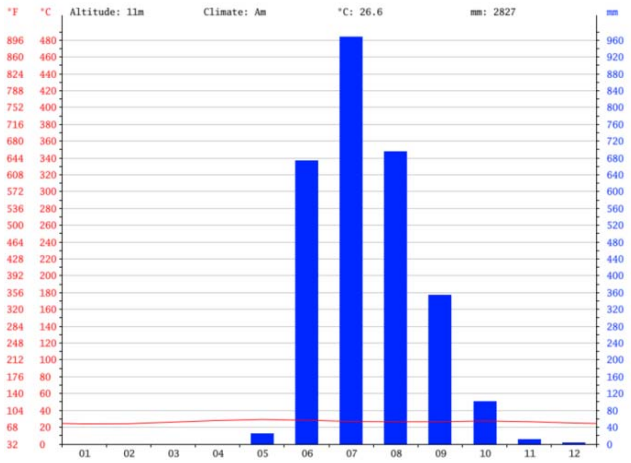


Chart 7: Climate graph Murud

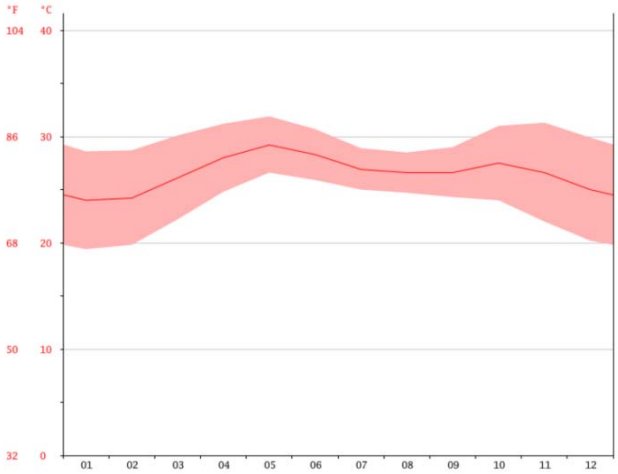


Chart 8: Temperature Graph of Murud

5.3.4 Cloudiness

During the south-west monsoon season skies are heavily clouded to overcast. In May and October the clouding is moderate. Clear or very lightly clouded skies are common in the rest of the year.

5.3.5 Wind

Winds are very strong and blow from west or south-west during monsoon season. During the period from October to December winds are generally moderate but sometimes strong in October and blow from directions between north-east and south-

east. In the three months from January to March the winds continue to be moderate and are predominantly from directions between north and east. In April while there is a slight strengthening of wind, the direction is variable. In May there is a further strengthening of winds and the directions are between south-west and north-west.

5.4 The Geology of the study region

5.4.1 The theories that explain the formation of the Western Ghats

1) The initial seaward facing scrap steep slope was created rift in fault line along the western margin of the eastern tilted Indian continental shelf.

2) Tectonic uplift asymmetrical warped the pre-existing surface. The uplifting of the lava flow created an asymmetrical divide with the steeper slope to the west and steeper to the east.

The geological formations in this area in the descending order of their antiquity is as follows 1. Coastal sands, soils and alluvium (recent and sub recent) 2. Laterite (Pleistoic) 3. Cuddalore series (Tertiary) 4. Deccan trap (Lower Eocene) 5. Infra trappean (Creataceous) 6. A qacid veins. 9. Dharwans (Archean).

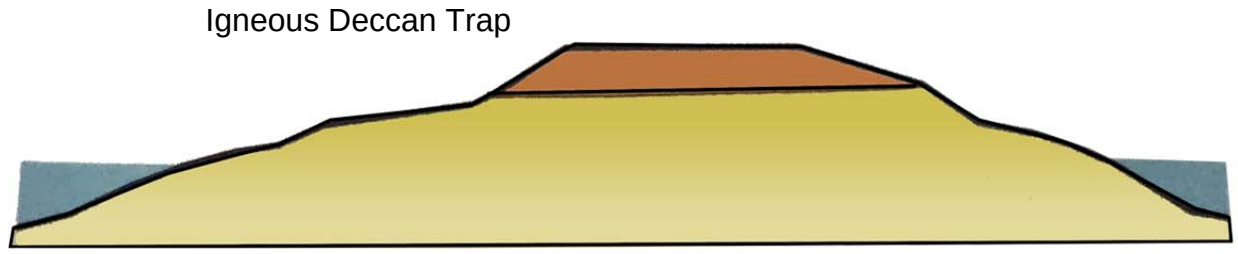
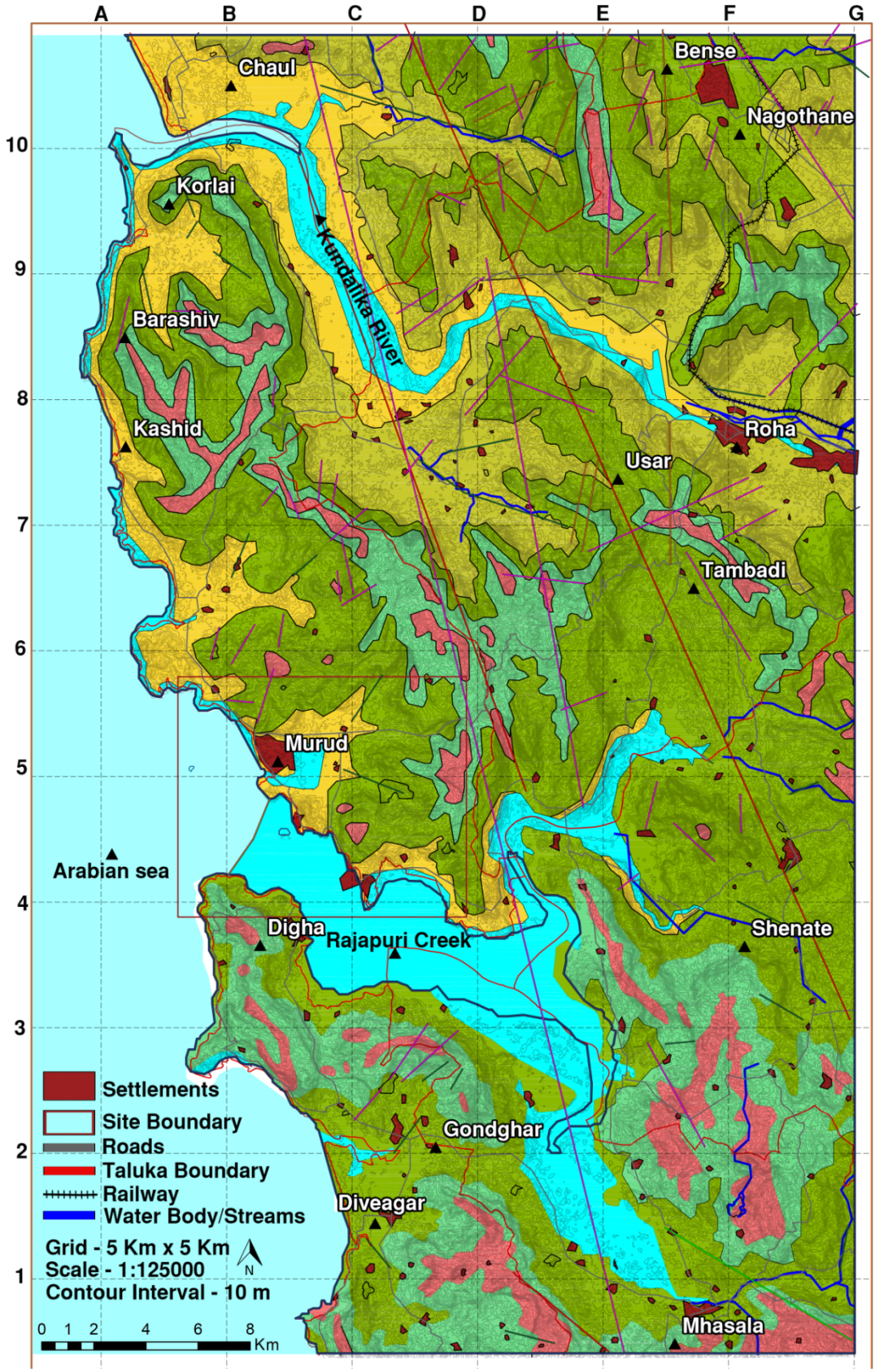


Figure 89: Fig: Section showing the layers of Deccan trap rock

The rock of the region is trap. In the plains it is found in tabular masses a few feet below the soil and sometimes standing out from the surface. In the hills it is tabular and is also found in irregular masses and shapeless boulders varying from a few inches to several feet in diameter. In many places the surface of the trap has a rusty hue showing the presence of iron.



Map 16: Geology map of the region

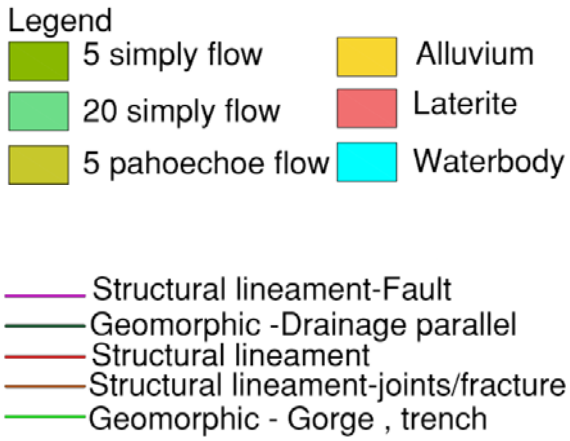


Figure 90: Legend of Geology map

TYPES OF GEOLOGY	AGE		NATURE AND CHARACTERISTICS
25 Simply Flow	Cretaceous to Palaeogene	Sahyadri group Deccan trap	(Hard, compact, fine grained and dark grey coloured)
20 Simply Flow	Cretaceous to Palaeogene	Sahyadri group Deccan trap	(Hard, compact, fine grained and dark grey coloured)
5 Pahoechoe Flow	Cretaceous to Palaeogene	Sahyadri group Deccan trap	(250 mtrs) fine to moderrate grained, moderately to sparsely porphyritic flows
Alluvium	Quaternary		Occurs as shale and limestones
Laterite	Cainozoic		Occurs as laterite and covers Deccan trap

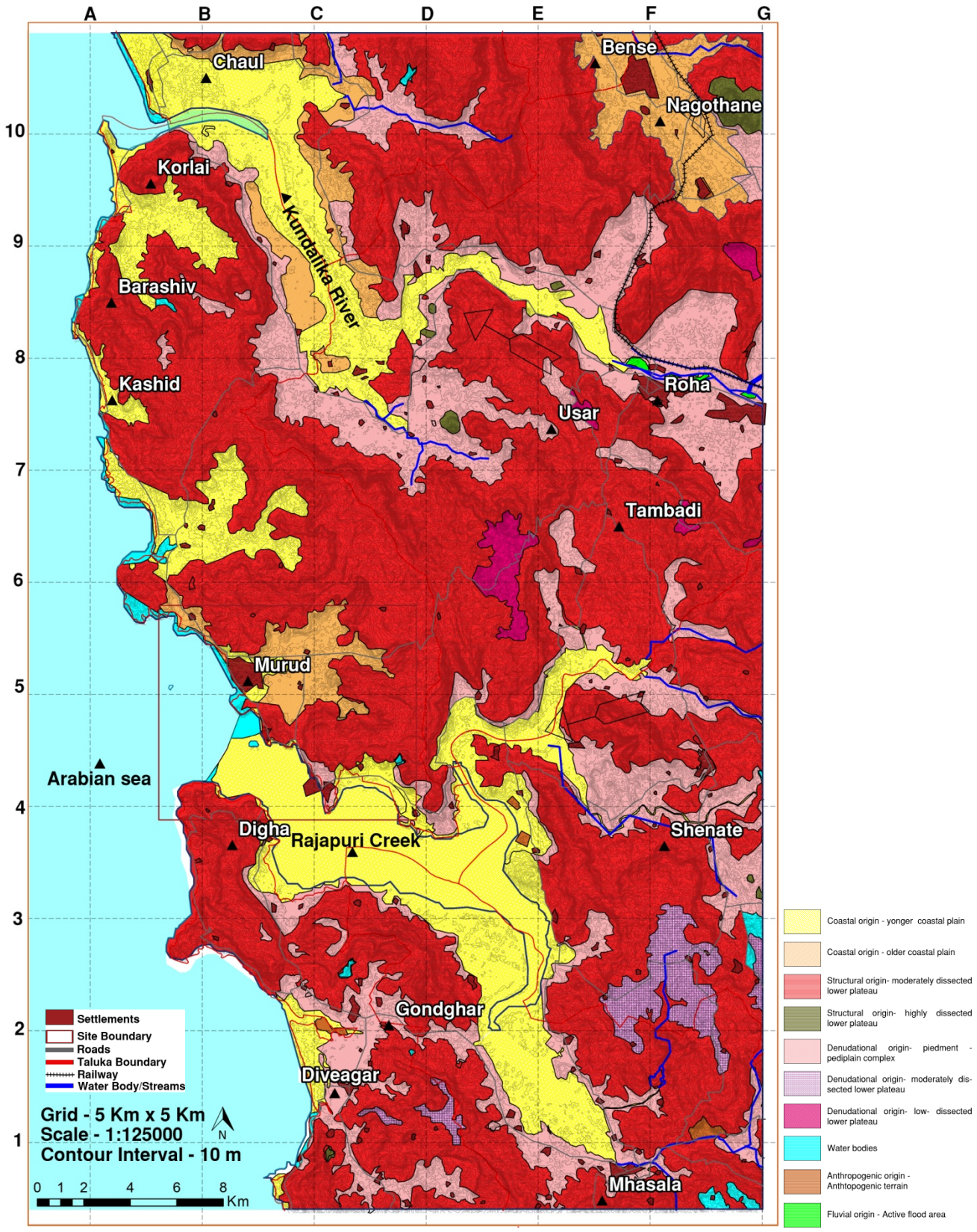
Table 6: Nature and characteristic of the geology of the region

5.5 Geomorphology and Soil Types

The district has three physiographic divisions i.e. (i) Coastal zone in west covers about 20% percent of the district (ii) Central zone covers about 1/3 rd of the district, consisting of fertile land in low lying area (iii) Hilly zone in the eastern part highly uneven in altitude and covered with forest. This hill range is characterized by ruggedness and uneven topography, with crestline of peaks and saddles forming the eastern horizon. Ulhas, Panvel and Patalganga are the three main rivers in northern part. Kundalika River is the main river in central part whereas in the southern part Savitri River is the main river. The soils in the district are formed from the Deccan Trap which is predominating rock formation with small out crops of Laterite at a few places in the Poladpur taluka and Matheran hill. The soils are grouped as Forest, Varkas, Rice, Khar or Saline, Coastal Alluvium and Laterite as per the location and topographical situation.

5.5.1 Alluvium

It is deposited by the rivers and the streams. its developed in lower part of the river forming flood plains and deltas. It is ideal for agriculture and the level of ground water is also high, thus the good source for water harvesting.



Map 17: Geomorphology map of the study region

5.5.2 Deccan trap

They are hard fine grained, compact, dark grey in colour. Deccan ba salt is an igneous formation and the water permeability is known to be very low.

5.5.3 Laterite

Laterite layers are formed by the process of leaching of the parent rock. Due to the lack of the vegetation on the plateau, the rain water here is very high (about 2080 mm per monsoon) it leaches some of the salts downwards making the stone porous and permeable. Laterite has an extremely high permeability for water and cannot hold any during the dry seasons. Hence the plateau tops have generally scraggy scrubland vegetation.Laterite is particularly used as a building block. The construction in this region is dominated by the texture of this laterite building block. The colour of the structures ranges from bright red if newly excavated to black if the structure is very old. This leads to a massive excavation in certain areas to soil erosion.

When moist, laterites can be easily cut with a spade into regular-sized blocks. Laterite is mined while it is below the water table, so it is wet and soft. Upon exposure to air it gradually hardens as the moisture between the flat clay particles evaporates and the larger iron salts lock into a rigid lattice structure and become resistant to atmospheric conditions. The Deccan trap rock is an impervious rock and have less water holding capacity. The water table is high in monsoon but recedes equally fast in the summer season. Laterite bricks may be used in the construction of the Port township

Figure 91: Deccan Trap

Figure 92: Laterite in the region

Figure 93: Laterite bricks

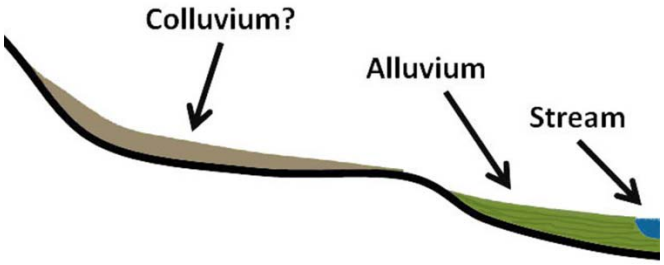


Figure 94: Cross section of alluvium deposits

5.6 Soils

The soils are mostly lateritic in the origin due to the geology. The lateritic soils range from bright red to brownish red owing to the presence of the hydrated iron oxides. They are acidic. lime is non-existent. The texture is loamy and the depth varies from zero to three feet. They are developed by intensive and long lasting weathering by underlying parent rocks.

It has a pH that runs from acidic to neutral. It is silica-poor, from leaching. It is a poor holder of is It matter. So its nutrient levels are low. The laterirtic soil have unusual comp action and absorbance properties. This can create a problem during road construction.

5.6.1 Kuryat soils : These are situated at higher levels. Kharif crops of paddy are generally grown here. They are very shallow, well drained Soils on the less sloping g lands. They have loamy texture. In most places the soils are blown away by wind to expose the bed rock.

5.6.2 Varkas soils : They are situated on the slope of the hills are eroded yellowish red and poor in fertility. They are low in depth and coarse in fertility. Ragi is the primary crop in this soil. These are shallow to moderately deep well drained soils.

5.6.3 Coastal alluvium: They exist in small quantities. They are sandy loams. They are deposited soils consisting of washed down materials from the Western Ghats and by the action of Arabian sea. These are deep to very deep, light grey, pale yellow or brown, sand loamy sand to sandy loam on the surface. The water table in this region is about 10 to 15 mts for most part of the year.

Beach deposits are formed on the sea side of the ghats in the form of small pockets. There are small strips of clean sandy beaches and some places. There are shoals between the mountain cliffs.

The laterite soil has good water holding capacity. The infiltration rate is more but due to the topography the surface runoff is also more. Thus in spite of the heavy rainfall the region is a water scare region. Rain water recharge is possible at the fractures and lineaments. The soil can support kharif crops. As a result of low soil moisture and less water holding capacity The existing forest has been degraded over the period of time. The soil erosion is very high along the steep slope.

Figure 95: Soil erosion on the slopes

Figure 96: Soil Erosion on the barren land

Figure 97: Varkas soil on the slope

Figure 98: Kuryat soil at higher levels.

Map 18: Soil map of the Study Region

SOIL TYPS OF THE STUDY REGION		
032	Soil on dissected hills and intervening valleys	Fine, Vertic ustropepts
022	Soil on undulating and rolling land	Clayey skeletal, mixed , Typic ustropepts
025	Soil on ridges and hill	Clayey, Iso hyperthermic, shallow , typic ustorthents
009	Soil on undulating and valley	Loamy, Mixed Lithic ustropepts

Table 7: Types of soil in the study region

5.7 Physiography

Physiographically the study region falls within the coastal zone. The study region extends upto the plains where the Konkan railway runs. The entire region exhibits peculiar physiographic set up with undulating terrain throughout the region, except coastal plains.

The region can be divided into three parts - steep slopes at the valleys, the plateau and the plains.

A- In some areas the slope of the land gradually increases from the sea, to form a plateau and steeply slopes down into the plains.

B- In some areas the land has a steep slope rising from the sea forming a plateau and sloping into the creek.

The topography and the soil condition of the region is such that there are no perennial rivers in the region. The seasonal small streams flow into the creek or the sea.

5.7.1 Plateau

The plateau region is generally flat. The dominant vegetation in this region is grasses and occasionally scattered trees. As a result of this the region looks barren.

5.7.2 Edges of the plateau (gradual slope) Parts of the land surface is hilly owing to the denudation effects of the small river systems that run from the ridge to the creek or the sea. The edges of the plateau are steep with dense vegetation.


Figure 99: (a & b) View showing the top of the plateau of the study region

5.7.3 Coast line

Along the coastline there are a few projecting bluffs that enclose small sandy bays.


Figure 100: The coastline near Agardanda

Figure 101: The coastline of Murud

5.7.4 Gradually sloping area

The gradual slope in seen only in few places, and most of these area is already developed, or have agriculture and plantations. There is very sparse vegetation on the gradual sloping lands.



Figure 102: The figures represents the sloping area of Murud

5.7.5 Settlements (description of the physical landscape)

The settlements are generally found in the valleys and along the gradual sloping land. they are seen along the sea coast or the creek. There is no development on the plateau.

Figure 103: Settlement in the valley

Figure 104: Settlement in the creek

Figure 105: Dispersed Settlement along slope

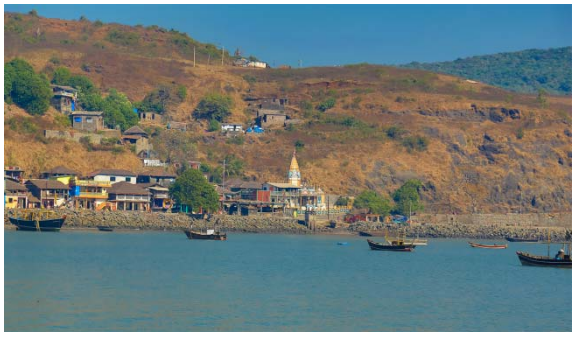


Figure 106: Settlement in the shore Currents

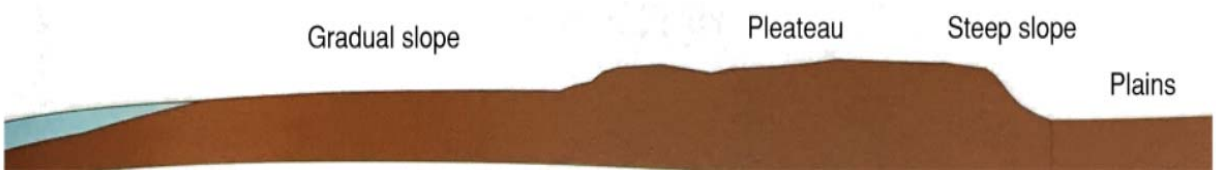


Figure 107: Section showing the physiography of the region

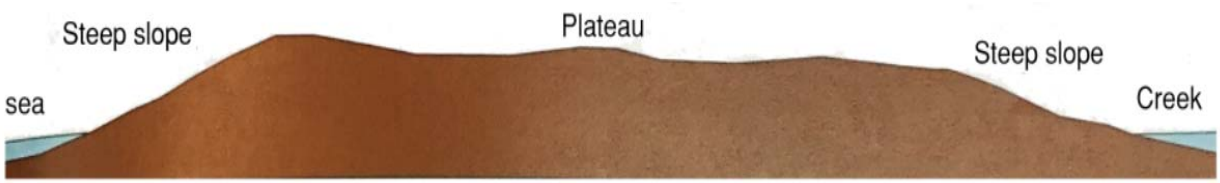
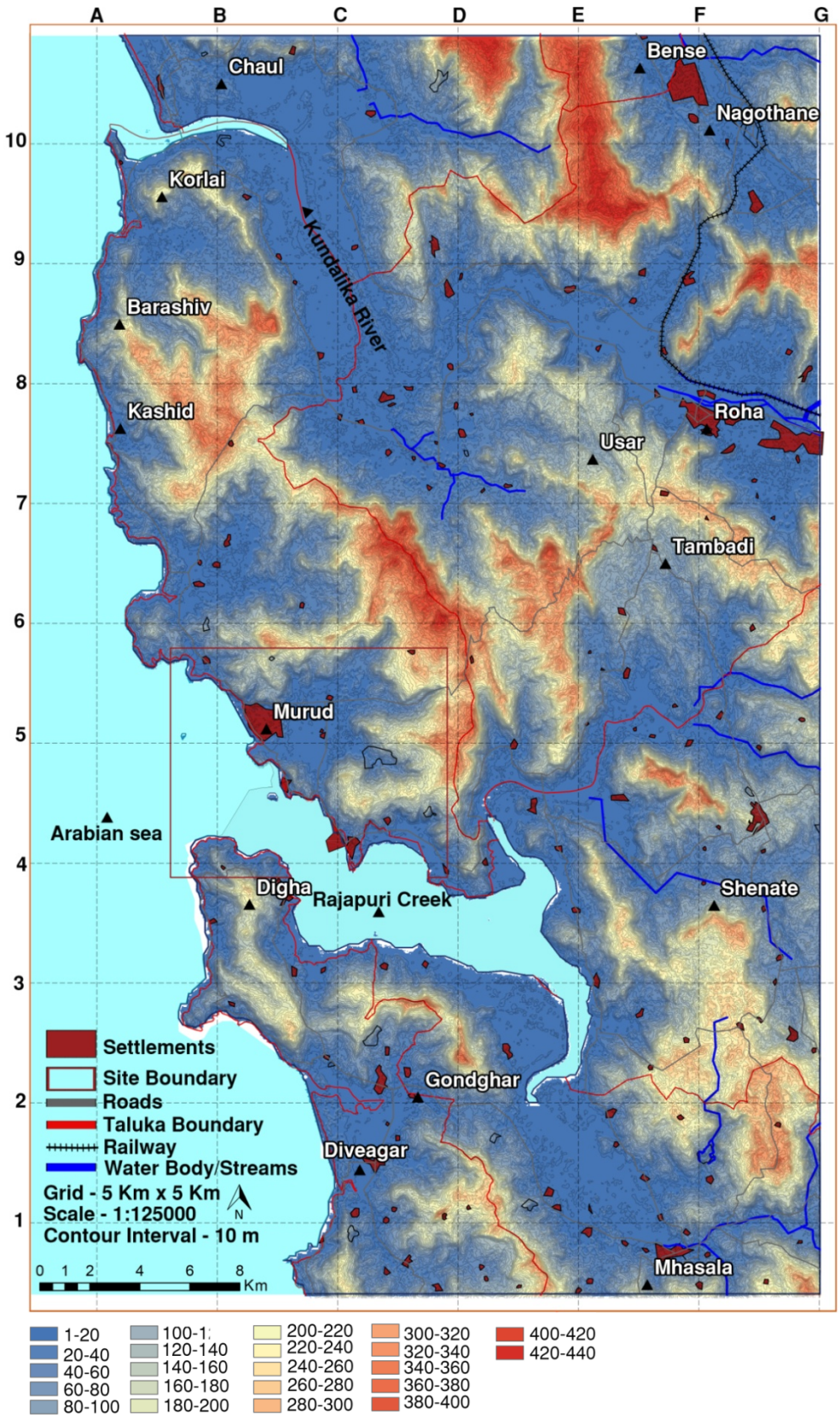


Figure 108: Section showing the physiography of the region



Map 19: Elevation map of the study region

Map 20: Slope map of the study region

5.8 Hydrology

5.8.1 Sea Level

The maximum tidal range = 3.6 mts. The mean spring tide = 3 mts. The mean neap tide = 0.66 mts

5.8.2 Currents

The maximum current speed of the tides = 0.8 m/s at the surface and 0.85 m/s at bottom.

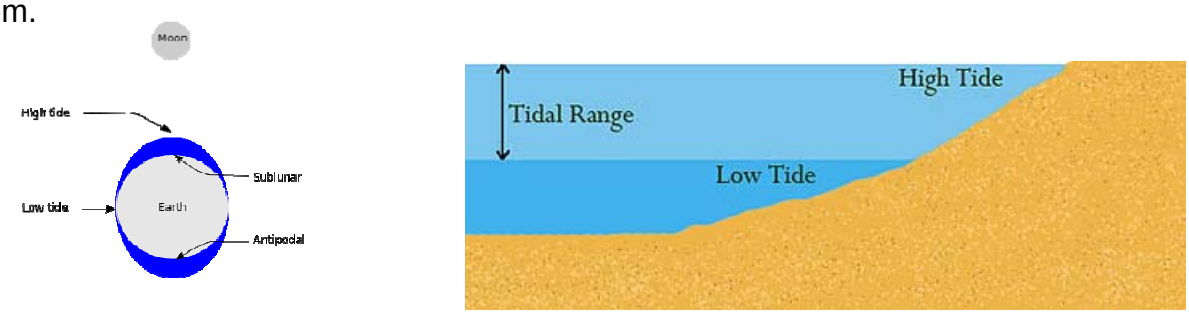


Figure 109: Diagram showing the relationship between the high and the low tide

5.8.3 Temperature

The average temperature varied from 29.1 to 29.6 °C The near shore waters were slightly warmer than the offshore waters with increase in mean temperature of 0.2 °C. Most of the large streams in the Konkan region start in the Sahyadri scrap, the central portion of the district is furrowed by these streams, which mostly have parallel drainage. The basins are narrow and rocky. The estuarine regions have comparatively good soil.

Figure 110: Beach area

Figure 111: Water body at the shore

Figure 112: Water body in the creek

Figure 113: Waterfall at Garambhi Dam

5.8.4 Rajpuri creek

The Port is located at the mouth of the Rajpuri creek, the entrance of the creek is rocky. The creek is mostly uniform in the depth throughout. The depth of the creek is 14 mts. The creek is %out 22.5 km is length and ends at the town of Mhasala.

At springs the tide rises 12 feet in the creek. The bottom is muddy. Shoalest water at low tide, 3J fathoms at the entrance of the creek, 41 inside the entrance in mid-channel. Steamers can enter, even during the rains, and lie in still water.

Small rivulets are formed due to high incident rainfall in this region. These rivulets have high erosive nature. Thus all the streams seem to flow over the Deccan trap geological strata, probably exposed by eroding away the laterite. They are seasonal and drain away into the sea. All the rain water is lost to the sea and the region experiences scarcity of water post monsoon.

The total quantity of rainwater that drains into the creek every year and the total quantity of water in the small rivulets that drains into the sea every year is given in table 11.

Catchment	Area(Sq Km)	Average Annual Rainfall	Quantity of rainfall (M.cu.m)	Percolation (M.cu.m) 40% of	Runoff (M.cu.m) 40% of	Total Water Quantity

		(mm)		Open Area	Open Area	(M.cu.m)
Total catchment of the creek	375	2080	780	312	468	468
Total catchment of the small rivulets near the port	212.5		442	176.8	265.2	265.2

Table 8: Table showing the total water quantity from the catchments of the study region

Every year about 733.2 M.cu.m of water is lost and the region experiences scarcity of water post monsoon. It is necessary to find means to tap and store water so it can be utilized in the non-rainy months. It can be utilized for irrigation so that the region can have double cropping.

5.9 Hydrogeology

Deccan Trap Basalt of upper Cretaceous to lower Eocene is the major rock formation and intruded by a number of dykes. The western part of the district consisting Basalt flows are altered to Laterite. Recent deposits comprising Beach Sand and Alluvium occur along the coast and in the river mouth, however they do not form potential aquifer. The region has a hard rock area which is Deccan trap basalt and soft rock areas which are beach sand and alluvium.

5.9.1 The ground water in hard rock areas

Ground water in Deccan trap basalt occurs mostly in the upper weathered and fractured parts upto 10-15 mts belowground level under unconfined condition. The wells in these areas show rapid decline in the water level during the pet monsoon period and practically go dry in summer. In the foothills zones tye water table is relatively shallower near the water courses.

5.9.2 The ground water in soft rock areas

In the beach sand and alluvial deposits primary porosity is due to the inter granular pore spaces making sands and gravels good water bearing formations. The thickness of alluvium ranges between 10 to 25 meters. These alluvial deposits are potential aquifer at relatively shallow depths only. The ground water below unconfined aquifer at relatively shallow depths of 3-5m and their yield ranges from about 18 to 43 m cube / hr at more depth, seawater intrusion damages this aquifer.

The pre monsoon depth to water level is < 2 m.

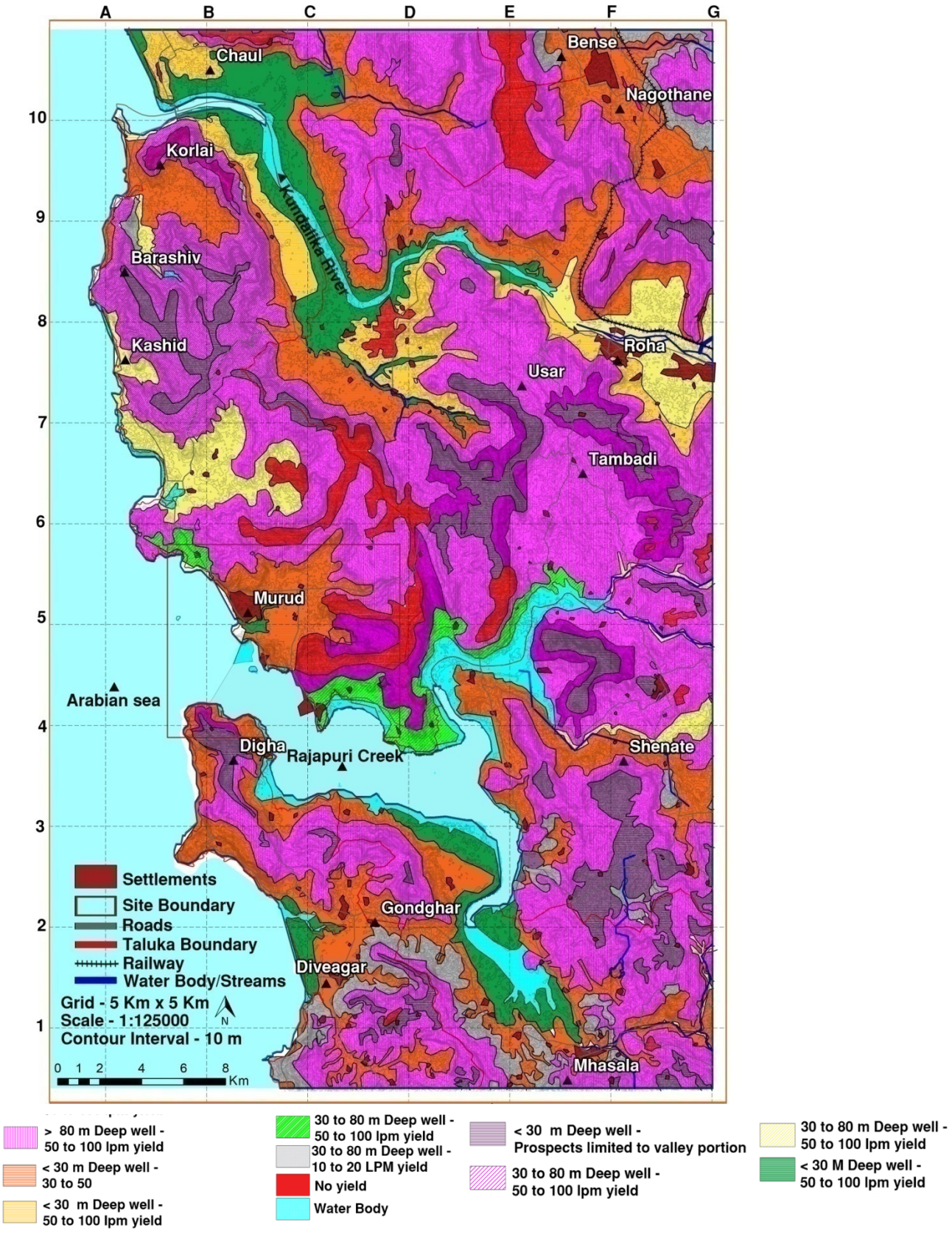
The post monsoon depth to water level falls by 0 - 0.2 m

Laterite depth is about 10 to 25 mts. Water percolates quickly the deccan basalt level. Deccan basalt rock has a lower percolation rate than laterite. Thus although certain amount of water percolates a lot more water is coming to the igneous rock than percolating.

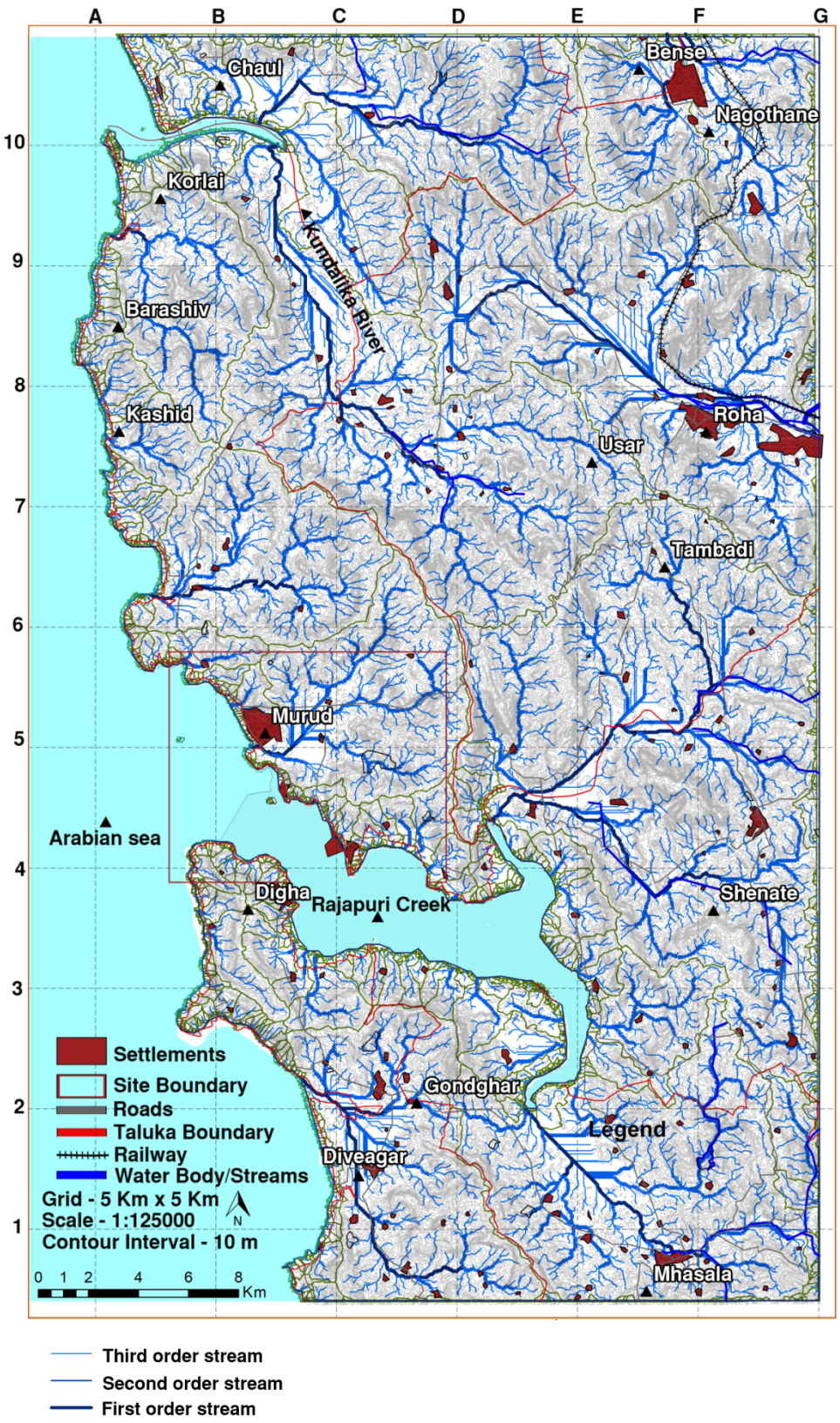
The central ground water board and Ground Water survey and development Agency have jointly estimated the ground water resources of the Raigad district.

Inferences

The groundwater level is very high in the months of July to December in the study region. Maximum utilization of the ground water should be done during this season. The level of ground water is high in the soft rock areas which are along the beach and creek. All the settlements are seen along these areas.



Map 21: Geo Hydrology map of the study region



Map 22: Hydrology map of the study region

5.10Types of vegetation

Forests are situated mostly on the higher slopes and spurs of these hills and lower slopes and flatter tops of the hills are invariably cultivated revenue lands . Thus the forests are mostly relegated to the middle, poorer and infertile slopes of hills which could not be of much use to the villages. the major part of forest contains a wet mixed deciduous type of tree growth on the hill slopes with semi-evergreen to pure evergreen types on the tops and plateaus.

5.10.1 Forest and Ecology

The climate and topography are responsive for the different types of forest in the Konkan region. the forests are the source of large forest produce. The forest produce includes shikakai, bidis, kaju, various fruits, specific spices, and chiwari. Most of these forest produce is made into Pia they are also an employment source for the villagers. The forest produce is processed and they supplied to the hinterland.

5.10.2 Moist deciduous

Slopes of the region have dense vegetation. Most of the timber is being sourced from these mountainous slopes. This forest occurs on the western side of western Maharashtra. Most of the species on the top are second storey. The undergrowth includes many evergreen and

small trees and shrubs. The trees are reaching up to the height of 25 — 30 mts.

5.10.3 Deciduous scrubland

Most of the region is scrubby, tall yellow grasses and deciduous trees are dominant. Soil erosion is high due to scarce vegetation and wind. Due to this the region has a yellow character with the exposed basalt rock. Hill tops are barren due to the soil erosion by heavy rains, at many places even the grasses don’t grow. Accodrding to the Champion and Seth classification, here the southernmost forest has degraded to secondary moist deciduous forest and then into deciduous.

5.10.4 Littoral vegetation on the coastal plains

The plantation along the beach strips. They have a quiet and reclusive character. This category is further divided into three sub groups — Mangroves on the estuarine flange, vegetation on the rocky and sandy coast and vegetation beyond high tide mark.

5.10.5 Ruderal vegetation - Beyond littoral vegetation

The vegetation has a similar characteristic as littoral vegetation and it is found in villages. The villages are along the coast, near d source of water. The villages are generally small with no facilities or amenities. the character of the village is defined by the littoral vegetation.

5.10.6 Mangroves

Mangroves are seen at the mouth of the rivers and creek. They have the tendency to sustain the salinity of the sea.

5.10.7 Agriculture

Agriculture is the second most important occupation of the region. It is done on the flat region near the coast. The cultivated lands are in the close vicinity and have a heavy rainfall of about 2000 mm. The region gets more than enough rainfall, but the rivers are not of the perennial nature as a result of which only one crop is cultivated in this region. The Kharif crop is cultivated in this region. According to the climatic conditions and natural resources available, double cropping is quite possible, but due to the scarcity of water only one crop pattern is seen.

5.10.8 Cropping pattern

The fields of the region are mostly rain fed, the irrigation system is not yet introduced in this region.The result of this a single cropping. The kharif crop of the region is paddy, in this case the rain water is plenty and the major concern is to let go off the bunded water at right time. The yield of this single main crop is about 2500 kg/ha of rice. The rabi crops of this region are vegetables, of this require less amount of water.

5.10.9 Plantations

The cultivated land in the lower region near the coast consists of horticulture and other tree plantations. The rich fertile soil of the region supports a variety of agricultural crops, including, rice, millet, coconut, cashewnut, amla, betelnut, vanilla and pine apple. But majority of the farmers of this region are poor. The resources of this region present a paradox of paucity amid plenty

5.10.9.1 Mango plantations

The Konkan alphonso mangoes are one of the most famous mangoes in India. A variety of mangoes are grown in this region. The plantation requires a lot of care, but the returns the investment are about 200 % annually. Maharastra's annual turnover from mangoes is about 600 crones. Most of it is from the six to seven lakh tonnes the Konkan region produces annually on about one lakh hectares.

5.10.9.2 Areca catechu

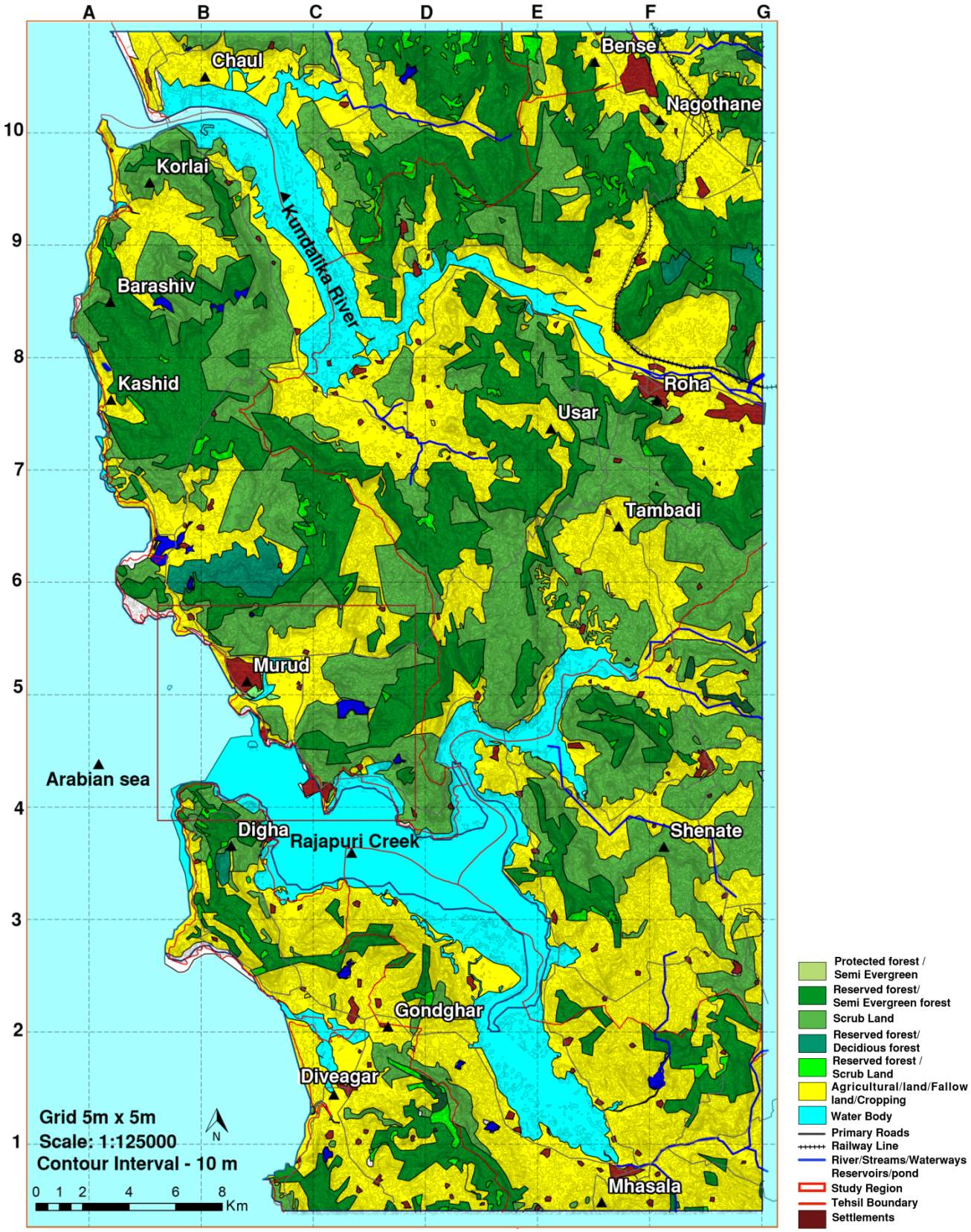
The Areca palm cultivations are the ruderal vegetation in the villages. Almost every house has an Areca plantation in their backyard. The betelnuts are sent to Mumbai, they are processed there and then exported.

5.10.9.3 Coconut Plantations

The coconut like any other coastal region is the native tree of Konkan. All the parts of the coconut tree are used, locally in construction of is the houses thatching etc. It is also the staple food of also the coconuts of this region is also exported commercially.

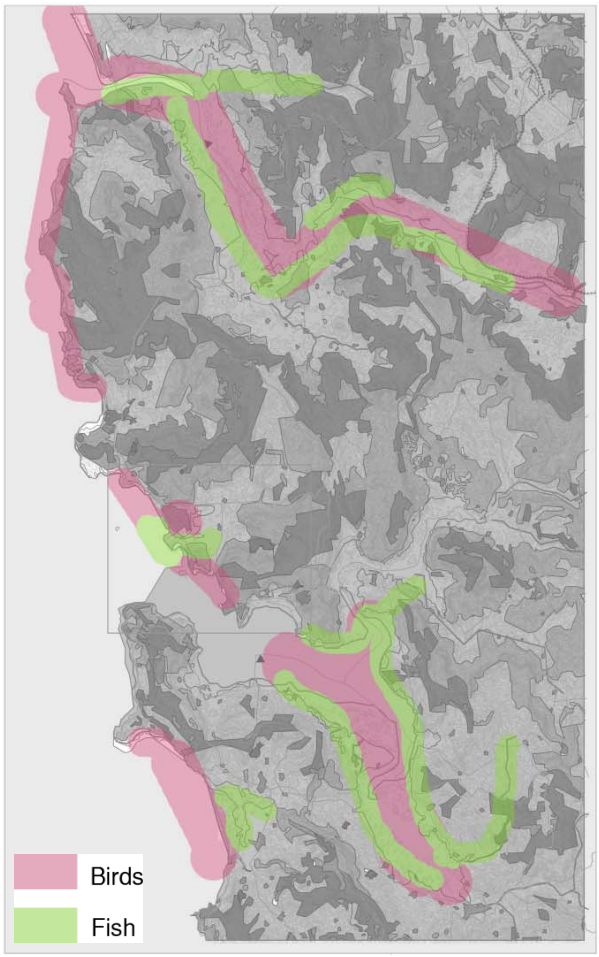
Inference

The region has an undulated topography, and a sloping terrain, due to which scope of development is limited. The construction on the regions with the slope of 1:10, 1:5 and more is not possible. As a result of which the plateaus are the areas which can be further explored for development.

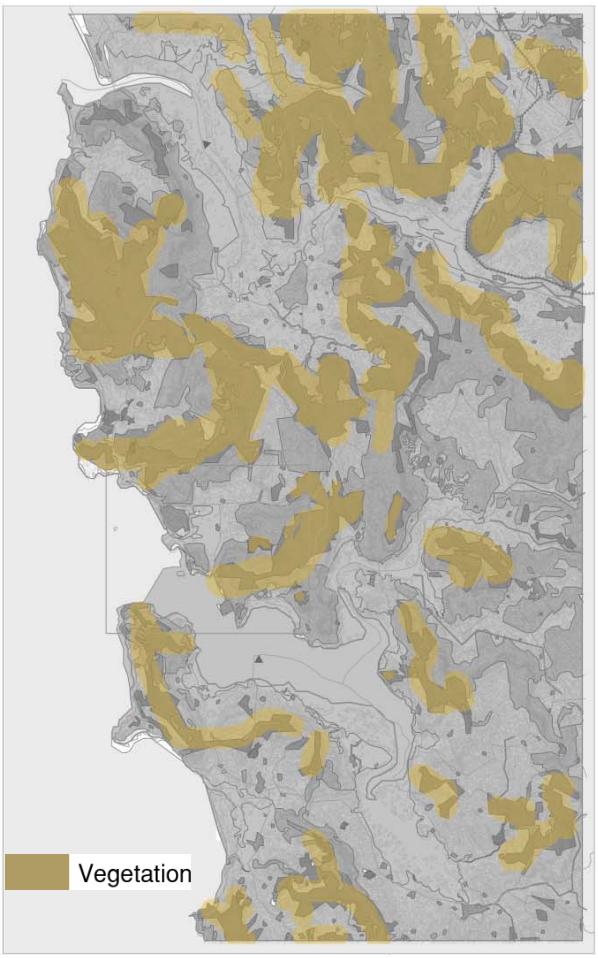


Map 23: Vegetation Map of the study region

5.10.10 Most prominent area to be conserved



Map 24: Faunal associations fish and birds



Map 25: Conservation of vegetated area

Bird Diversity is prominant near wetland , creek and marshy land near the coast line. Fish Diversity is prominant near River mouth and near the Murud creek.The areas marked as reserved forest, protected forest , mangrooves, wetlands, and the coastline are important vegetated areas.

5.10.11 Two broad sub-types can be recognized

5.10.11.1. Teak-bearing areas (*Tectona grandis*) **and 5.10.11.2 Fuel areas** Ain (*Terminalia tomentosa*) and Kinjal (*Terminalia paniculata*). In the former, sub-type teak (*Tectona grandis*) and its associates occur in the following order of incidence: Ambani (*Trewia nudiflora*), Ain *'* (*Terminalia tomentosa*), Dhavda (*Anogeissus latifolia*), Shiris *"*(*Albizzia lebbek*), Ranbhendi (*Tetrameles nudiflora*), Bibla (*Pterocarpus marsupium*), Sawar (*Bombax malabaricum*), Kinjal

(*Terminalia paniculata*), Sissum (*Dalbergia latifolia*). The pre-ponderance of teak is overwhelming in all the teak-bearing areas, the percentage being above 60.The species forming the middle storey are:-Dhaman (*Grewia tiliafolia*), Shivan (*Gmelinaarborea*), Hedi (*Adina cordijolia*), Kumbhi (*Careya arborea*), Pangara (*Erythrina indica*), Sterculia species, etc.The undergrowth mostly consists of Karvi (*Strobilanthus callosus*), Kuda (*Holarrhenaantidysenterica*), Kalkuda (*Wrightia tinctoria*), Kevni (*Helecteris isora*), Karvand (*Carissacarandus*), Ghaneri (*Lantana camara*), etc.This is the only type of forest which gives some timber.

5.10.12 Flora and fauna in the region of Murud

Figure 114: Dhaman (*Grewia tiliafolia*)

Figure 115: Shivan (*Gmelina arborea*)

Figure 116 : Hedi (*Adina cordijolia*)

Figure 117: Kuda (*Holarrhena antidysenterica*)

Figure 118: Kumbhi (*Careya arborea*)

Figure 119: Pangara (*Erythrina indica*)

Figure 120 : *Sterculia*

Figure 121: Karvi (*Strobilanthus callosus*)

Figure 122: Common Kingfisher

Figure 123:Indian Blackbird

Figure 124: Oriental White-eye

Figure 125: Indian Peafowl

Figure 126: Asian Pygmy Goose

Figure 127: Indian Cuckoo

5.10.13 Mangrove species in the region of Murud

Acanthus ilicifolills, Acrostichum aureum, Avicennia officinalis Rhizophora mucronata, Sonneratia apetala, Kandelia candel

Figure 128: Acanthus Ilicifolills

Figure 129: Acrostichum Aureum

5.10.14 Marine species of the region

Surmai, Rawas, Prons, Lobster ,Octopus ,Bombay duck(bombil)

Figure 130: Bombay duck

Figure 131: Surmai

Figure 132: Prawns

Figure 133: Lobster

5.10.15 Minor forest products from the Murud , Raigad district

Apta: (*Bauhinia racemosa Lam.*) Leaves for bidis.

Bahava: (*Cassia fistula* Lam.) Pods.

Chilian: (*Cæsalpinia sepiaria* Roxb.) Bark.

Harda: (*Terminalia chebula* Retz.) Fruit.

Shemb: (*Cæsalpinia digyna* Rottl.) Bark.

Shikekai: (*Acacia concinna* DC.) Pods for hair-wash.

Tad: (*Borassus flabellifer* Linn) Leaves for thatching.

Timru: Leaves for bidis.

Palas flowers: Used for medicinal purpose.

Dhaiti flowers: Used for medicinal purpose.

5.11 Tourism analysis of Murud

Murud-Janjira city is renowned as a tourist spot. The existing infrastructure is in adequate to support tourism in the city and it needs urgent up gradation. The city has wide range of tourism products, which need to be integrated and made a circuit to increase the duration of stay of the tourists in the city.

5.11.1 The Settlement pattern of the region

The settlements are located along the sea coast or on the banks of the creek. The settlements turn sparse as one moves towards the hilly areas. The settlements are linear along the sea coast and in the form of clusters on the banks of the creek. Murud is major town of the district having all the important amenities and facilities. The other settlements are small hamlets and are dependent on the natural resources of the region. They are dependent on Murud for educational and health services. Murud has a Marathi speaking population and also Islamic communities. The occupation of the people being fishing and farming. They live in villages and urbanization is yet to be witnessed. The people are not tribal, they are not cut off from the urban development. The villages of Konkan are well connected with the major cities of Maharashtra. The villages have good educational facilities like a primary and secondary schools. The health care facilities of the village are adequate for the sustenance. In the case of emergencies, the people need to visit the town. The staple diet in the region includes sea food, rice, wheat (in the form of rotis). pulses, onion, spices. There is generally a tamarind. coconut or kokam dressing.

5.11.2 Houses

The houses are raised above the ground level by30 to 60 cms, on a squarish plinth, of mud or gravel. the walls are wattled and they have sloping roofs with Mangalore clay tiles. The slope of the roof is more than 30 degrees as the region experiences heavy rainfall. The front yard or 'angane", which is sometimes used as a threshing-floor, has several mud-smeared wicker-work rice frames, kangas, and rows of cow dung cakes drying in the sun. The houses vary with culture and economic status.Thus the houses

can be of simple thatched roof or a sophisticated two storeyed structure. In most of the cases the materials used are local.

Figure 134: Housing typology in Murud

Figure 135: Abandoned house

5.11.3 Population

The population density of the big towns like Murud is about 800 persons per sq km. The population density of the small hamlets is about 200 to 300 persons Per Sq km.

Census years	Population	Decadal increase(+) Decadal decrease (-)	% variation	Incremental increase per decade	Annual growth rate in %
1961	10055	311	3.19%	-976	3.19%
1971	11210	1	0.01%	-310	0.01%
1981	11234	24	0.21%	23	0.21%
1991	12111	977	7.81%	853	7.81%
2001	12551	440	3.63%	-437	3.63%
2011	12216	-335	-2.67%	-775	-2.67%

Table 9: Table showing the population of the region of last 50 years

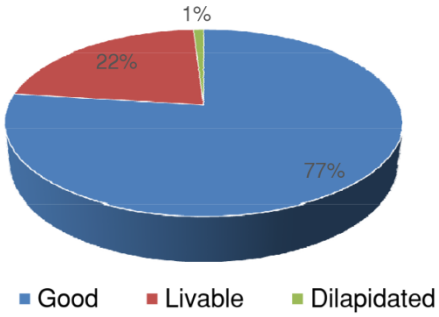


Chart 9: Housing conditions

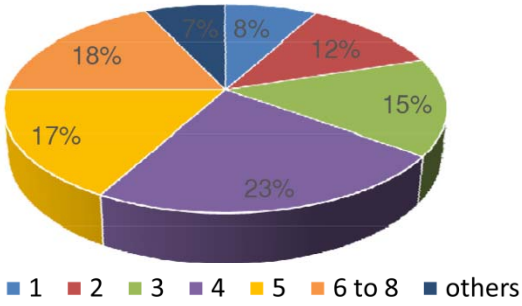


Chart 10: Housing size

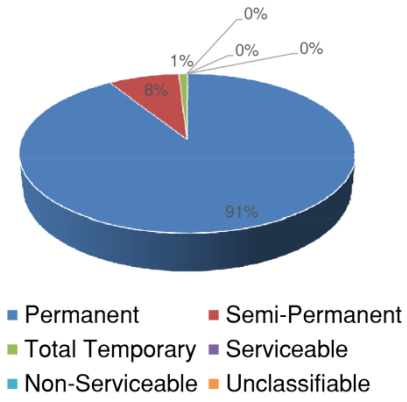


Chart 11: Type of structure

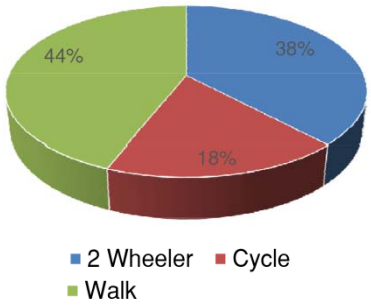


Chart 12: Preferable mode within area

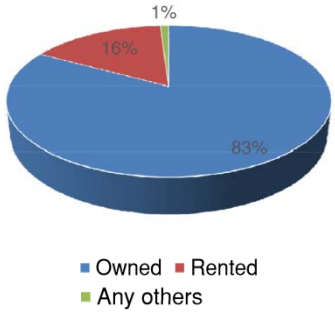


Chart 13: Ownership status

5.11.4 The source of main occupation

The entire Konkan coast has a very high yield potential for fishing. Fishing being the primary occupation of the coastal villages and towns. Most of the fish is supplied to the hinterland. The estimates of the year 1980 suggest that the district of Raigad is 10,000 metric tonnes.

Total production of fish in Konkan region of Maharashtra is 3.5 lakh tonnes per year out of that, nearly 30% are dried and sold as a dried food in the market mostly during the off-season from June to September.

5.11.4.1 Fish species

Marine fishes - mackrel, sardines, anchovies, pomfrets, catfish, sciaenids, prawns, crabs, lobsters, sqids, shell, soles.

Estuarine fishes - Mullets, gerres, estroplus.

5.11.4.2 Infrastructure for fishing

5.11.4.2 (a) Non mechanised boats

Most of the small villages have non mechanised methods for fishing; they rely on proper netting and placement of small boats. This is the traditional method of fishing; It is not very efficient and wholly reliable.

5.11.4.2 (b) Mechanised boats

The Dighi and Agardanda Ports have mechanized boats and trawlers which travel upto 20 kms in the sea. The fish is then exported to the hinterland. As a result of mechanization Murud has large annual catch.Fishing is the primary boats occupation of the region. The region has a high potential for fishing,due to the proximity to sea and the creek. The Port and the allied activities will have a direct impact on fishing. The impact on the water quality and decline in the yield of the fish will reduce the economy of the region.

5.11.5 Impact of the Port development

- Water
- Air
- Land
- Biological environment
- Socio-economics

5.11.5.1 Impact on water and its measures

Port operations can have adverse effects on water quality and subsequently to marine life. These effects may include bacterial and viral contamination of commercial fish and shellfish, depletion of oxygen in water and bioaccumulation of certain toxins in fish. Major water quality concerns at ports include waste water and leaking if toxic substances from ships, storm water runoff and dredging.

Breakwaters and landfills may change current patterns and cause stagnation of water behind the structures. If municipal or industrial effluent flows into a port, stagnant port water may deteriorate through a dramatic increase of phytoplankton and a decrease of dissolved oxygen, resulting from eutrophication of water, caused by effluents containing nutrient salts. Anaerobic water leads to the generation of hydrogen sulphide and can be identified by its odour. It has serious effects on organisms. Municipal sewage also brings coliform bacteria into the port and may cause unacceptable contamination of the harbour.

Careful site selection and port design should be carried out, focusing on the possibility i of water stagnation. If the basic pollution level s critically high, a sewage treatment system should be planned as part of the environment management of the area. Regulations on discharges of effluents into water and provision of sanitary treatment facilities are indispensable for reducing pollutants from hinterlands. In a polluted bay or port, it could be effective to dredge or cover contaminated bottom sediment capping to reduce the flux of pollutants from the sediment to the water.

5.11.5.2 Impacts on coastal hydrology and its measures

The location of a port may cause changes in current patterns and littoral drifts due to alteration of wave refraction, diffraction and reflection. The change of littoral drift may lead to erosion or accretion in shore zones. Altered currents or reflected waves may endanger small ships manoeuvring near structures. The creation of a port may cause changes in river flow and waterfront drainage.

Careful site selection and port design could minimize changes in current patterns another coastal hydrology. Model experiments or computer simulations of these changes are used in developing an appropriate design. Typical measures against beach erosion are construction of sea walls, jetties, offshore breakwaters, and periodical beach nourishment.

5.11.5.3 Impact on bottom contamination

The location of the port may accelerate sediment deposition in stagnant water behind structures and cause contamination of the sea bottom. Sediment deposition covers bottom biota and physical habitat. Pile structures shade the bottom and affect habitat. Eutrophication of water induces sedimentation of dead plankton and changes chemical characteristics of bottom sediments, resulting in an increase of organic matter, hydrogen sulphide and mobilization of harmful substances.

5.11.5.4 Impacts on marine/coastal ecology and its measures

The location of a port affects aquatic fauna and flora through changes of water quality, and bottom contamination. Land reclamation from the sea destroys bottom habitat and

displaces fishery resources. Terrestrial fauna and flora may also be location of a port. Diminution of bottom biota is usually linked to a reduction of fishery resources, and occasionally to an increase of undesirable species. Deterioration of water quality usually gives rise to changes in aquatic biota: a decrease in the number of species; and an increase in the quantity of the one or two species. Further deterioration may lead to the destruction if all kinds of aquatic biota. Diminution of plants in a shore zone within enclosed water may degrade its aeration capability and worsen water pollution. Mangroves in wetlands play an important role in providing habitat for terrestrial and aquatic biota and indirectly recovering water quality.

Adverse effects on marine and coastal ecology usually result from: deterioration of water and air quality; current pattern changes; bottom contamination; physical loss of water area and air quality ' and changes in natural land habitat. Careful survey of the ecological characteristics of a project area is indispensable if the welfare of endangered and fragile species is to be considered and disruption of their spawning seasons and areas migration is to be minimized. Planting of green plants around a port may be an and effective means to mitigate adverse effects on terrestrial habitat.

5.11.5.5 The impact on mangroves and mudflats

The out flush of water from the creek is lesser. The polluted water with oil spills and effluents will get accumulated in these areas. The mangroves and mudflats in these areas are thus endangered. Dredging and filling activities have caused flooding of mangrove habitat. Standing water covers the aerial roots, making it impossible for oxygen to reach the specialized roots as well as the underground 'Pas'" root systems. Eventually this leads to the deaths of mangrove trees.

CHAPTER NO.6

6 Tourism

6.1 Analysis of tourism in the region of murud

Murud-Janjira city is renouned as a tourist spot. The existing infrastructure is inadequate to support tourism in the city and it needs urgent upgradation. The city has wide range of tourism products, which need to be integrated and made a circuit to increase the duration of stay of the tourists in the city.

The city has immense scope of development in the field of tourism sector. Since tourism is a major sector, which can contribute to overall development of the city, and at the same time achieve the objectives of conservation and development of cultural heritage, art and architecture, there is a need for added attention on tourism development in the city.

(Tourism survey for state of Maharashtra under Ministry of Tourism , 2011)

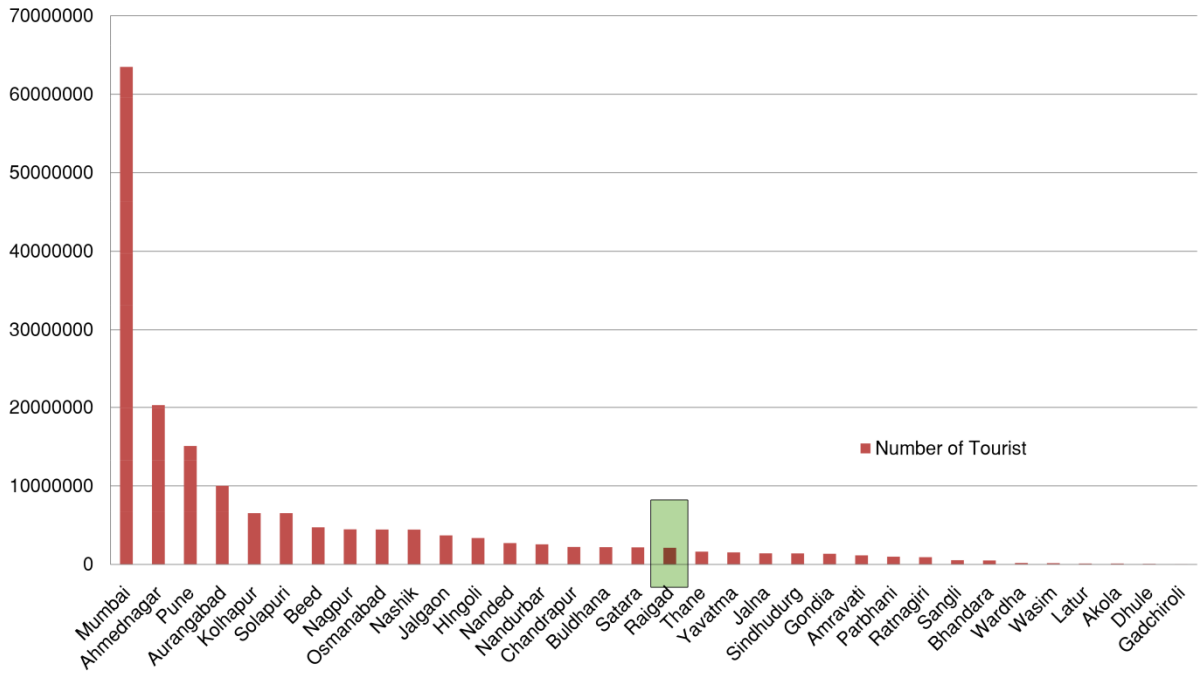
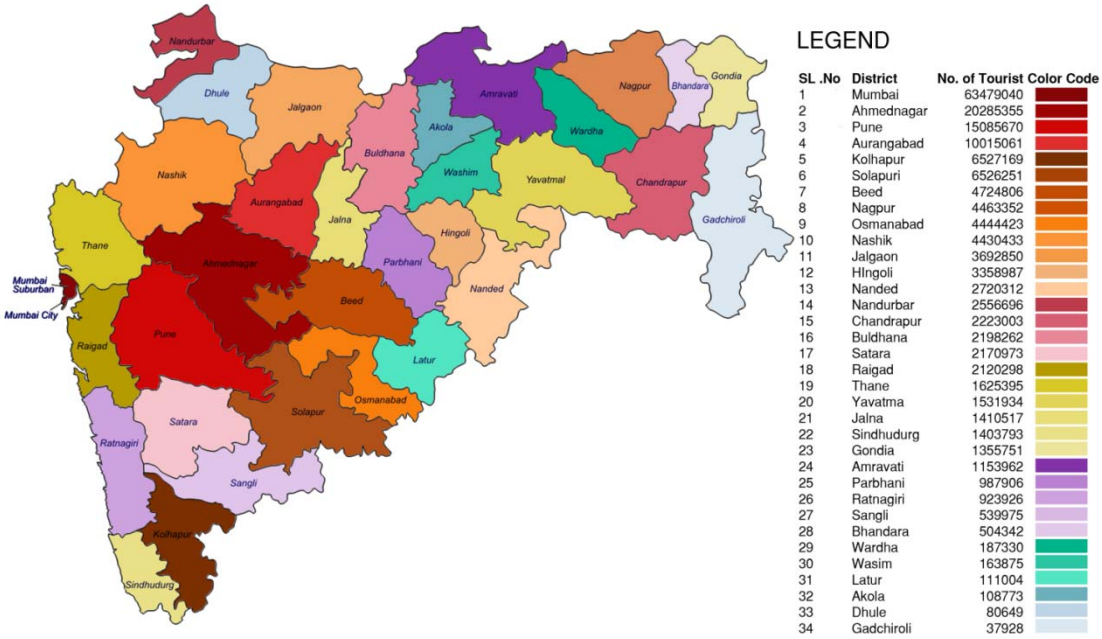


Chart 14: District wise domestic visitors' arrival in Maharashtra

Mumbai had the highest number if tourist arrival with 25% while the second highest is the district of Ahmednagar with 11% and Raigad had the 18th highest tourist arrival with in the state of Maharashtra. The district wise domestic tourist arrival is shown in the above table



SL .No	District	No. of Tourist	Color Code
1	Mumbai	63479040	
2	Ahmednagar	20285355	
3	Pune	15085670	
4	Aurangabad	10015061	
5	Kolhapur	6527169	
6	Solapuri	6526251	
7	Beed	4724806	
8	Nagpur	4463352	
9	Osmanabad	4444423	
10	Nashik	4430433	
11	Jalgaon	3692850	
12	HIngoli	3358987	
13	Nanded	2720312	
14	Nandurbar	2556696	
15	Chandrapur	2223003	
16	Buldhana	2198262	
17	Satara	2170973	
18	Raigad	2120298	
19	Thane	1625395	
20	Yavatma	1531934	
21	Jalna	1410517	
22	Sindhudurg	1403793	
23	Gondia	1355751	
24	Amravati	1153962	
25	Parbhani	987906	
26	Ratnagiri	923926	
27	Sangli	539975	
28	Bhandara	504342	
29	Wardha	187330	
30	Wasim	163875	
31	Latur	111004	
32	Akola	108773	
33	Dhule	80649	
34	Gadchiroli	37928	

Map 26: Map representing the highest tourist flow of the districts of Maharshtra to Raigad

The city has wide range of tourism products, which need to be integrated and made a circuit to increase the duration of stay of the tourists in the city.

The city has immense scope of development in the field of tourism sector. Since tourism is a major sector, which can contribute to overall development of the city, and at the same time achieve the objectives of conservation and development of cultural heritage, art and architecture, there is a need for added attention on tourism development in the city.(Murud vevelopment plan, 2009)

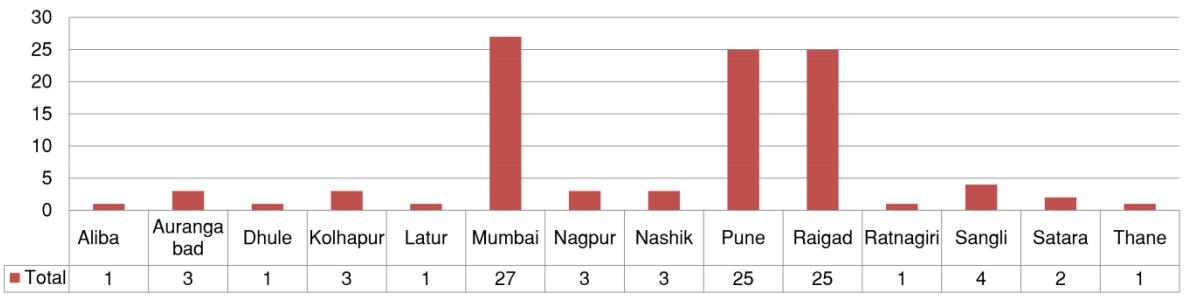
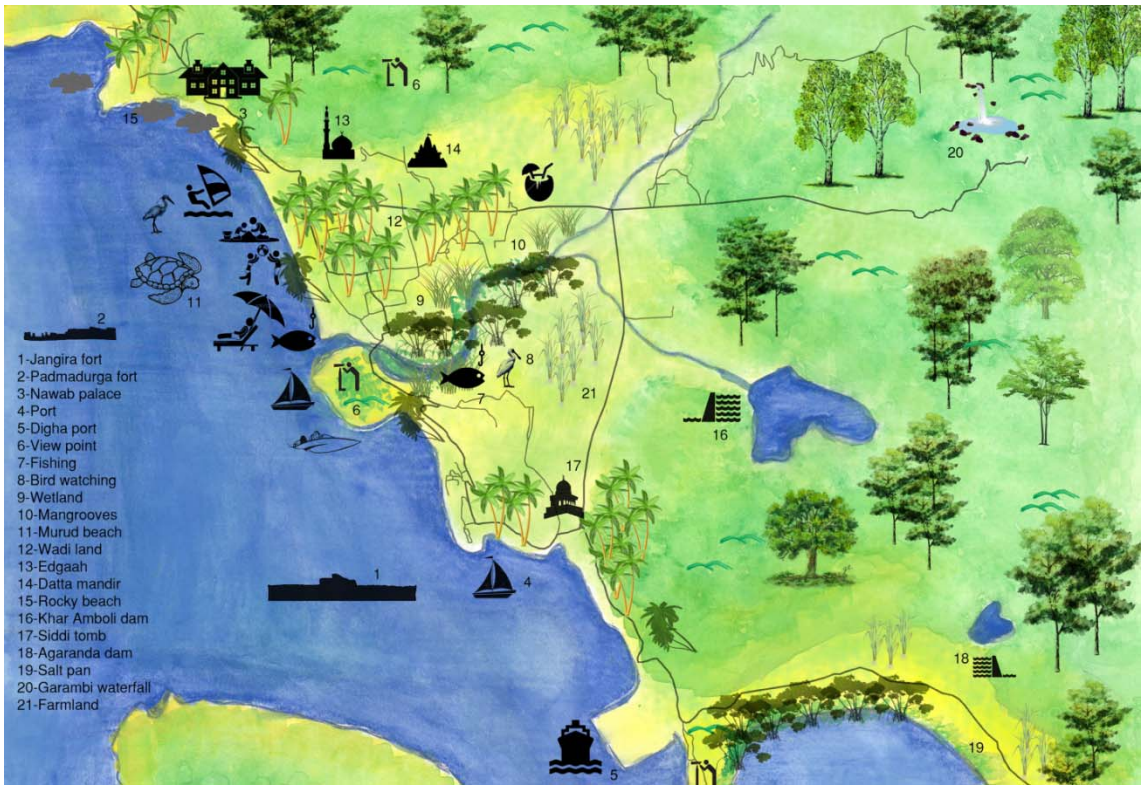


Chart 15: District wise origin of tourists



Map 27: The potential places where tourism can be developed

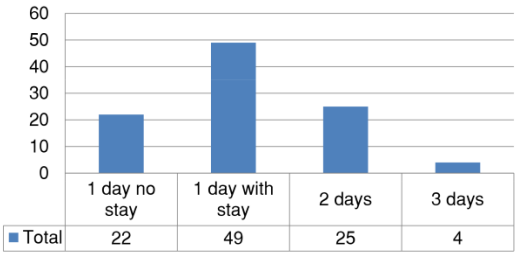


Chart 16: Prefer of staying

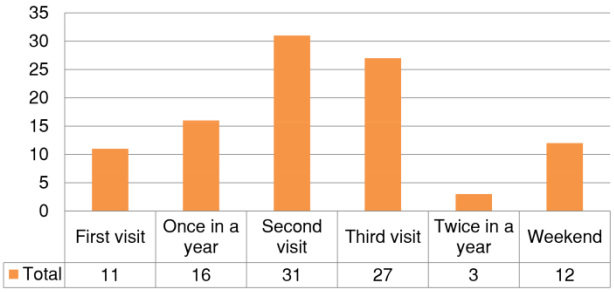


Chart 17: Frequencies of tourist

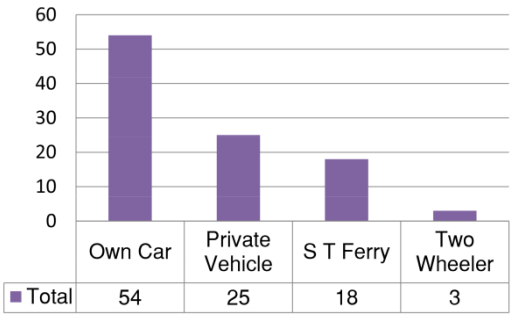


Chart 18: Mode of transport

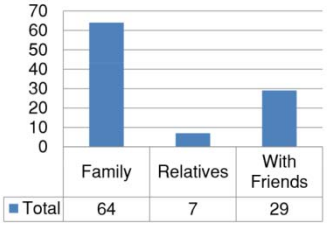


Chart 19: Accompanying member

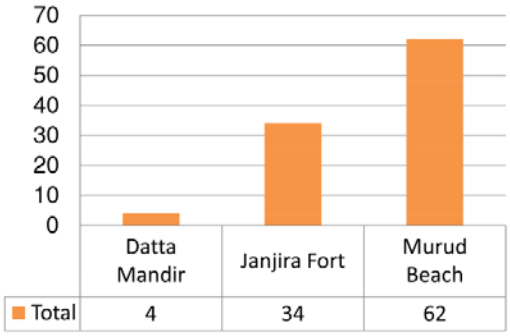


Chart 20: Maximum visited place

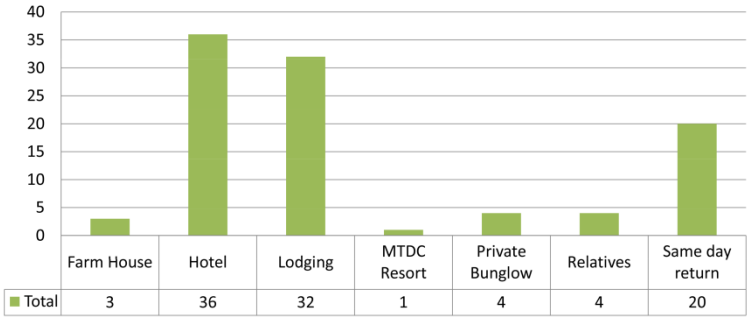


Chart 21: Mode of Accommodation

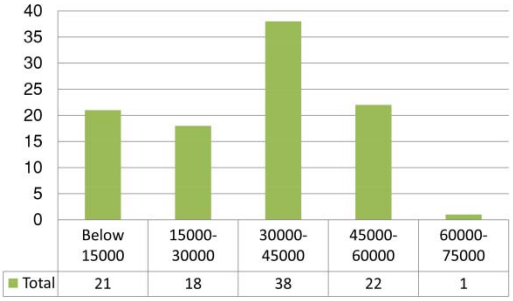


Chart 22: Income level of tourist

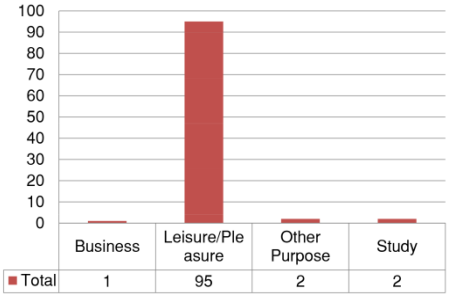


Chart 23: Purpose of tourist

Need/Priority for Development of Existing facilities						
Priority	1	2	3	4	5	Total
Food	0	4	12	25	59	100
Cleanliness	61	17	13	5	4	100
Drinking water	2	8	56	21	13	100
Parking	4	11	21	48	16	100
Toilet	35	58	5	2	0	100

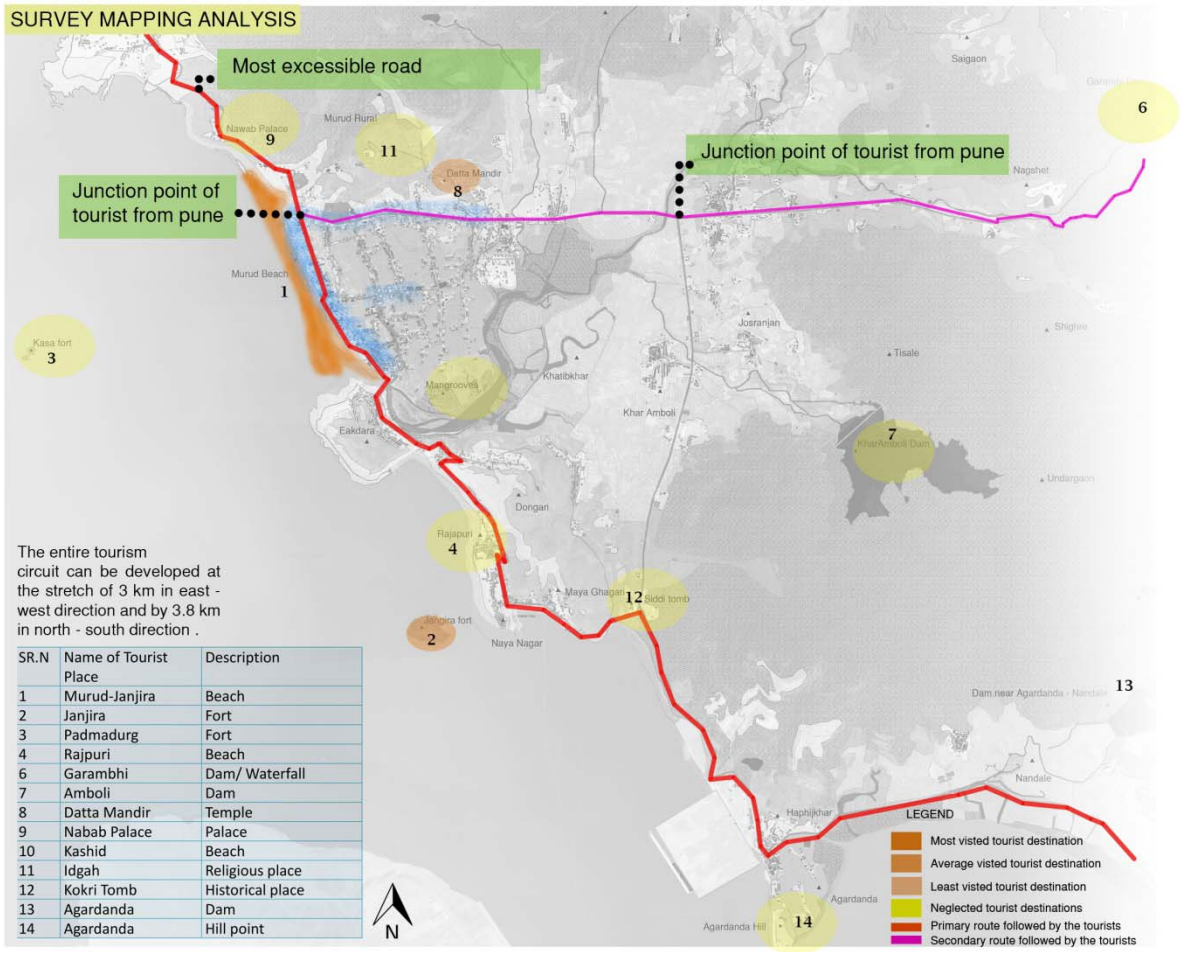
Table 10: Priority of development of existing facilities

Tourists view about facilities		
Facility	% of tourist Satisfied	Total Tourist
Parking	62%	100%
Cafeteria	93%	100%
Toilet	19%	100%
Water	20%	100%

Table 11: Facilities satisfactions

Tourists expenditure on Tourism	
Facility	Avg. % Expenditure
Accommodation	19%
Food	32%
Transport	34%
Shopping	5%
Others	10%
Total	100%

Table 12: Tourist expenditure



SR.N	Name of Tourist Place	Description
1	Murud-Janjira	Beach
2	Janjira	Fort
3	Padmadurg	Fort
4	Rajpuri	Beach
6	Garambhi	Dam/ Waterfall
7	Amboli	Dam
8	Datta Mandir	Temple
9	Nabab Palace	Palace
10	Kashid	Beach
11	Idgah	Religious place
12	Kokri Tomb	Historical place
13	Agardanda	Dam
14	Agardanda	Hill point

Map 28: Surveying mapping analysis

PROBLEMS IDENTIFIED
• Tourism spots should be developed and well maintained.
• Parking for tourism is a major issue.
• Drainage problems , Re use of the waste water in fields , verme composting of sol id waste
• Development of the Mumbai – Murud roads.
• Street infrastructure should be developed.
• Development of sea shore.
• Sand and silt deposition in creek should be removed and bandara (groynes emba nkment) should be built will help in increasing backwater and help fishing.

• Water sport activity should be developed.
• Regional connectivity should be improved.
• Roads doesn't have proper infrastructure
• Changing room and sanitation facilities to visitors should be provided
• Tourist getting disappointed due to proper facilities.
• Security from municipal council should be present on beach to have controls.
• No life guard on sea led to danger to life of visitors.

Table 13: Problems identified in the region

TOURIST DESTINATION AND DESCRIPTION	INFRASTRUCTURE FACILITIES						
	Shopping	Eating joints	Toilet	Drinking water	Resting place	Waste bins	Cate
Murud-Janjira Beach: Is located on west side of the city and is the major attraction points for tourist							Natural
Murud-Janjira Fish Market: The major attraction of visitors and provides branding to Murud-Janjira.							Econo
Janjira Fort: Janjira is one of the strongest marine forts of India.							Histo
Nawab Place: The palace was built in 1885 for administrative purpose.							Histo
Datta Temple: Located on the hill top on the east side of Murud- Janjira city .							Religi
Kokri Tomb: Three 500-year-old massive stone tombs of early Janjira rulers							Histo
Ekdhara mountain: It is a place of Muslim religious important help in developing the spot							Religi
Garambi Dam: Situated on east side of Murud-Janjira and has high tourist potential							Natural
Padmadurg: Historical sea forts built by Shivaji Maharaj in 1672-1673 C.E							Histor
Khar Amboli Dam: A dam in Murud							Na

Table 14: Tourist destination and descriptions

Off-Site & On-Site Infrastructure	
No Facilities/Not present	
Available but insufficient/Low quality	
Available with good Quality/Sufficient	

Sustainable tourism development potential in Murud-Janjira city
• Tourism infrastructure development/improvement
• Beach/sea shore landscaping and introducing water sports
• Eco-tourism potential: The geographic diversity of the region of Murud-Janjira provides as opportunity ecotourism facilities. Along with many natural ecotourism sites Raigad is surrounded by several beautiful and historic Forts like Raigad, Murud-Janjira, Sudhagad fort etc. These Forts are the best ecotourism sites of Raigad district.
• Raigad is also blessed with many beautiful tourist desinations like Matheran, Elephanta caves, Dhak Bahiri fort and caves, Karnala bird sanctuary, Pandavkada waterfall. etc

Table 15: Sustainable tourism development potential in Murud – Jangira city

Figure 136: Inter linkage of the management issues that the coast is facing

Figure 137: Oil spilled from boat traffic

Figure 138: Sewage disposal

Figure 139: Hotels coming up along the coast

6.2 Impacts of habitat modification in the natural areas affecting the region of Murud

- **Sand dunes** – The flattening of sand dunes and clearing of beach vegetation both led to beach/ sea shore erosion
- **Beach areas (including the shoreline)** – Infrastructure construction, continuous human presence
- **Mangroves** – vital buffers and spawning grounds are cleared for reclaiming land
- Estuaries, creeks, etc. –
- Construction on the shore line
- Municipal waste dumping from villages (Borli, Barshiv)
- Sand removal, dredging (Rajpuri creek, Murud)
- Land filling/ reclamation (Agardande)
- Near shore eco-systems – sea grass beds, reefs, etc.
- Offshore waters – pollution caused by oil spills from boat traffic, rubbish dumps and open sewage lines

6.3 Impacts on flora and fauna (localized problems)

Disruption in critical periods of faunal life-cycles

Disruption in floral regeneration due to tourism activities or infrastructure

Direct impact on population via trade wildlife

Trade in fauna – pets, food, artifacts, trade for medicines

6.4 Pollution

Sewage disposal – the sea is a convenient dumping ground for coastal towns as well as upriver settlements, and so do heritage (Janjira Fort) Garbage , Chemical runoffs into the sea, mainly from industrial areas (at Revdanda)

6.5 Disruption of traditional uses

Loss of beach/ sea shore access due to exclusion or upcoming constructions

Loss of beach area for traditional activities like fishing and drying fish, etc.

6.6 Disruption of social equilibrium

Low-level employment of locals in the tourism industry leads to changing patterns of employment Breaking links with traditional occupation

6.7 The wealth of murud region is being destroyed due to the following reasons

Lack of strong agency responsible for conservation, as there is for the forest regions

Lack of activity to educate the public on conservation and management of coastal zones

Lack of information database on coastal heritage

Lack of proper use of land for tourism and industries

Lack of CRZ being used in the appropriate context

Lack of awareness of this heritage as a potential resource

Lack of policies for Coastal Heritage Management systems

6.8 Main Economic generation of Murud- Janjira

1) Fishing 2) Agriculture / Poultry Farm 3) Tourism 4) Wadi lands

Figure 140: Fishing activity in Murud

Figure 141: Tourist near the beach

Figure 142: Agricultural land

Figure 143: Wadi land near Siddi Tomb

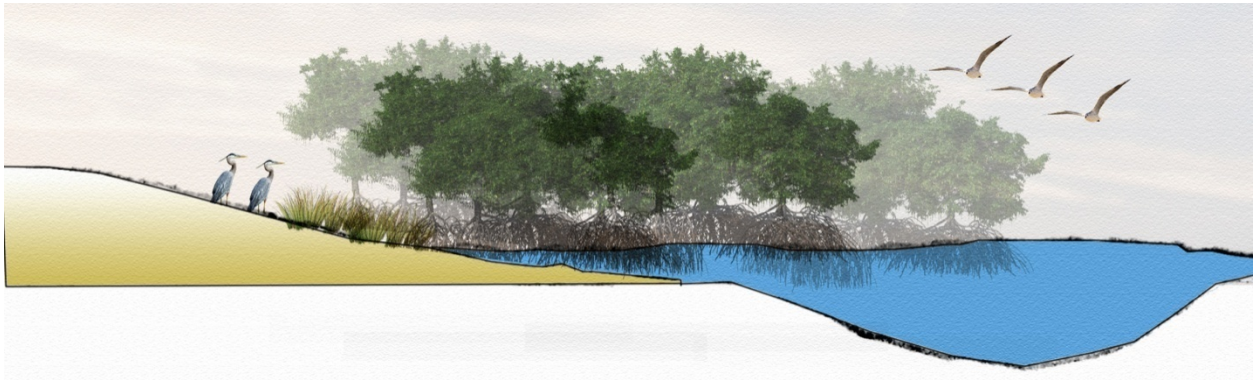


Figure 144: Section showing mangroves in the creek

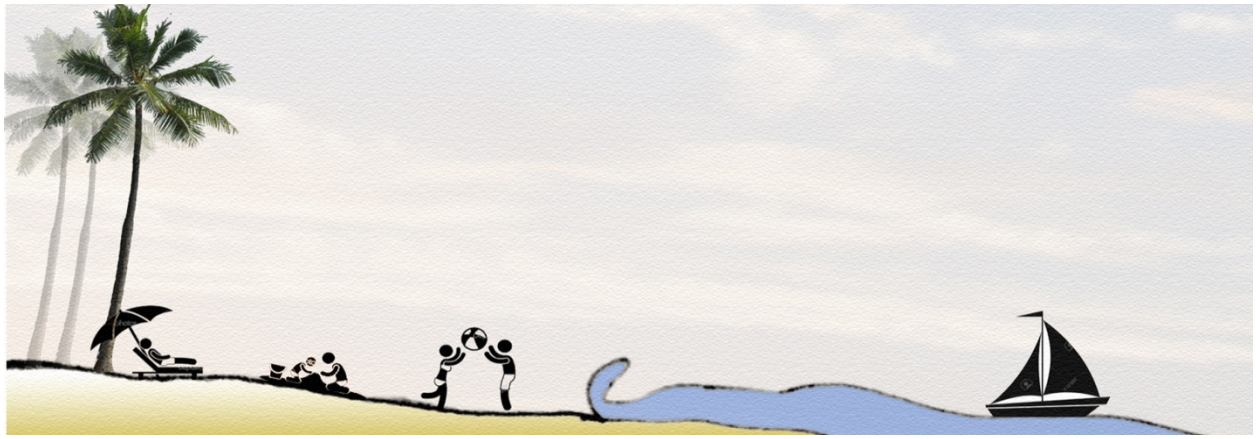


Figure 145: Tourism at the beach

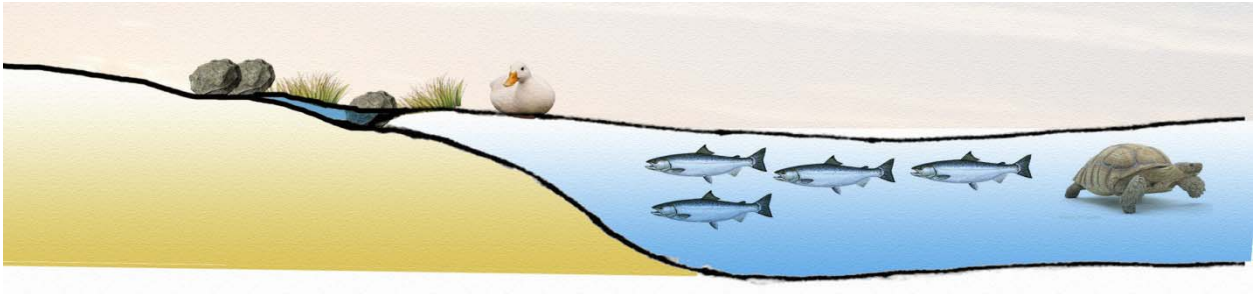


Figure 146: Living species in the coastal area

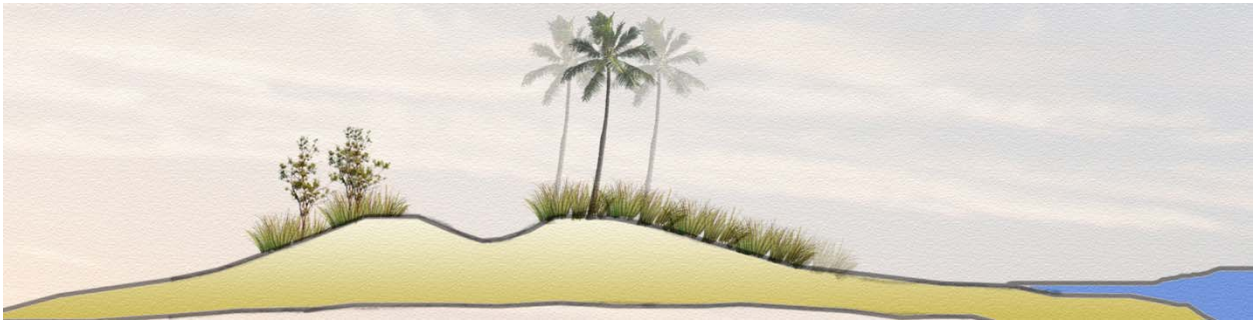


Figure 147: The sund dunes

Figure 148: The fishing activity

Figure 149: Birds species in the wetlands

Figure 150: The road which runs from Janjira fort to Siddi tomb

CHAPTER NO.7

7 Proposal

In this chapter some proposals are discussed how the coastal area of Murud – Janjira is revitalized. And some guidelines and conclusions are given based on the result of this research.

7.1 Revitalized is done by the following ways

1) Conserving, preserving and rehabilitation of the natural resources and historical precinct of the place together with the biological diversity.
2) Coastal management plan is proposed for the coastal area of Murud where sustainable tourist is applied in the existing tourism route by following some cultural and traditional means.
3) Encourage the enhancement of knowledge of coastal resources and its importance and the effect of human activities on the coastal zone.

7.2 The main three proposal level for the region of Murud- Janjira are

PROPOSAL LEVEL – 1	PROPOSAL LEVEL - 2	PROPOSAL LEVEL – 3
Revitalized all the identified historical structures like Janjira fort, Padmadurga fort, The Haveli , Siddi tomb , Data Mandir, and the Eidgah.	Proposed a mangrove park with an information center and a tourist guide centre. Shelter belts for the beach area and Spaces were given for fish market and storage , an a proper jetty dock is proposed.	A Complete sustainable tourism is developed. Various trails have been proposed like mangrove trail, wadi trail, forest trail, wetland trail, agricultural trail and coastal trail.

7.3 The overall guidelines for the Murud – Janjira region are

- Historic areas and special natural areas should be given priorities for conservation works.
- To prepare strategies for consolidation and conservation for the invincible significant island fort of Janjira .
- Study the impact of tourism on the coastal heritage resources and find out sustainable means to minimize the impacts.
- Sustainable Tourism activities can be promoted - along with empowering local community and traditional economy like fishing, agro based products, local special cuisine, etc.
- Coastal settlements should also be given special subsidies for traditional sustainable livelihood systems.
- Document the ecological, environmental, archaeological and built heritage related information for the coastal area and define the nature of resource and its importance/ significance.
- Analyze and access the nature and severity of threats of coastal, ecological, environment and archaeological remains.
- Recommended future survey and data collection priorities based on an assessment of the importance and vulnerability of coastal archaeological remains.
- Heritage tours by Sea - to promote Maritime coastal Heritage.
- To promote campaigns and installation of various signage against impacts causing damage to the Heritage and Environment.

7.3.1 Detail activity and its guideline (Conservation of Cultural Heritage)

	Activity	Positive Quality	Negative Quality	Guidelines
Heritage & Religious Places	Temples Precincts, Tombs and mosques, Ancient Palacial houses, Significant buildings	Proper Road connection, availability of transport	Proximity to industrial areas. Unavailability of basic amenities- public utilities, cafeterias	Public amenities to be provided. No heavy industries within 500 m of radius, regular maintenance and conservation needed

7.3.2 Detail character, location and its mitigation measures (Conservation of Nature conservation)/ Erosion Control

		Character	Severity	Impacts	Location	Mitigation
Erosion	**Wave erosion at Shore line**	Recession of beach line due to the effect of waves and storm surges and sediment transfer due to Long shore currents	High- Recession at the rate of average 11m or higher per year Low- Recession at the rate of less than 11m per year	Threats to existing settlement: hence threat to the economic activities related to beach tourism	All along the beach near the Haveli , to the Murud beach	Hard measures to be adopted- Gabrion revetments (concrete sea wall or tetrapods) to dissipate the wave energy, Groynes perpendicular to shore to nullify the effect of Longshore current and trap the sediments. Beach nourishment from adjacent accretional beaches or inland wind-blown sand
					Ekdara Hills	Mix of hard and soft measures to be adopted. Groynes perpendicular to shore to nullify the effect of Long shore current and trap the sediments. Beach nourishment and beach drainage to reduce the moisture content of the beach and facilitate more sediments deposition.
	Wind erosion at Front Dune	Erosion and cutting away of Dune Face sand and accumulation towards the inland or near in the littoral zone if sea(under the effect of waves reaching the Dune)	High	Threat to the Dune Ecosystem and natural barrier to the inlands, winds blown sand covering inland agricultural lands	All along the Murud – Beach	Soft measures to be Adopted- Dunce fencing to facilitate sediment trapping, Dune Grass planting to hold the sand from blowing away and helping in further natural formation of Dune. Dune Thatching during the initial stage of Dune planting to protect the saplings from wind. Casuarina Equisotifolia plantation to minimize the impact of Cyclonic winds in the inland areas.

	Soil Erosion (Slope)	The sandy soil of the Dunes is washed down to the flat fertile areas creating a layer of sand over it.	High	Decrease in fertility of soil lowering its potential for agriculture, inherent salt content dissolved in storm water increases the salinity of adjacent flat land	All the sloping areas along the road	Contour Bunding and Contour trenching in case of crop areas in the Slope (15-33%)on Sand Dune Complex (Landward sides of Front Dune and both side of Older Dune Complex). Re-establishment if Shrub Thicket in non-crop areas.

7.3.3 Detail character, location and its mitigation measures (Conservation of Nature conservation)/ Agricultural land

Agriculture land

Character	Severity	Impacts	Location	Mitigation
Rice cultivation, Other Cereals, Vegetables and Oilseeds	Least Salinity Level of 0-2 dS/m, very low Flood Prone, fertile Loamy Soil, Highly	The Alluvial flat away from dune region, the Deltaic Alluvial Plain	Proximity to industrial areas. Unavailability of basic amenities-public utilities, cafeterias	Kharif, Rabi and Tur Rice cultivation, Collection of rain water in catchment

7.3.4 Detail character, location and its mitigation measures (Conservation of Nature conservation)/ Settlement types

			Character	Existing Settlement	New Settlement
Settlement	**Type 1**	Settlement on Older Dune	Highly compressed sandy soil. Dune Complex running somewhat parallel to the Coast. Elevation of 6-16m, No flood probability	Urbanized areas mostly 2/3 story permanent buildings, village area-single storey mud houses with tiled roof, brick houses with tin/asbestos roof.	Full-fledged development of residential units, carrying capacity to be guided through bye laws to maintain density, local architectural character to be followed.
	Type 2	Settlement on High Lands in ancient flat	Isolated Elevated area (4-10m) in the Coastal Plain region. Good soil foundation, Low flood probability, Susceptible to cyclonic winds	Village area-single storey mud/bamboo houses with tiled roof, brick houses with tin/asbestos roof.	Construction of ground and one floor. Permanent type brick houses with wind resistant roofing structure. Carrying capacity to be guided through bye laws to maintain density. For agricultural communities, Plinth level to be higher than 100 years Flood level
	Type 3	Settlement within 200-500 m of HTL or Front Sand Dune belt(whichever is higher)	On the sea front dune area on loose sandy soil. Elevation of 8-18 m, highly Susceptible to cyclonic winds, detrimental to sand dune ecology	Existing settlement are to be guided with adequate bye laws to protect from indiscriminate extensions	No new building activity to be carried out. Adaptive relocation through phases to Type 1 areas.

7.3.5 Detail activity and its guideline / Recreation types and Suitability

			Activity	Positive Quality	Negative Quality	Guidelines
Recreation	**High Impact**	Beach activity	Sea bathing. Beach Sports, Horse Riding	Width of beach both at high and low tide, good quality of non-sticky sand	Foul odour of Fisheries. Bouldery or rocky beaches, sewage outlet of town	To be carried in all season except monsoon. June-Mid july, Proper coast guard facilities for safety of tourist. Management to control pollution
		Water Sport	Water skiing, parasailing, water scooter, speed boating	Require deep water min 2m, 200 feet clear side space	Rocky sea surface	Avoid monsoon. To be away from bathing zone to avoid accidents
		Deep Sea activity	Deep sea fishing, river cruise	Abundance of fish population, availability of boat &infrastructure. Navigable depth of river, jetty facilities	Cyclones and storm in sea	
		Luxury Sports	Golf	Large track of undulated land, seasonal and perennial water bodies. Existing woodlands and groves	Bad infrastructure (star quality hotels) to welcome high profile guest	High quality hotels to be built to promote luxury tourists to visit
	Low Impact	Bird watching	Bird watching trails	Bird habitats-Wetlands, Estuaries, mud flats, creeks and tidal bars, scrub lands	Proximity to industrial areas. Urbanized area-noise pollution, overcrowding	No urbanization, industrialization within harmful limits. Access to be controlled by authorities via permissions
		Camping	Nature Trails, Tent accommodation, River Boating, Educational trips	High scenic value, high air quality, infrastructure to support tenting and guidance	Proximity to industrial areas, urbanized area, noise pollution, overcrowding	No urbanization, industrialization within harmful limits. Access to be controlled

7.4 Major Main conservation areas

7.4.1 Zone 1 - Area of Reserve Forest

Figure 151: Area of reserved forest

Character: Dense forest stand of *Tectona grandis*, *Terminalia tomentosa* and *Terminalia paniculata* mostly on the secondary dune complex within 500 mts from Sea

Prohibition : No development, No High impact recreation. No industrial use of timber.

Exemption : Limited forest cultivator. Low Impact recreation. Bird watching and camping .
Proposal - Area boundary to be demarcated and security posts to be created at various posts .

7.4.2 Zone 2 - Area Under Woodlands

Figure 152: Area under woodland

Character: Moderatly dense woodlands *Grewia tiliafolia*), Shivan (*Gmelinaarborea*), Hedi (*Adina cordijolia*), Kumbhi (*Careya arborea*), Pangara (*Erythrina indica*), Sterculia species

Prohibition : No development, No High impact recreation. No industrial use of timber.

Exemption : Limited forest cultivator. Low Impact recreation. Bird watching and camping

Proposal : Area boundary to be demarcated and security posts to be created at various posts .

7.4.3 Zone 3 - Beach Front Sand Dune

Figure 155: Beach front sand dune

Figure 154: Plantation of creeper ipomea biloba

Figure 153: Planting with Casuarina as shelter belts

3-18m high sand dune chain parallel to the shoreline with some discontinuities, most of the dunes are planted with Casuarina Equisotifolia .No alteration or dressing of dune topography, no building, no groiund water extraction, no recreation and no commercial activity Demarketed passage or walkover bridges to reach the beach

Planting with Casuarina wherever missing. Planting with dune grass-AeluropusLegapoides and creeper ipomea biloba

7.4.4 Zone 4 - Mangrove Swamp

Figure 156: Mangrove swamp

Breeding ground for aquatic fauna, provide habitat for birds, act flood receptacle during High tides and storm waves . No fishing activity, no prawn catching and shrimp farming

Limited access to low impact recreation

like educational trip and bird watching . Dredging out of already accumulated extra sediment, dune thatching to stop wind blown sand

7.4.5 Zone 5 - Estuarine Zone and Creek mouth

Figure 157: Creek mouth

Breeding ground of Fishes and many other aquatic flora useful to maintain the underwater ecosystem

No jetty construction, no heavy locomotion

7.4.6 Zone 6 - Controlled fisheries

Figure 158: Wetlands in the creek

Wetland Bird habitat
Intetidal areas, shallow fish culture ponds, creeks and inlets, tidla bars, scrub land

No construction, no fisheries activity, restricted sound zone, no industrialization, no salt pans Controlled fishing, low impact recreation like bird watching .Access to controlled by authorities via permission

7.4.7 Zone 7– Intertidal zone

Figure 159: Intertidal zone

Areas under influence of tidal fluctuation, important habitat for biodiversity, ground water recharge zones, flood buffer

Restricted zone, No fisheries pond. No prawn catching, no alteration of existing mangrove vegetation, no

salt pans

Limited access points for river use. Navigational and fisheries, controlled parking of vessels and trollers

Physical demarcation of higher HTL, vegetative demarcation of line through mangrove plantation, access points can be on slits to leave the hydrological system undisturbed

7.4.8 Zone 8- Open Scrub lands

Figure 160: Open scrub land

Vast open lands adjuscent intertidal areas, sparse vegetation with grasses and few water loving shrubs, ground water recharge zones .

No development, no high impact recreation, no settlement , no agriculture or plantation .

Limited access roads towards the river

Access roads can be on Stilt to leave the hydrological system undisturbed .

7.4.9 Zone 9- Removal of Spit Formation

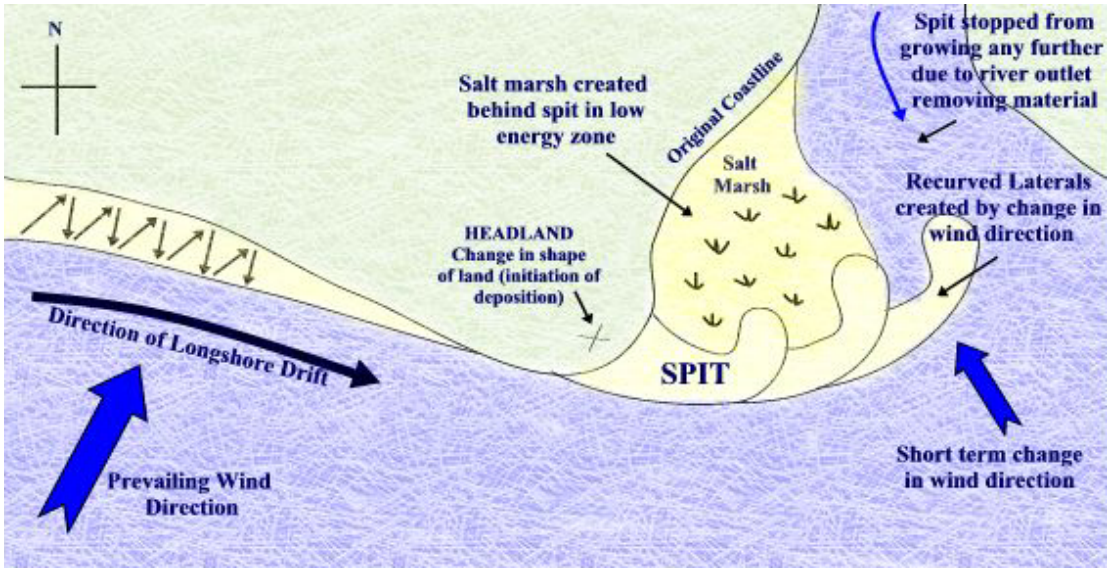


Figure 161: Removal of spit formation

Elongated sediment deposited landform under the influence of west-east longshore current and the sediment from Arabian Sea .

Not allowing the spit formation to grow further, using mechanical means

Allowed to grow the landform for a period of 30 years, dredging in every 30 years

Dredging of sediment and relocation to eroded parts of beach to facilitate the original direction of long shore current..

7.4.10 Zone 10-Restoration of Dune Belt

Figure 162: Restoration of dune belt

The original dune formation of 18 m high has been reduced to 3 m due to prolonged action of wind erosion and human intervention .

No alteration or dressing of dune topography, no building, no ground water extraction, no recreation, no commercial activity and no sand mining .

Demarketed passages or walkover bridges to reach the beach.

Dune Thatching, grass planting and dune fencing to trap the wind blown sand and facilitate the dune formation. At later stage plantation of Shelter Belts.

Plantation of Casuarina for Shelter Belt on Dune : Groves and Shelter.

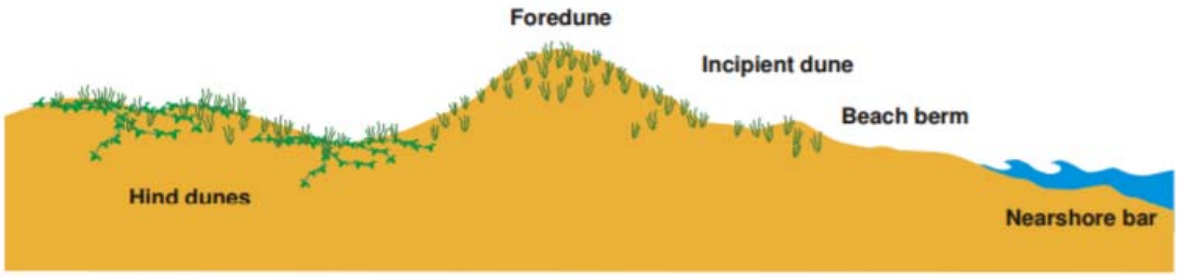


Figure 163: Grasses and creepers (primary species)

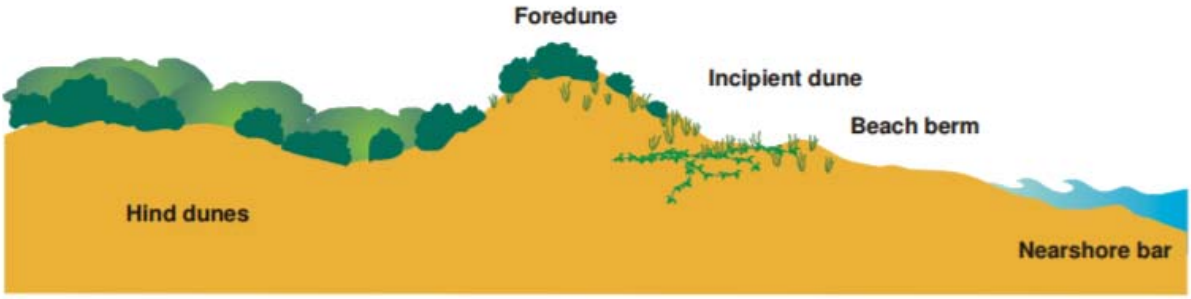


Figure 164: Shrubs (Secondary species)

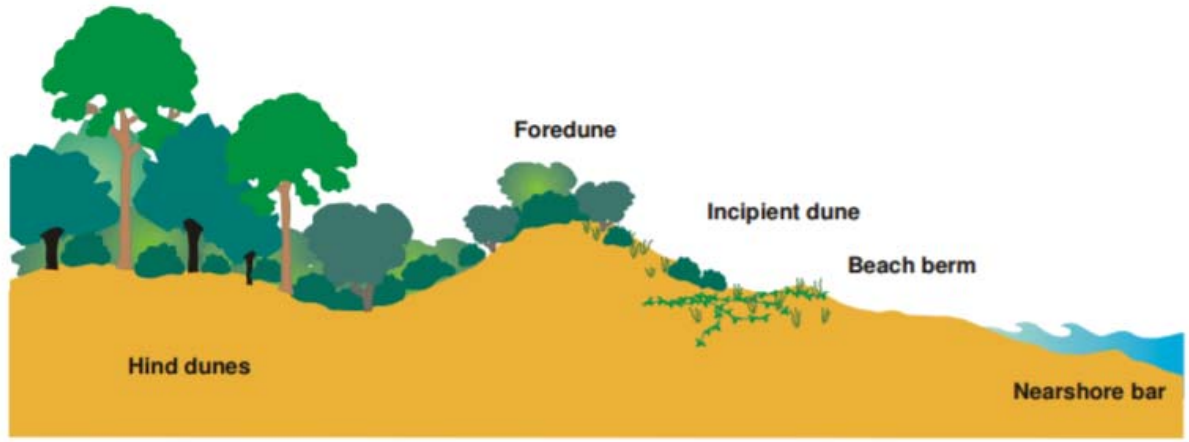


Figure 165: Long-live trees (tertiary species)

Figure 166: Shelter belts near the beach

Dense Social forestry acting as a background to sea beach adding to the beauty of the area, acts as Shelter belts.

No recreation, no commercial activity, no trampling by human being of vehicles.

Demarketed passages to reach the beach

Plantation of new casuarina trees with dune thatching to stop wind erosion of sand particles.

7.4.11 Zone 11- Mangrove vegetation

Figure 168: Mangrove vegetation in creek

Figure 167: Mangrove protection

Stop the impact of high waves and tidal flooding, provide breeding ground for aquating fauna provide bird habitat . No fisheries pond or salt pans.

Limited access to low impact recreation like educational trip, bird watching
Use of Bamboo enca

CHAPTER NO.8

8. Concept

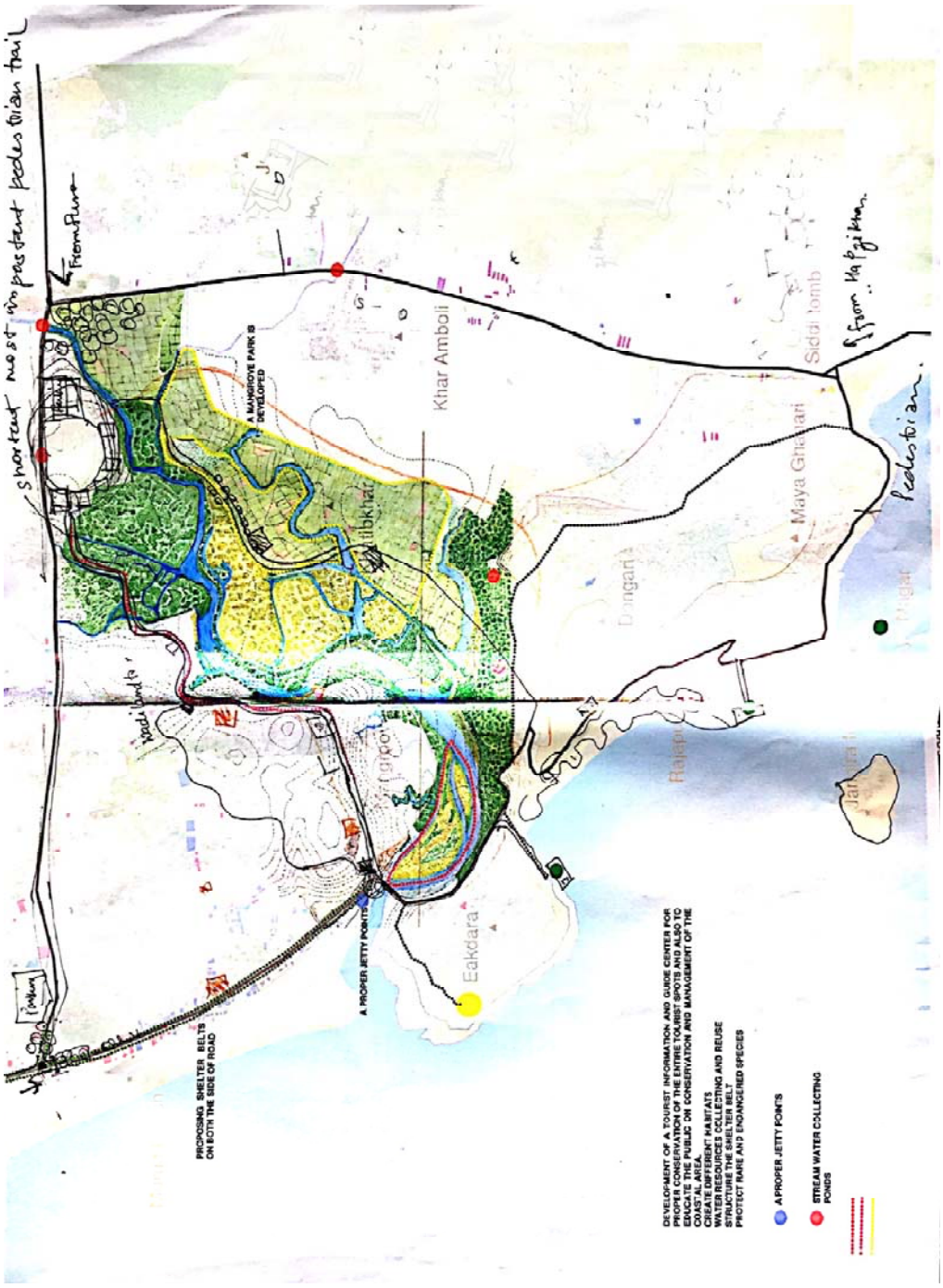


Figure 169: Management plan

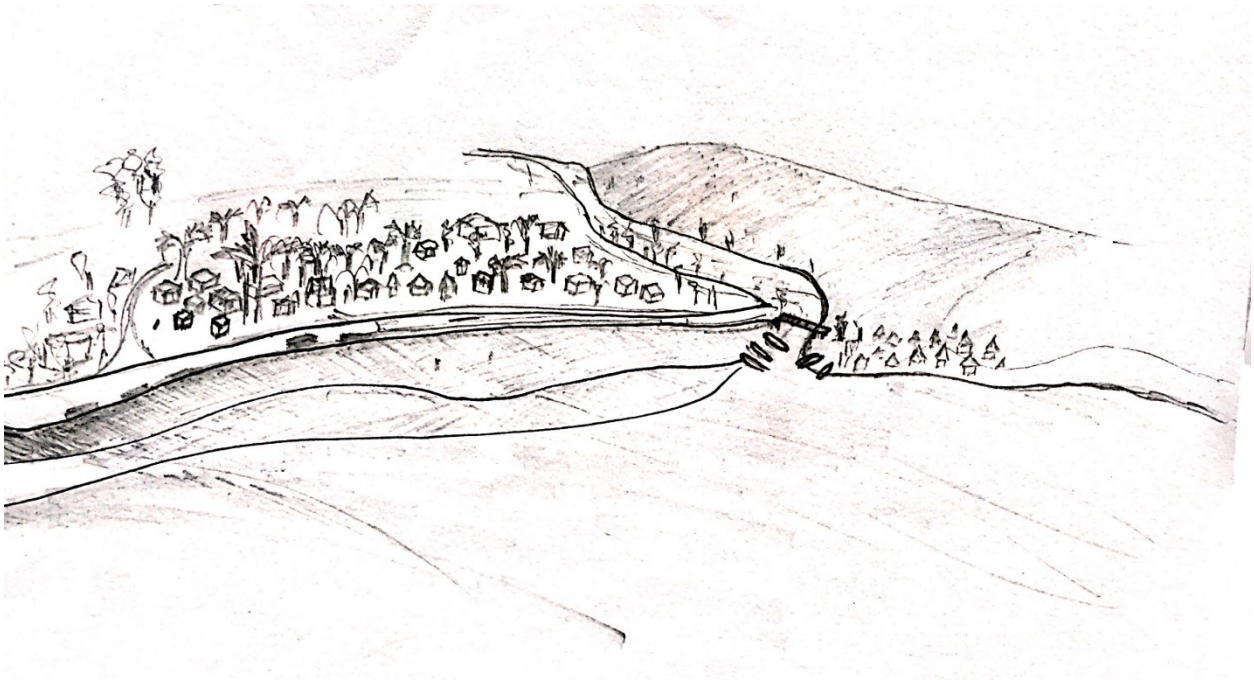


Figure 170: The coastal region of Murud , proposal of various trails and shelter belts along the beach.

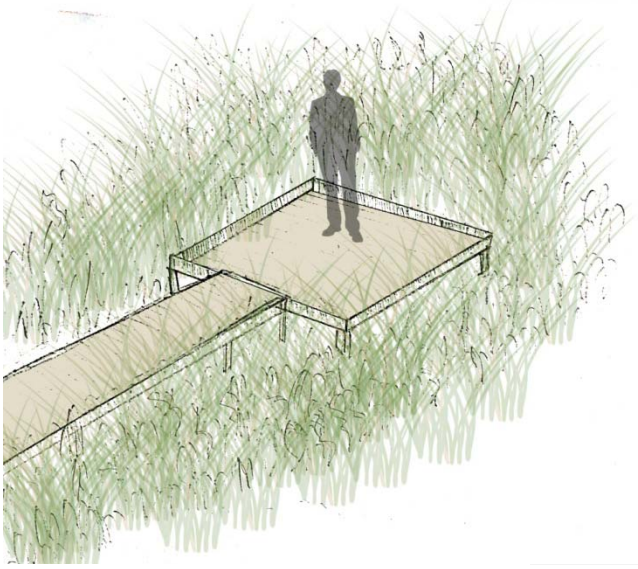


Figure 171: Proposal of wooden viewing deck at various trails which will give a definite path and point to mesmerize the beauty of the land and it will help the public to know the importance of various habitats in the coastal region .

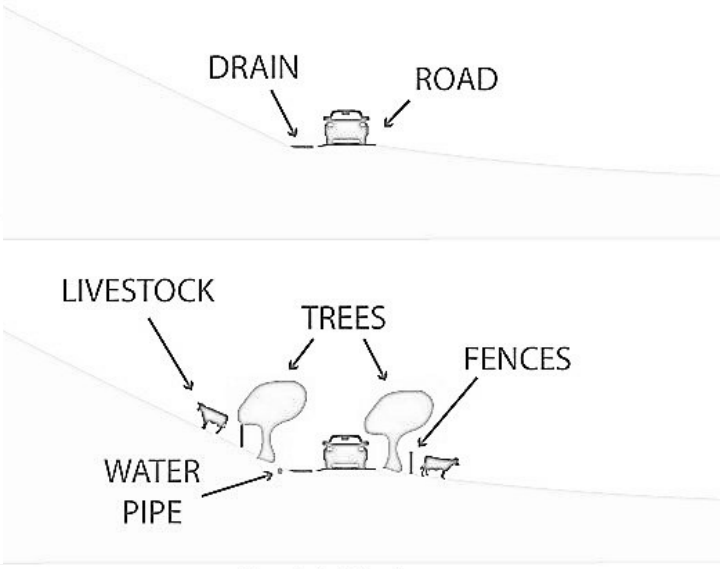


Figure 172: Plantation of trees on both side of the roads to save soil erosion.

CHAPTER NO.9

9. Design Sheets

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