INTEGRATED COASTAL ZONE MANAGEMENT PLAN (ICZMP) FOR MAHARASHTRA

DEPARTMENT OF ENVIRONMENT,
GOVERNMENT OF MAHARASHTRA

Integrated Coastal Zone Management Plan (ICZMP) for the State of Maharashtra

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Abbreviations

Abbreviation	Expansion
CAGR	Compounded Annual Growth Rate
CBO	Community Based Organization
CIDCO	City and Industrial Development Corporation of Maharashtra Limited
CPHEEO	Central Public Health & Environmental Engineering Organisation
CRZ	Coastal Regulation Zone
DMS	Data Management System
EPA	Environment Protection Act 1986
ESR	Elevated Service Reservoir
EWS	Economically weaker section
GOI	Government of India
GSDP	Gross State Domestic Product
ICZMP	Integrated Coastal Zone Management Plan
IHSDP	Integrated Housing & Slum Development Project
JnNURM	Jawaharlal Nehru National Urban Renewable Mission
JNPT	Jawaharlal Nehru Port Trust
LIG	Low Income Group
Lpcd	litres per capita per day
MBR	Master Balancing Reservoir
MCZMA	Maharashtra Coastal Zone Management Authority
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MIDC	Maharashtra Industrial Development Corporation
MMR	Mumbai Metropolitan Region
MoEFCC	Ministry of Environment, Forest and Climate Change
MoU	Memorandum of Understanding
MPCB	Maharashtra Pollution Control Board
MRSAC	Maharashtra Remote Sensing Applications Centre
NEP	National Environment Policy
NGO	Non-Government Organizations
PPP	Public Private Partnership
SHG	Self Help Groups
SPA	Special Planning Authority
STP	Sewage Treatment Plant
SWOT	Strength Weakness Opportunities Threats
TEU	20-foot-equivalent unit
ULB	Urban Local Bodies
VVCMC	Vasai Virar City Municipal Corporation
VVSR	Vasai - Virar Sub-Region
WTP	Water Treatment Plants

1. Introduction

Maharashtra's coastline is endowed with a variety of landscapes such as mangroves, sea grasses, salt marshes, sand dunes and estuaries among others. The state has a total coastal line of 742 km[1]. The biodiversity rich coastal line is 8.8% of India's coastal line, yet supports an estimated 19 millions of people[2]. Of the total 32 mangrove species found in India, 20 are found in the Maharashtra coast, making it the richest state in terms of species diversity in the western coast[3]. This, coastal line, also called the Konkan coast, also houses some of the major industrial houses of India, and plays a key role in India's economic well-being. These areas also support many sub-terrain aquifers, as many rivers flow into the Arabian Sea from the Western Ghats in the Konkan region. Sustainable management of coastal ecosystem and maintaining it in good health is essential to safeguard the state's economic interests; especially in the face of vulnerability caused due to the relentless changes in the weather patterns and anthropogenic pressures.

The Indian coast is vulnerable to anthropogenic pressures because of industrial and urban development; and climate change-related devastation – from growing intensities of cyclonic storms to sea surges and sea level rise[4]. A sea level rise of 0.13 – 2 cm in the Maharashtra coast has been observed based on historical analysis of 100-year tide gauge data and 17-year satellite data[5]. Further, Large scale development activities since India's Independence have resulted in a proliferation of industries, mostly located near the major ports. Many of these development activities have, apart from extensive change in the land use of the area, adversely impacted the shoreline[6].

Integrated coastal zone management (ICZM) is a process for the management of the coast using an integrated approach to achieve sustainability, regarding all aspects of the coastal zone, including geographical and political boundaries[7]. The present project proposes to apply the concept of ICZM to two districts of Maharashtra, namely Ratnagiri and Sindhudurg.

The plan envisages to preserve environment and ecology through a multi-pronged integrated approach so as to minimize cross-sectoral impacts, enhance co-ordination among implementation agencies, maximize livelihood opportunities to the resource dependent communities, ensure adaptation to climate change, and safeguard the biotic and economic resources of the state for sustained consumption. Targeted activities have been developed under the ICZM after an exhaustive stakeholder consultation process and several rounds of iterations. These actions, detailed in chapter 7 of this report are grouped into four categories: 1) Conservation of Coastal and Marine Ecological Resources, 2) Coastal Pollution Management and Related Infrastructure Upgrade, 3) Livelihood Security of Coastal Communities and 4) Capacity Building and Implementation of ICZM Plans. The integrated management proposed through this plan will be carried forward through these actions to be

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[1] http://cwc.gov.in/CPDAC-Website/Data/Other%20Data%20files/New%20Coastal%20Status%20data%20from%20Shoreline%20Change%20Atlas.pdf
[2] http://www.census2011.co.in/census/state/districtlist/maharashtra.html
[3] http://cat.org.in/wp-content/uploads/2017/07/HISTORY-OF-MANGROVE-MANAGEMENT-IN-MAHARASHTRA.pdf
[4] http://www.cseindia.org/userfiles/Indias_coastal_concern.pdf
[5] http://www.moef.gov.in/sites/default/files/Maharashtra%20Climate%20Change%20Final%20Report.pdf
[6] https://deepakapte.com/attachments/article/20/Challenged%20Coast%20of%20India_Lowres.pdf
[7] http://iczmpodisha.org/project_description.htm

implemented by various State, Community and Private organizations through innovative partnerships. We have also proposed financial instruments such as the pilot Maharashtra Sea Flood Insurance Program (MSFIP) to provide a safety net to the people living in coastal zones.

The implementation will be over three years, in three phases: 1) Establishment Phase (1-9 months), Piloting phase (10-15 months) and Implementation phase (16-36 months). The Department of Environment, Government of Maharashtra is the Implementing Agency. An ICZM Project Management Unit (PMU) headed by [designation0, DoE, GMU will be housed supervise day-to-day activities of the project. The structure of the PMU is alsu elaborated in this report.

Section I

2. Profile of the State of Maharashtra

2.1. Physio-geographic details

Maharashtra is located in the north-central part of the Indian Peninsula and spreads across a geographical area of 3,07,713 km^2 [8]. It is located between latitudes 15°35' and 22°02' N and longitudes 72°36' and 80°54' N. The state has a population of 11,23,74,333 which accounts for 9.36% of the total population of the country[9]. Administratively the state is divided into six divisions and 36 districts. The state is highly urbanized with 45.2% of the population residing in urban areas. The coastline is comprised of 6 districts, and is 720 km long.

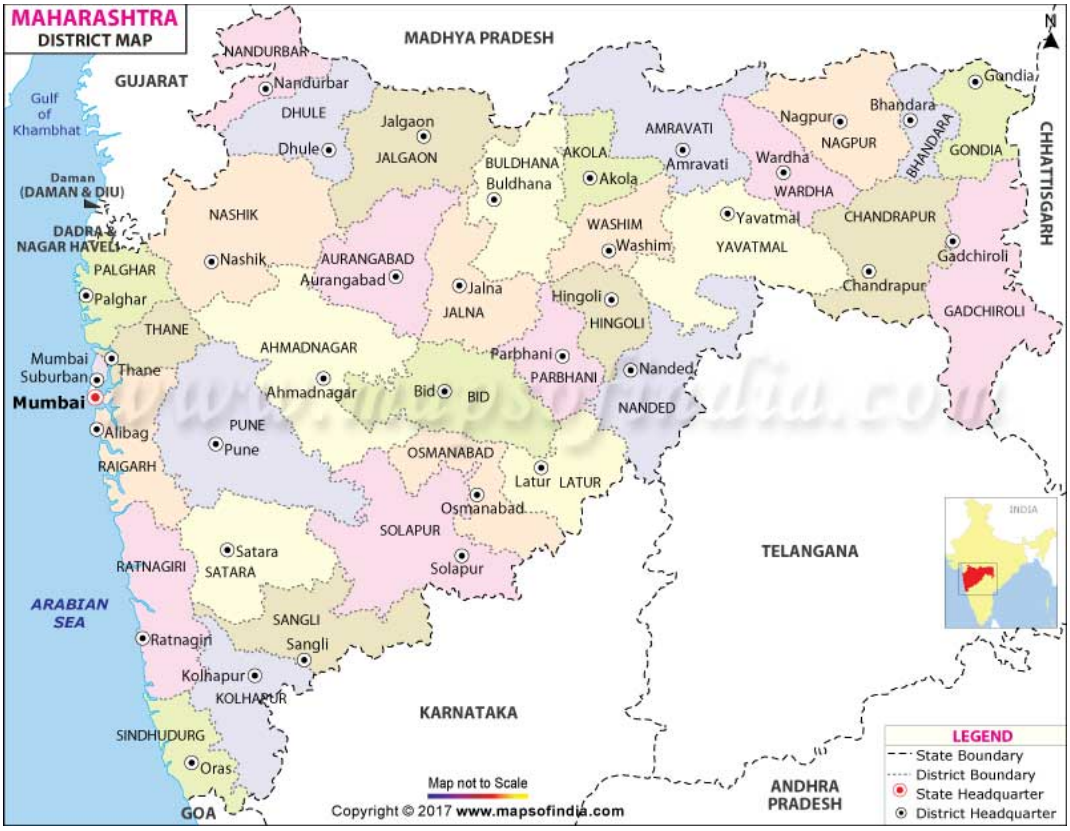

Figure 1: District map of Maharashtra

For the purpose of proper implementation development work and supervision of normal revenue work, the Government has divided State into 6 Divisions – Konkan, Nashik, Pune, Aurangabad, Amravati, and Nagpur.[10]

Table 1: Division-wise distribution of districts in Maharashtra

Konkan Division			
Mumbai City	Mumbai Suburban	Thane	Palghar
Raigad	Ratnagiri	Sindhudurg	

[8] http://iipsenvis.nic.in/Database/Population_4077.aspx
[9] http://fsi.nic.in/sfr2005/maharashtra.pdf
[10] https://www.maharashtra.gov.in/1128/Districts

Nashik Division			
Nashik	Dhule	Nandurbar	Jalgaon
Ahmednagar			
Pune Division			
Pune	Satara	Sangli	Solapur
Kohlapur			
Aurangabad Division			
Aurangabad	Jalna	Parbhani	Hingoli
Beed	Nanded	Osmanabad	Latur
Amravati Division			
Amravati	Buldhana	Akola	Washim
Yavatmal			
Nagpur Division			
Nagpur	Wardha	Gondia	Bhandara
Chandrapur	Gadchiroli		

These revenue divisions fall in the following 5 regions:

1. Vidarbha - (Nagpur and Amravati divisions) - (Old Berar Region)
2. Marathwada - (Aurangabad Division)
3. Khandesh and Northern Maharashtra Region - (Nashik Division)
4. Desh - (Pune Division)
5. Konkan - (Konkan Division)

Maharashtra has five distinct physio-geographic regions – Deccan Plateau, Central Highlands, Eastern Chhotanagpur Plateau, Eastern Ghats and Coastal Plains. More than 80% of the state is covered with by extensive sheets of horizontally bedded lava flows comprising the Deccan trap.

The Western Ghats running from the north to the south of the State as Sahyadri Hills[11] cover many popular hill stations such as Lonavala-Khandala, Matheran, Mahabaleshwar, Panchgani, etc. This range separates the six coastal districts of Maharashtra from the rest of the state.

The National Bureau of Soil Survey and Land Use Planning segregates 356 soil-mapping units in Maharashtra which are broadly categorized as soils of Konkan coast, soils of Western Ghats, soils of Upper Maharashtra and soils of Lower Maharashtra. The soil profile indicates that incidence of erosion is highest in the Western Ghats. In the semi dry plateau, the black-cotton soils are clayey, rich in iron and moisture-retentive, though poor in nitrogen and organic matter. When re-deposited along the river valleys, the black soils are deeper and heavier, better suited for Rabi crops. The higher plateau areas comprise of soils which contain more gravel. Red laterite soils are present in the Konkan and Sahyadri region. These are productive under a forest-cover.

[11] http://www.westernghat.org/

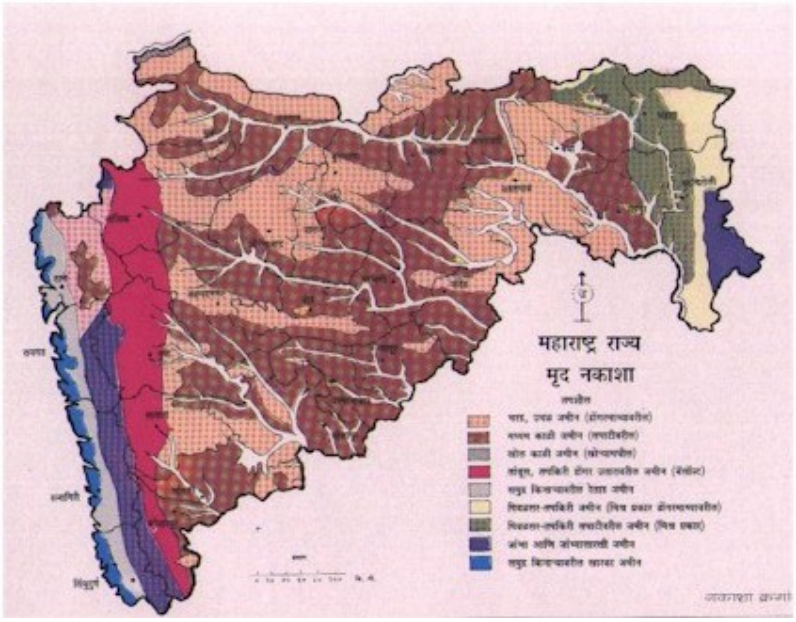

Figure 2: Distribution of Soil in Maharashtra

(Source: Department of Agriculture, Govt. of Maharashtra[12])

The soil cover of Maharashtra in general is shallow and of poor quality. The soil in the Deccan plateau is rich in humus and is made up of black basalt soil. The Wardha - Waliganga river valley has old crystalline rocks and saline soils which make the soil infertile. This type of soil has a natural resistance to wind and water erosion because it is rich in iron and granular in structure. A very important advantage of this type of soil is that it can retain moisture. This makes the soil very reactive to irrigation. [13]

2.2. Climate

Maharashtra has a tropical monsoon climate. The summer season extends from March to May, with thundershowers being a common feature in the months of April and May. Average temperature varies between 22°C and 39°C during this season. Winter season extends from the month of November to February. Cool dry spell, with clear skies gentle breeze and pleasant weather prevail during these months. The eastern part of Maharashtra receives some rainfall in this period. Temperature varies between 12°C and 34°C during this season.

Rainfall occurs between the months of June and October. There is significant spatial variation in rainfall. The coastal districts of Raigad, Ratnagiri and Sindhudurg receive significantly heavy precipitation of 2,000 mm annually, while the districts of Nasik, Pune, Ahmednagar, Dhule, Jalgaon, Satara, Sangli, Solapur and parts of Kolhapur get rainfall less than 500 mm.

The Konkan region comprising of the six districts of Thane, Mumbai (Bombay) city, Mumbai Suburb, Raigad, Ratnagiri, and Sindhudurg receive 2,000 to 3,000 mm rainfall. The rain-shadow belt adjoining the eastern slopes of the Western Ghats is called Desh. It is the western upland Maharashtra with an average height of 500m to 600m, interspaced with river valleys and low hilly ranges forming eastern offshoots of the main Ghat range. The region

[12] http://mahaagri.gov.in/Maps/Statistical_maps.html
[13] http://nidm.gov.in/pdf/dp/Maharashtra.pdf

includes districts of Dhule, Nandurbar, Jalgaon, Nashik, Ahamadnagar, Pune, Solapur, Satara, Sangli and Kolhapur. The Desh region receives 500 to 1,000 mm of annual rainfall. The Western Ghats (Sahyadri) receive 4,000 to 6,000mm of annual rainfall. The Marathwada region is comprised of the districts of Aurangabad, Jalna, Beed, Osmanabad, Latur, Nanded, Parbhani and Hingoli. The average rainfall in the region is 500 mm. Vidarbha is the eastern-most division of the state and comprises of eleven districts namely – Buldana, Akola, Washim, Yeotmal, Amaravati, Wardha, Nagpur, Chandrapur, Bhandara, Gadchiroli and Gondia. The Division receives 1,000 to 1,500 mm of rainfall. [14]

2.3. Socio-economic Profile of Maharashtra

According to the provisional figures by Census of India for 2011[15], Maharashtra has a population of 11.23 crore and is the second most populous state in India contributing 9.29% to the nation's population with a density of 365 persons per sq.km. The literacy rate in the State (excluding children in the age group 0-6 years) is 82.91 per cent.

The State constitutes about 9.3 per cent population of the country and ranks second after Uttar Pradesh.

Table 2: Demographic details of Maharashtra (Census 2001 and 2011)

Description	2011	2001	Percentage Change
Population	11.24 Crore	9.69 Crore	16%
Male	58,243,056	50,400,596	16%
Female	54,131,277	46,478,031	16%
Population Growth	15.99%	22.57%	-29%
Sex Ratio	929	922	1%
Density/km^2	365	315	16%
Area (Km^2)	307,713	307,713	0%
Literacy	82.34 %	76.88 %	7%
Male Literacy	88.38 %	85.97 %	3%
Female Literacy	75.87 %	67.03 %	13%

- **Rural/Urban Distribution**

According to Census 2011, 45.22% people live in urban regions while around 54.78 percent live in the villages of rural areas. As per SECC 2011, there are 1.38 crore households in rural areas with average household size of 4.62. Out of total rural households 0.17 crore are of SC and 0.19 crore are of ST.

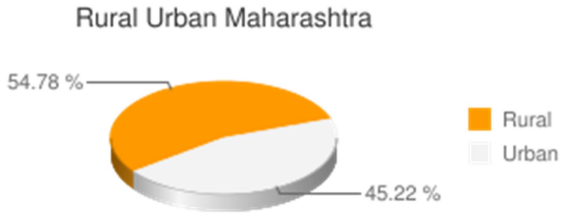

Figure 3: Rural/Urban Population, Maharashtra (Census 2011)

[14] http://fatbirder.com/newsite/links_geo/asia/india_maharashtra.html
[15] http://www.census2011.co.in/census/state/maharashtra.html

- **Agriculture and Allied Activities**

As per Agriculture Census 2011-12, out of the total 307.58 lakh hectares geographical area in the State, the Gross Cropped area was 231.06 lakh hectares, net area sown was 173.86 lakh hectares, (56.57%), area under forest was 52.11 lakh hectares (16.96%), land not available for cultivation was 31.78 lakh hectares (10.33%), other uncultivated land was 24.13 lakh hectares (7.9%) and fallow land was 25.70 (8.31%) lakh hectares.[16]

Agriculture & allied activities sector is the primary constituent of the State's economy. Any situational change in this sector has a multiplier effect on the entire economy. The annual average share of gross value added of 'Crops' sub-sector in the total Gross State Value Added (from 2011-12 to 2016-17) is about 7.8 per cent while the average annual growth rate is about 1.7 per cent. About 25 per cent of the workers in the State are cultivators and another 27 per cent are agricultural laborers.

- **Livestock**

Animal Husbandry, dairy and fisheries are allied activities to agriculture, which supplement farm income by generating gainful employment, resulting in growth of rural economy. Livestock Census is conducted quinquennially. As per the 19th Livestock Census 2012[17], the State ranks sixth at national level with total livestock of about 325 lakh, less by 9.7 per cent as compared to 18th Livestock Census 2007. Livestock per lakh population was about 29 thousand in 2012. In case of poultry population the State ranks third at national level with poultry population of about 778 lakh which is 10.7 per cent of poultry population of India. Poultry population has increased by 20.1 per cent as compared to 18th Livestock Census.

- **Fisheries**

The State has a coastline of 720 km with 173 fish landing centres and the area suitable for marine fishing is 1.12 lakh km^2. There are 15,716 marine fishing boats in operation, of which 13,002 are mechanized. In addition to this, the area suitable for inland and brackish water fishing in the State is 4.19 lakh ha and 0.10 lakh ha respectively. There are 30 fish seed production centres in the State with 2,414 lakh spawn production capacity per year for catering to inland fishing.[18]

- **Industry**

According to the India Brand Equity Foundation[19], Maharashtra is the most industrialized state in India and has maintained its leading position in the industrial sector in the country. The state is a pioneer in small scale industries and boasts of the largest number of special export promotion zones. Maharashtra has a large base of skilled and industrial labor, making it an ideal destination for knowledge based and manufacturing sectors.

Between 2004-05 and 2015-16, Gross State Domestic Product (GSDP) expanded at a Compound Annual Growth Rate (CAGR) of 11.3 per cent to US$ 300.5 billion whereas the Net State Domestic Product (NSDP) expanded at a CAGR of 11.1 per cent to US$ 263.6 billion.

The state's capital, Mumbai, is the commercial capital of India and has evolved into a global financial hub. The city is home to several global banking and financial service firms. Pune,

[16] Industrial State Profile of Maharashtra 2016-17 (http://dcmsme.gov.in/dips/state_wise_profile_16-17/Maharashtra%20Industrial%20State%20Profile%202016-17-Final.pdf)
[17] https://ahd.maharashtra.gov.in/pdf/livestock%20census/livestock_census_19th_2012.pdf
[18] Ibid.
[19] https://www.ibef.org/states/maharashtra-presentation

another major city in the state, has emerged as the educational hub. It is the one of the largest producer of sugarcane, pomegranates and cotton in the country.

The following sections briefly discuss the districts covered under this project – Sindhudurg and Ratnagiri.

2.3.1 Sindhudurg

Sindhudurg district is the southern part of the greater tract of the Konkan region, historically famous for its long coast line and safe harbors. Sindhudurg was earlier a part of the Ratnagiri district. For administrative convenience and industrial and agricultural development Ratnagiri district was divided into Ratnagiri and Sindhudurg with effect from 1st May, 1981. Sindhudurg district now comprises of eight tehsils of Sawantwadi, Kudal, Vengurla,Malvan,Devgad, Kankavli, Vaibhavwadi and Dodamarg.[20]

Sindhudurg district is spread over an area of around 5,207 km^2. The population of the District is 849,651 as per Census 2011. The district is surrounded by the Arabian Sea on the east, the Belgaum District (Karnataka state) and Goa on the South and the Ratnagiri district on the North. With a population density of 163 persons/square km, the district is home to 0.76% of Maharashtra state's population. The district has a high literacy rate of 85.56%.[21]

Figure 4: District Map of Sindhudurg

The length of sea coast in Sindhudurg is 121 km with 16,000 km^2 continental shelf. There are 8 Main Fish landing centres namely Vijaydurg, Devgad, Achara, Malvan, Sarjekot, Kochara, Vengurle and Shiroda. Fishermen population of the district is 25,365 and Total Fish Production is 27,283 M.T.[22]

The net cultivated area in the district is 262,637 sq. km with almost 36% of the agricultural workforce working as cultivators and 23.5% working as agricultural labour.[23] More than 76% of the landholders in the district are marginal landholders (holding 1 ha of land or less).

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[20] http://dcmsme.gov.in/dips/state%20profile%20sindhudurg.pdf
[21] http://www.census2011.co.in/census/district/367-sindhudurg.html
[22] C-DAP Sindhudurg, Dept. of Agriculture, Govt. of Maharashtra (http://krishi.maharashtra.gov.in/Site/Upload/Pdf/sindhudurg_cdap.pdf)
[23] DSA 2013 (Sindhudurg) (http://krishi.maharashtra.gov.in/Site/Upload/Pdf/sindhudurg_cdap.pdf)

Climate, Rainfall and Topography

Being a coastal district, Sindhudurg's climate is generally moist and humid and the temperature variations during the day and throughout the seasons are not large. The maximum temperatures touch 33.8 degree Celsius, whereas the minimum temperatures hover around 16.3 degree Celsius.[24]

The district receives rain for full four months i.e. June, July, August and September. The normal annual rainfall over the district varies from 2,300 mm (Malvan) to about 3,205 mm (Kudal). It is minimum in the western part of the district along the coast and gradually increases towards east and reaches maximum along Western Ghats. The average annual rainfall for the period 2002-2011 ranges from 2,752.19 mm (Devgadh) to 3,980.19 mm (Vaibhawadi).[25] Though the average rainfall is rather high, almost all the rainwater causes surface run off, due to undulating topography and lack of any water impounding structures.

Among the important rivers flowing through the district are the Terekhol, Gad, Devgad, Karli and the Vaghotan River. The most important crops grown in the district are rice, coconut, kokam, mango and cashew. A large part of the land holdings in the region, almost 74 percent, are held by small and marginal farmers. There are two major irrigation projects in the district, namely Tilari and Talamba. Most of the district area is covered by dense rain forests. The Amboli hill station area is inhabited by wild animals like leopard wild cats, rabbits, and wild hen. Apart from this, elephant and wild buffalos are also found in the district.[26]

The district has one of the few sites in the whole western coast of India where marine turtle nesting takes place. The endangered species of Olive Ridley turtles (*Lepidochelys olivacea*), locally known as *Tupalo*, along with leatherback turtle (*Dermochelys coriacea*), locally called *Kurma*, as well as green turtles (*Chelonia mydas*) have been seen in offshore waters in the Vengurla and Mavlan blocks. The encounters of green turtles seem to be higher towards the south. Olive Ridley turtles are frequently encountered. There has been a report of a leatherback turtle encountered near the Malvan block. Encounters with turtles have been reported mostly in the post-monsoon season after September, although some locals believe that there is no particular season for nesting. (Sanaye & Pawar, 2009)[27]

However, impact of climate change and overfishing is reducing the population of marine turtles. Notably, in 2017 the Government of Maharashtra, in a first such effort on the west coast, has initiated an effort to study the breeding pattern and movement of Olive Ridley turtles, in order to conserve the endangered species effectively. This effort is a joint collaboration between the State forest department, Mangrove Cell, and forest officials from Odisha who will be training their counterparts in Maharashtra.[28]

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[24] http://dcmsme.gov.in/dips/state%20profile%20sindhudurg.pdf
[25] http://www.cgwb.gov.in/District_Profile/Maharashtra/Sindhudurg.pdf
[26] http://dcmsme.gov.in/dips/state%20profile%20sindhudurg.pdf
[27] Sanaye, S.V., Pawar, H.B., 2009, "Sea turtle conservation in Sindhudurg district of Maharashtra". Indian Ocean Turtle Newsletter No. 9, January 2009
[28] http://www.hindustantimes.com/mumbai-news/after-odisha-maharashtra-to-study-olive-ridley-turtle-s-migratory-route/story-FsfjNDLEqkn0NXM0JkFB6M.html

Figure 5: A turtle nesting site in Ganjam, Odisha

(Source: Down To Earth)

2.3.2 Ratnagiri

Ratnagiri District is located in the southwest part of Maharashtra. The total geographical area of the district is 8326 Sq. Kms. which is 2.7% of the total Maharashtra State. Sahyadri Hills are bordered on the East & Arabian Sea is on the West side of the District. In 1981, the district was bifurcated in two districts, carving out Sindhudurg from the existing Ratnagiri district. Rivers Shastri, Bor, Kajali & Muchkundi flow through the district. Due to heavy rainfall in the district there are high landscapes in the coastal areas.[29]

Over 85% of the land surface in Ratnagiri district is hilly. It has 167 km long sea coast which contains many beaches, pats, and forts. 180 km long Sahyadri hill range, contains hills, hill forts, wild life and many places of scenic beauty. The many creeks in the district are ideal and safe for water sports, boating, fishing, swimming, camping etc.[30]

[29] http://dcmsme.gov.in/dips/DIPS%20Ratnagiri.pdf
[30] http://ratnagiri.nic.in/#

Figure 6: District map of Ratnagiri

Climate, Rainfall and Topography

The district has a tropical climate. Rainfall is significant most months of the year, and the short dry season has little effect. The temperature in the district averages 27.0 °C. The rainfall here averages 3047 mm. The least amount of rainfall occurs in January. Most of the precipitation here falls in July, averaging 1014 mm. The temperatures are highest on average in May, at around 29.7 °C. February is the coldest month, with temperatures averaging 24.7 °C.[31]

Topographically, Ratnagiri District is divided into three parts:[32]

1) The East part is Sahyadri Ranges with hilly track with an area of 15 Sq. km
2) The Middle part of 15 kms. Away from coastline Known at Valat Patti
3) The western part, coastal part known as Khalat Patti

Ratnagiri is one of the least urbanized districts in the state, having about 16.3 percent population in urban areas whereas about 45.2 percent of the state's population lives in urban area.[33] The district is famous for alphonso mango crop and processing industries. Marine fishery is the most important non-agricultural economic activity of the district. The "White Beach" and "Ganpati Pule" are very famous tourist centres in Ratnagiri district.

[31] https://en.climate-data.org/location/24258/
[32] http://dcmsme.gov.in/dips/DIPS%20Ratnagiri.pdf
[33] http://www.censusindia.gov.in/2011census/dchb/2732_PART_B_DCHB_%20RATNAGIRI.pdf

Figure 7: Anjarle Beach, Ratnagiri (Source: Hindustan Times)

2.4. Coastal Profile

The coastline of Maharashtra is 720 km long coastline. It is hilly, narrow, highly dissected with transverse ridges of the Western Ghats (Sahyadri). It stretches from the River Tapi in the north up to the River Terekhol in the south and encompasses six districts viz. Thane, Palghar, Mumbai, Raigad, Ratnagiri and Sindhudurg. The six coastal districts together constitute 25% of the population of Maharashtra. Figure 8 presents a shoreline map of Maharashtra. Table 2 presents few socio-economic parameters of the coastal districts.

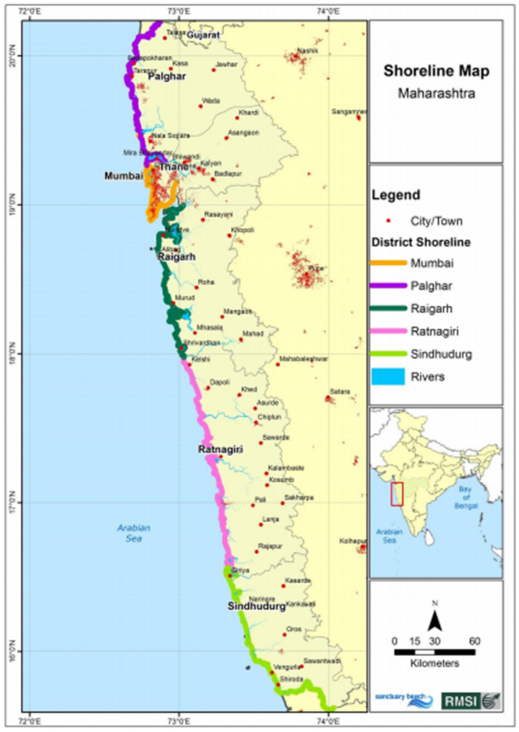


Figure 8: Shoreline Map of Maharashtra

Table 3: District-wise demographics for the coastal region (Census 2011)

District Name	Population (2011)	Sex Ratio	Population Density (per sq. km)	Literacy Rate (%)
Thane (including Palghar)[34]	11,060,148	886	1157	86.18
Mumbai (Suburban)	9,356,962	860	20980	90.9
Mumbai	3,085,411	832	19652	88.48
Raigarh	2,634,200	959	368	83.89
Ratnagiri	1,615,069	1122	197	82.43
Sindhudurg	849,651	1036	163	86.54
Total	2,86,01,441		930.8	

According to the surveys by State Government agencies, the total area of all the coastal districts is 30,645.5 km^2 comprising of built up land (1.58%), agricultural land (44.14%), forests (19.48%), wastelands (28.72%), water bodies (4.13%) and land under grasslands, mining areas and saltpans (1.95%). Coastal plains, shoreline terraces, sand dunes, sandy pocket beaches, tidal inlets, creeks and estuaries are the dominant features in the coastal belt.

The continental shelf along the Maharashtra coast widens from south to north (refer to Figure 9). The Maharashtra coastline can be classified as sandy beach (17%), rocky coast (37%) and muddy flats (46%)[35]. The west coast of India experiences high wave activity during the southwest monsoon with relatively calm sea conditions prevailing during rest of the year. The average wave direction shifts from 246°T to 258°T along the coast[36]. Further, longshore sediment transport is towards the south along the Maharashtra coast[37]. The tidal ranges increase from south to north, due to the strong influence of the continental shelf and Gulf of Khambat in Gujarat[38].

[34] Since Palghar district was formed in 2014, district-level Census 2011 data is not available for the same.
[35] http://www.iisc.ernet.in/currsci/aug252006/530.pdf
[36] https://mahammb.maharashtra.gov.in/site/upload/pdf/MaharashtraSMP2017.pdf
[37] http://www.iisc.ernet.in/currsci/aug252006/530.pdf
[38] https://mahammb.maharashtra.gov.in/site/upload/pdf/MaharashtraSMP2017.pdf

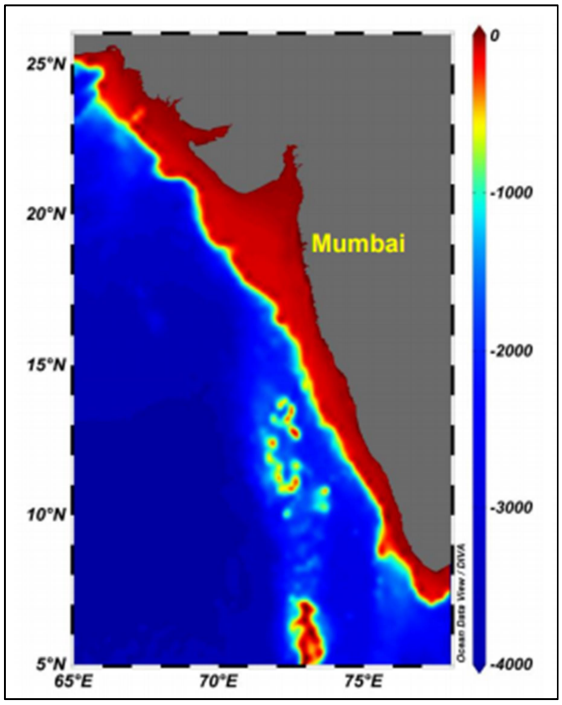


Figure 9: Bathymetry of the Western Coast of India[39]

The coastline is indented by numerous river mouths, creeks, small bays, headlands, sandy and rocky beaches, promontories, cliffs etc. The width of the region decreases from north to south. It is as wide as 100 km in the north to 40 km near Vengurla in the south. The coast is indented with a number of beaches, 15 rivers, 5 major estuaries and over 30 backwater regions.

In recent years, majority of the mangrove forests of Maharashtra have vanished due to anthropogenic pressures. During the last 25 years, about 40% reduction in the mangrove cover of Maharashtra has been due to human interference. Mangrove statistics as per *Maharashtra Remote Sensing Applications Centre* (MRSAC) analysis from satellite imagery of the year 2005 is summarised in Table 3.

Table 4: Statistics of Mangroves in Maharashtra State (Area in sq. km)

District	Taluka	Mangrove		Mud Flat	Salt pan	Grand Total
		Dense	Sparse			
Thane	Bhiwandi	4.07	4.53	4.15	0	12.75
	Dahanu	0.32	2.21	26.88	6.1	35.51
	Kalyan	0.84	0.44	1.47	0	2.75
	Palghar	2.51	13.79	37.75	14.94	69
	Thane	26.82	9.49	16.29	3.69	59.29

[39] https://mahammb.maharashtra.gov.in/site/upload/pdf/MaharashtraSMP2017.pdf

	Vasai	5.82	9.16	21.37	14.59	50.94
Sub Total		40.38	39.62	107.91	39.32	230.24
Mumbai City & Suburbs	Andheri	2.14	0.35	0.72	0	3.21
	Mumbai	2.19	0.39	1.83	0	4.41
	Borivali	12.24	5.28	6.88	0.04	24.44
	Kurla	23.64	2.42	18.01	0.96	45.03
Sub Total		40.21	8.44	27.44	1	77.09
Raigad	Alibag	15.19	9.4	24.79	0.31	49.69
	Mahad	0.18	0.51	1.55	0	2.24
	Mahalsa	2.07	6.04	11.26	0	19.36
	Murud	1.89	2.47	6.42	0.86	11.64
	Panvel	2.78	8.19	20.16	0.85	31.98
	Pen	6.77	4.39	10.69	5.21	27.06
	Roha	1.05	5.77	7.47	0.41	14.71
	Shrivardhan	1.17	3.82	5.92	1.46	12.37
	Tala	0	2.06	4	0.46	6.52
	Uran	6.19	7.6	28.18	4.66	46.64
Sub Total		37.3	50.25	120.43	14.23	222.2
Ratnagiri	Chiplun	1.6	1.17	0.22	0	2.99
	Dapoli	1.61	2.07	1.94	0.16	5.79
	Guhaghar	2.14	1.42	1.51	0	5.07
	Khed	1.6	1.6	0.23	0	3.48
	Mandangad	2.57	1.41	1.43	0	5.41
	Rajapur	3.07	2.01	3.6	0.02	8.71
	Ratnagiri	2.35	5.93	9.4	0.08	17.76
	Sangam	0.04	0	0.13	0	0.17

	eshwar					
Sub Total		14.98	15.62	18.52	0.26	49.37
Sindhudurg	Devgad	2.17	1.55	5.77	0.11	9.59
	Malwan	2.69	3.3	2.76	0.72	9.47
	Sawantwadi	0.13	0.42	0.63	0	1.19
	Vengurla	0.04	0.62	1.97	1.25	3.87
Sub Total		5.03	5.89	11.14	2.07	24.13
Grand Total		137.9	119.81	285.43	56.9	600

(Source: Dept. of Environment, Govt. of Maharashtra)

Along the Maharashtra coast, about 15 rivers, 5 major creeks and 30 backwater regions have been reported (Jagtap et al, 1994). The major upstream freshwater flowing rivers or estuaries are absent, except few small rivers like Kundalika, Savitri, Vashishti, Shastri, and few creeks like Vaitarna, Ulhas-Thane complex, Karanja-Dharmatar complex, Dabhol, Jaigad, Sakhartar, Bhatye, Purnagad, Vijaydurga, Devgarh, Achra and Karli creeks. All these creeks and estuaries together form the drainage in East-West direction and flow/ drain to the Arabian Sea in the west. Mouths of these rivers and creeks are wide-open, funnel shaped with shoals.[40]

Although the State does not have a prominent growth of corals, patchy coral reefs are found in the inter-tidal areas and occasionally at sub-tidal depths in the district of Ratnagiri. Malvan region is known to have rich marine biodiversity and Porites, a stony coral is observed in the region.

Climate change related Sea Level Rise (SLR) increases the vulnerability of coastal ecosystems by posing threat to many coastal cities, urban centres, and coastal population in developed as well as in developing countries. Coastal areas are predominantly rich in resources, easily accessible and facilitate infiltration of people and investments. The 8118 km long coastline in India is characterized as fragile and highly productive. Rapid urban development, increase in the number of polluting industrial units, the growth of luxury tourism and the expansion of industrial shrimp aquaculture have considerable socioeconomic and environmental impacts on the coast of India. The following points show different types of effect of climate change on fishery. (Senapati & Gupta 2014)[41]

1. Ecological impacts: Change in ecosystem processes, change in yield i.e. fish stocks and production, change in species distribution i.e. fish migration, increased variability of catches, changes in seasonality of production i.e. decrease in fishing season.

[40] http://www.bnhs.org/bnhs/phocadownload/esa.pdf
[41] Senapati, S., Gupta, V., "Climate change and coastal ecosystem in India: Issues in perspectives" (2014). International Journal of Environmental Sciences, Volume 5, No 3, 2014 (http://www.ipublishing.co.in/ijesarticles/fourteen/articles/volfive/EIJES51047.pdf)

2. Impact on livelihood: Damage to infrastructure, damage to fishing gears, increased danger at sea, loss/gain of navigation routes, flooding in the living areas of fishing villages.
3. Socio-economic impact: Economic drain on fishermen, rehabilitation, increase in fuel costs, reduced health due to diseases.

It has been estimated that due to 1 meter sea level rise, Maharashtra along with Tamil Nadu will be the most affected because of their high density of coastal population. Maharashtra will also be one of the major affected coastal states in terms of cultivated land and settlement land, due to a rise in sea level by 1 meter. (TERI, 1996)

The Maharashtra coastline has a wide continental shelf marked by backwaters and mud flats. Mangroves are located all along estuarine areas, deltas, tidal creeks, mud flats, and salt marshes.[42] Climate change is causing increased frequency of floods and cyclones in the coastal areas. Increased flooding and salt-water intrusion have direct effect on coastal agriculture, fisheries, aquaculture, freshwater resources, human settlements and tourism. The impact of climate change can also be related to the loss of biodiversity in coastal areas. The Vulnerability Atlas of India (BMTPC, 2006) shows 8.5% of total land in India is vulnerable to cyclones, 5% of land is vulnerable to floods and 1 million houses are vulnerable to other allied damage annually.[43]

[42] http://www.doccentre.net/cc/cc_vulnerability_to_climate_change.pdf
[43] Senapati, S., Gupta, V., "Climate change and coastal ecosystem in India: Issues in perspectives" (2014). International Journal of Environmental Sciences, Volume 5, No 3, 2014 (http://www.ipublishing.co.in/ijesarticles/fourteen/articles/volfive/EIJES51047.pdf)

3. Coastal Zone Management in Maharashtra

3.1. Current Status

Integrated Coastal Zone Management (ICZM) is a complement to sector-specific planning. It is an adaptive process of resource management for environmentally sustainable development in coastal areas. It is not a substitute for sector-specific planning, but focuses on the linkages between sector-specific activities to achieve more comprehensive goals. It is a dynamic and continuous process by which progress towards sustainable use and development of coastal areas may be achieved. It may be defined as,

"ICZM is a process of governance and consists of the legal and institutional framework necessary to ensure that development and management plans for costal zones are integrated with environmental (including social) goals and are made with the participation of those affected. The purpose of ICZM is to maximize the benefits provided by the coastal zone and to minimize the conflicts and harmful effects of activities upon each other, on resources and on the environment."

3.2. Laws and Policies on CZM and their Current Status

The approach to managing India's coastal zone has been a purely regulatory one, as per the Coastal Regulation Zone (CRZ) Notification of 1991, promulgated under the Environment (Protection) Act of 1986. The 1991 notification prevents, restricts and controls development activities within a landward distance of up to 500m from the high tide line along the coasts. In the last decade, as the pressure of development has been growing, on one side there were largescale reported violations of the provisions of the notification, and on the other demands from the various economic sectors to rationalize it.[44]

In this regard, the Government of India has developed a vision for long term management of the coastal and marine areas, as articulated in the National Environment Policy, 2005 and has already initiated steps to operationalize one part of the agenda, which is to create a suitable policy environment for integrated management of coastal and marine areas. The second part is to develop and finance institutional arrangements, capacity and adequate knowledge systems adequate for the country's long term needs. The following are some legal provisions put in place under which the ICZMPs are designed and operated in India.

3.2.1. Legal and Regulatory Framework for ICZMP

3.2.1.1. The Environment (Protection) Act, 1986 (EPA)

According to EPA, "Environment" includes water, air and land and the interrelationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property; Section 3 of the EPA states that Central Government shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing controlling and abating environmental pollution.

3.2.1.2. Coastal Regulation Zone Notification, 6th January 2011

In exercise of the powers conferred by sub-section (1) and clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government, with a view to ensure livelihood security to the fisher communities and other local

[44] ICZM & CRZ - Dr R N Sankhua, Director, NWA (http://cwc.gov.in/CPDAC-Website/Training/9_ICZM_NWA.pdf)

communities, living in the coastal areas, to conserve and protect coastal stretches, its unique environment and its marine area and to promote development through sustainable manner based on scientific principles taking into account the dangers of natural hazards in the coastal areas, sea level rise due to global warming, declared the coastal stretches of the country and the water area upto its territorial water limit as Coastal Regulation Zone (CRZ) and has restricted the setting up and expansion of any industry, operations or processes and manufacture or handling or storage or disposal of hazardous substances as specified in the Hazardous Substances (Handling, Management and Transboundary Movement) Rules, 2009 in the aforesaid CRZ.

3.2.1.3. National Environment Policy, 2004

The National Environment Policy (NEP, 2004) is a response to the national commitment to a clean environment, mandated in the Constitution in Articles 48A and 51 A (g), strengthened by judicial interpretation of Article 21. The Objective of NEP 2004 is:

• Conservation of Critical Environmental Resources

• Intra-generational Equity: Livelihood Security for the Poor

3.2.1.4. Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008

These Rules regulates the transport of Hazardous Waste from generators establishment to Recyclers for recycling, Reuse or reprocessing to facilities authorized by State Pollution Control Board for disposal. Every person engaged in generation, processing, treatment, package, storage, transportation, use, collection, destruction, conversion, offering for sale, transfer or the like activities related to Hazardous Waste is required to take Authorization from Maharashtra Pollution Control Board

3.2.1.5. Municipal Solid Waste Management Rules, 2000

These rules apply to every municipal authority responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes. Every municipal authority, within the territorial area of the municipality, is responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.

3.2.1.6. Biomedical Waste Management & Handling Rules, 1998

These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form. As per these Rules it is the duty of every occupier of an institution generating bio-medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment. It prescribes the treatment & disposal method of Biomedical Waste.

3.2.2.Coastal Zone Legislation in Maharashtra

Ministry of Environment, Forest & Climate Change (MoEFCC) under Environment (Protection) Act, 1986 constituted the Maharashtra Coastal Zone Management Authority (MCZMA). This Authority has the power to take the necessary measures for protecting and improving the quality of the coastal environment and preventing, abating and controlling environmental pollution in the coastal areas. The MoEFCC has issued the Coastal Regulation Zone (CRZ) Notification, 2011 which consolidates the frequent changes post the

Notifications issued in 1991. The main objectives of the Coastal Regulation Zone Notification, 2011 are:

- To ensure livelihood security to the fisherman communities and other local communities living in the coastal areas;
- To conserve and protect coastal stretches and;
- To promote development in a sustainable manner based on scientific principles, taking into account the dangers of natural hazards in the coastal areas and sea level rise due to global warming.

The Maharashtra Pollution Control Board (MPCB) advises the state on environmental related issues and monitors the quality of air, water (river, creeks, sea, ground water and industrial effluents), and noise. The State Government responded to the global issue of climate change by entering into Memorandum of Understanding (MoU) with The Energy and Resources Institute (TERI). This Institute will prepare action plan for climate change within a period of two years. This action plan includes study of key sectors like

- Hydrology & water resources,
- Agriculture & food system,
- Coastal areas marine ecosystem & biodiversity,
- Livelihood (irrigation and conflict) associated sectors like human health, forests and disaster management.

3.3. Key Institutions and Authorities for ICZMP

A list of institutions that have been nominated for implementation of this components of ICZM Maharashtra project are suggested below –

3.3.1. National Institutions

- Central Ground Water Board
- Central Water Commission
- National Institute of Oceanography, Goa
- National Institute of Ocean Technology, Chennai
- Integrated Coastal and Marine Area Management Project Directorate, Chennai
- National Institute of Hydrology, Dehradun
- Botanical Survey of India, Kolkata
- Fishery Survey of India, Mumbai
- Central Marine Fisheries Research Institute, Kochi
- National Institute of Disaster Management
- Centre for Environment Education

3.3.2. State Institutions

- Relevant line departments under the Government of Maharashtra
- Marine Research Centers in Ratnagiri and Malvan (Established by Dr. Babasaheb Ambedkar Marathwada University and Shivaji University respectively
- National Environmental Engineering Research Institute, Mumbai
- Indian Institute of Technology, Mumbai

- B.N. Bandodkar college and Mumbai University (Diversity and status of floral and faunal elements in mangroves)
- Agricultural University of Konkan (Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli)
- Kharland Research Station, Panvel
- Environmental Assessment Division of Bhaba Atomic Research center, Mumbai
- Maharashtra Remote Sensing Authority
- Bombay Natural History Society
- Disaster Management Centre, Mantralaya Mumbai.

3.4. Problem Statement

The coastline of Maharashtra is 720 km long and is increasingly subject to a wide range of economic development related activities; many of which create conflicts and pressures on the increasingly disturbed natural coastal environments; erosion, sedimentation, water quality are a few of the issues. 44% of the coastline is subject to erosion[45]. Rural coastal districts such as Raigad and Palghar have been adversely affected by erosion. Coastal urban areas such as Mumbai 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. 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.[46]

Further, groundwater exploitation in coastal aquifers is one of the primary cause of saline water intrusion. In the coastal alluvium in Palghar district, quality of ground water is brackish to saline (EC up to 4000 µ S/cm) in the lowlands. In Raigad district ground water in shallow dug wells is fresh to brackish. In the coastal alluvium of Sindhudurg district south of Achra creek in Malvan - Devgad - Kelus - Shiroda area the quality of water is fresh to brackish[47]. Reduced availability of fresh water due to saltwater intrusion into groundwater aquifers near the coast is a major issue. In lieu of the same, it is crucial to curtail over-extraction of groundwater in the coastal districts.

A sea level rise of 0.13 – 2 cm has been observed based on historical analysis of 100-year tide gauge data and 17-year satellite data[48]. By the end of the twenty-first century, global mean sea level is projected to increase by 30 to 55 cm for a medium range climate change scenario (RCP 4.5). 68% of the world's coastlines are projected to experience sea level rise of within ±20% of this range for this scenario. This corresponds to a range of about 24 cm to 66 cm for the Maharashtra coastline. Further, sea level rise could also lead to salinization of coastal aquifers.

The diversity and distribution of mangroves along the Konkan coast indicates the sensitivity of mangroves to various environmental changes. The increasing anthropogenic pressures, in the form of conversion of habitats or pollution, are responsible for the decline in species level diversity of mangroves along the coast. In Thane district, industrial expansion is the

[45] https://www.adb.org/sites/default/files/project-document/64308/40156-01-ind-tacr.pdf
[46] Deshmukh, S.V., Dept. of Life Sciences, University of Mumbai (http://www.ncscm.res.in/cms/more/pdf/download/Coastal%20Issues%20and%20Concerns%20-%20Challenges%20for%20the%20Research%20Community.pdf)
[47] http://www.cgwb.gov.in/WQ/Costal%20Report.pdf
[48] http://www.moef.gov.in/sites/default/files/Maharashtra%20Climate%20Change%20Final%20Report.pdf

significant cause for mangrove swamp conversion. The present floristic diversity in the northern coast of Maharashtra shows that species like *Lumnitzera racemosa*, *Bruguiera parviflora* recorded by the earlier workers have become locally extinct. Overall, the zonation pattern in the mangroves of Maharashtra is highly influenced by human interference and rarely there are patches showing natural zonation. On the contrary, threat resistant and opportunistic species grow luxuriantly and dominate the mangrove forests. The pressures on mangrove cover are described below -

- Moth infestation

A common teak defoliator *Hyblaea puera (Lepidoptera Hyblaeidae)* is found to infest *Avicennia marina* in Mumbai, Thane and Raigad. The area infested has increased from 450 ha in 1999 to 6,000 ha in 2008.

- 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.

- Wood felling

Mangrove clearing from swamps renders an irreversible change to the landform. Woody mangrove species are frequently utilized for fuel and low quality timber products.

- 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 (mostly paddy) in order to enrich the nutrient content of the soil. This is a common practice in Thane and Raigad district. Further, there is widespread conversion of mangrove land for agriculture. Construction of dykes in the intertidal regions and conversion of mangrove areas into rice fields has been observed in large extends.

- Dumping of non-biodegradable solid wastes

Indiscriminate dumping of industrial and domestic solid waste in mangrove swamps has been observed in numerous parts of the coast, especially in the district of Ratnagiri and Thane.

- Water pollution

Pollution of the brackish water due to the industrial and sewerage discharge is a serious threat to coastal ecosystems in Maharashtra. Increasing urbanization in densely populated cities like Thane, Mumbai and fast developing cities like Alibag, Ratnagiri and Malwan has led to generation of huge quantities of domestic sewage. Further, the development of Industrial belts in Dahanu-Tarapur (Thane), Thane-Belapur (Mumbai), AlibagRoha (Raigad) and Lote Parshuram (Ratnagiri) among has resulted in increased industrial effluents.

- Conversion of mangrove swamps

Mangrove swamps are observed to be transformed for various purposes like aquaculture, agriculture, extension of residential, industrial or related developmental activities. The temperatures and wind conditions prevailing along the northern coastline of Maharashtra are congenial for saltpan activities. Saltpans provide livelihood for a large number of unskilled workers and form raw material for several other industries. Unsustainable management of saltpans can lead to saline water intrusion in coastal aquifers.

Section II

4. The Project Architecture

4.1. State's Vision and Strategy: Introduction

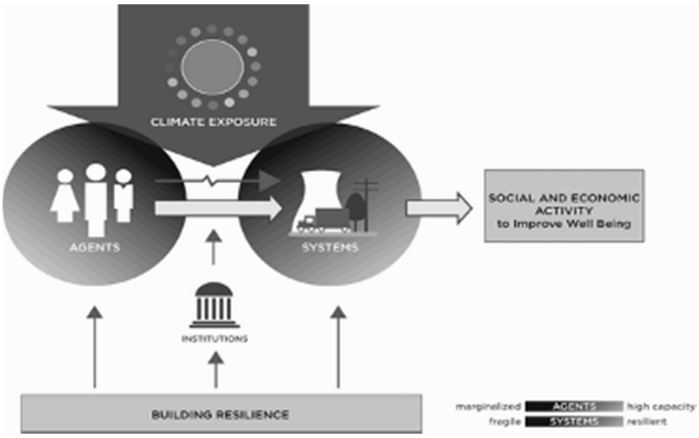
Climate change will have unavoidable impacts on urban systems and populations, especially in the coastal areas of the Maharashtra state. Several large cities including Mumbai are located on the western coast and form a part of the Coastal Zone ecosystem. Climate adaptation of the coastal zone will be essential, and planning for adaptation shall have to be engineered through concepts of climate resilience and vulnerability. Climate resilience shall have to be integrated into an operational framework for planners and would integrate the theoretical and empirical knowledge of the factors contributing to resilience with processes for translating those concepts into practice through urban and coastal systems, the agents that depend on and manage those systems, institutions that link systems and agents, and patterns of exposure to climate change. These shall allow the local planners and engineers to define the factors in order to develop practical strategies as part of this Integrated Coastal Zone Management Plan (ICZMP).

The application of climate projections to determine future risks and the identification of specific measures for responding to these lead to the approach and methodology for planning for climate adaptation through adjusting policies, practices and plans in order to avoid negative impacts of climate change. The term "resilience" when dealing with climate change, refers to applications in psychology and community development as well as disaster risk reduction. This ICZMP project for Maharashtra state requires such build-up of resilience into the project components.

Resilience comprises development of core systems for the Coastal Zone project area which have flexibility and diversity, redundancy and modularity and safe failure as attributes. The second key element is the agents and stakeholders including the locals and implementing and executing departments- the MCZMA and Govt. of Maharashtra. The agents must be responsive, resourceful and have capability to learn and respond to dynamic situations. The third element is the Institutions which may enable and support, or constrain and inhibit the resilience.

4.2. Vision

Linking of institutions to agents involves objective assessment of rights and entitlements, decision making processes, information flows and application of new knowledge for developing resilience. Understanding the vulnerabilities of these three key elements and planning to remove them is critical to the resilient planning and engineering of urban and coastal systems for the coastal zone. Many climate-driven shocks and stresses can be projected on the basis of experience and climate science, many others are unanticipated so building resilience through increasing the inherent capacity of complex systems to manage a range of stresses and shocks, through experience or strategic preparation is a vital ingredient of our approach and methodology. The figure below depicts the mechanism to develop resilience for the climate change events of the future.



Within this conceptual framework building the coastal zone climate resilience means

- Strengthening systems to reduce their fragility in the face of climate impacts and to reduce the risk of cascading failures;
- Building the capacities to anticipate and develop adaptive responses, to access and maintain supportive urban systems; and
- Addressing the institutional factors that constrain effective responses to system fragility or undermine the ability of agents to take action.

4.3 Guiding Principles and Objectives

The MCZMA shall be expected to fulfil its objectives namely:

- Develop/modify master plans for wastewater, waste management and drainage and the integration of urban and coastal climate change resilience principles into project design;
- Mainstream climate change resilience with related works for urban water and flood management (water supply, storm water, and wastewater)
- Build capacity of institutions and stakeholders in applying climate change resilience principles in ongoing and future projects and coastal zone management programs.

The MCZMA would therefore require (i) investment in environmental services (water, waste water, drainage and waste management) with support from various national programs

namely AMRUT and Smart City Missions, NLCP and NRCD related funds and internal allocations; (ii) service improvements in coastal areas and (iii) initiate corrective measures to improve service efficiency in coastal zones.

MCZMA shall require engagement of suitable agencies to conduct surveys and investigations in the project area to map and upgrade the existing infrastructure. The existing services and utilities shall be replicated on GIS platform for all future interventions and integration of the database.

Engineering proposals for the proposed investments (grant) under the ICZMP from the grant received from the World Bank, the IDA, the ADB's Urban Climate Change Resilience Trust Fund (UCCRTF) will be in line with the specified guidelines and requirements of the ADB / World Bank and will further support the MCZMA in its efforts to enhance its adaptive capacity for urban climate change resilience.

MCZMA shall require and may engage the services of agencies which have planned, designed and executed projects as Design Engineering and Project Management Consultants for coastal areas and municipal corporations involving water and energy sectors, under the various programs like the JnNURM and AMRUT during the last decade. The detailed approach and methodology for each of these components shall be formulated by the MCZMA. All these services shall have to be integrated on GIS platform and shall be operable with SCADA.

MCZMA shall also require the application of Asset Management Cycle and Building Information Modelling studies and their utilization for meeting the long term needs of the ICZMP objectives as envisaged by the World Bank in its project Appraisal Document for the ICZMP in India for this purpose.

The development and implementation of the long-term plans of the MCZMA for achieving dramatic reductions in greenhouse gas emissions, embed this work within their larger climate resilience agenda, and ensure that low-income community does not suffer the adverse effects of the climate change will be the ultimate goal of this project. Avoiding the most destructive effects of climate change would require re-imagining and reinventing our coastal zones / areas with all their attributes to put them on a path toward a zero-carbon future will be the ultimate goal. Transformative changes in coastal transportation networks, energy systems, commerce centres, neighborhoods and even governance practices are essential if global society is to remain within the carbon budget that will prevent average global warming from exceeding two degrees Celsius, relative to a threshold beyond which the impacts of climate change are likely to become unmanageable.

4.4Strategy: The Need for ICZMP

Generally, the approach to the coastal issues remains on a sectoral basis and the solutions are formed in an ad-hoc fashion. The inventories are not long lasting. Integration of knowledge, skills and information at different levels within the administration and different stakeholders are neglected. The problem in policy coordination is a standard and recognized one in developed and developing countries. In all cases, where government is organized in sectoral ministries there is difficulty in coordinating issues. Hence, it could be argued that there is also a need for structural reforms if there is to be capacity for Integrated Coastal Zone Management as a sustainable development tool. Integrated coastal zone management (ICZM) is conceived as a holistic management tool working across sectoral, disciplinary, and institutional boundaries. The key challenge for ICZM is lack of integrated coastal policies and effective implementation, due largely to the difficulty of coordinating among several

government agencies responsible for managing coastal activities. Collaborative and integrated approach for decision making is required to secure the sustainable development of marine areas in a healthy environment. In the recent past, the ICZM concept has been practiced in both developed and developing countries.

There are many researches and contributions for the development of ICZM plans for coastal zones towards the latter are sustainable development. However, resource managers often face pressures to act positively in establishing measures that will maintain sustainable development of the environment. Many marine ecosystems have faced exploitation and the data compiled from them reflects a degree of alteration from human impacts. It is however important to establish current levels of diversity as a starting point for future management plans. Sustainability has been given consequence by national governments through institutional reform. Identification of major interactions between CZM components and their dynamics allows the type of problem(s) to be assessed in conjunction with their impacts on stakeholders. Understanding the scale of influence of components of system and risk associated to changes taking place form important considerations to the solution formulation process. Identification of a preferred solution is made from consideration of all the alternative solutions and balances the possible outcomes of each solution against three objectives: sustainable development, minimizing risk to people and property, and minimizing the cost of sustainable development.

ICZM is a continuous and dynamic process that unites governments and the communities, science and management, sectoral and public interests for developing and implementing an integrated plan. The ultimate goal of ICZM is to improve the quality of life of human communities. Coastal area management needs an integrated, interdisciplinary and multi sectoral approaches for sustainable utilisation of resources, which is the fundamental objective of the resource planners and managers. ICZM practices can enhance the nature's contribution to human welfare and preventing undesirable effects. ICZM can suggest suitable legislations, strategies and policies to the managers for conserving and managing the natural re-sources. ICZM can minimise the costs and costly delays in project implementation; minimise the losses to the various users; minimise damage to the marine environment; make the most efficient use of infrastructure and avoids conflicting use of coastal and marine environment. Successful ICZM depends on effective participation of government agencies, Non-Governmental Organisations (NGOs), and all institutions of the society.

The livelihood issues of the coastal population during the non-fishing season merits special consideration in the integrated coastal zone management planning as these issues directly impact the outcomes of the planning process. Further, the management of the resources and goods and services within the zone are best managed by the indigenous population and this aspect must form the basis of the planning and design of management strategy.

4.5Adoption of ICZM Principles and Identification of sites for ICZM

ICZM has become the standard approach to coastal planning and management throughout the world. Planning is the important consequence of ICZM. ICZM cannot be implemented unless clear planning processes with opportunities for community input are designated.
Development and implementation of ICZM plan combines –

- identification of the baseline requirements of the indigenous population, taking into consideration the local customs, historical perspective, traditions and livelihood issues
- establishment of an overall policy for the sustainable development of the coastal zone in the context of the above identified requirements,
- formulation of sectoral development policies and plans that are compatible with the objectives of the overall policy,
- integration of sectoral plans into statewide development plan and
- coordination of development initiatives at the state, district and local levels.

A key principle that should also be adopted is the optimization of long-term productivity of resources. This requires greater cooperation among different sectors and levels of government, adjustment to legislation and improvement of basic management skills. An institutional, organizational, legal, and financial framework is required for an integrated approach to materialize the management objectives. Creation of an enabling environment is a precondition for successful cooperation among different organizations for execution of multi-sector projects. The participating organizations or the stakeholders must have full control over the management of all aspects of their components, leaving only central coordination to the lead agency for participatory management planning.

ICZM plan process provides opportunities to find out the local communities needs and initiate participation in natural resource management. The key to comprehensive participation is not only to ensure public participation through consultation but also to have community representatives sitting directly on the decision-making bodies. The planning model provides an essential first step in integrated management. There is no universal design for a marine-integrated management system. Different regions will have different suites of human activities drawing on different ecosystems on different scales.

The fundamental purpose of all coastal management initiatives is to maintain, restore, or improve specified qualities of coastal ecosystems and their associated human societies. All the Government Departments of Maharashtra have sectoral plans, but they need to be integrated with the other segments. The present ICZM Plan will be integrating the activities of the departments. One dimension of integration is integration among different levels of government. This typically requires national mandates for ICZM and incentives that encourage appropriate action at lower levels in the governance hierarchy. Benefits of ICZM is relevant to the plan area such as development of economic and environmental quality management programs and plans, integration of sectoral policies (fisheries, tourism, energy, transport, agriculture, natural risks, waste disposal, etc.), integration of different levels of government, from local to international, integration of all interest groups into the management process, integration of all management tools (the drawing up of plans, their implementation and evaluation), integration of different disciplines (legal, eco-logical, geo-morphological, economic and social aspects, among others), integration of the administration’s re-sources in all the departments involved.

5 Project Management Structure

5.1 Institutional Architecture

The effective planning and management of the Integrated Coastal Zone Management Plan will be done through Maharashtra ICZMP Society (MICZMPS) which will be a registered society as per the Societies Registration Act. The structure envisioned for MICZMPS, is a two tiered system – a Governing Council and an Executing Body

The Governing Council would provide overall directive for the project. It would be responsible for taking key decisions for the overall implementation. The Executing Body is envisioned to undertake the day-to-day management of the ICZMP. The Executing Body would report to the Governing Council in a periodic manner on the status of implementation of different project components. A Senior Advisory Committee is envisaged as a multi-stakeholder expert committee to review the interventions implemented by the Executing Body from a scientific and technical standpoint. Figure 10, Figure 11 and Figure 12 presents the indicative institutional structure for MICZMPS.

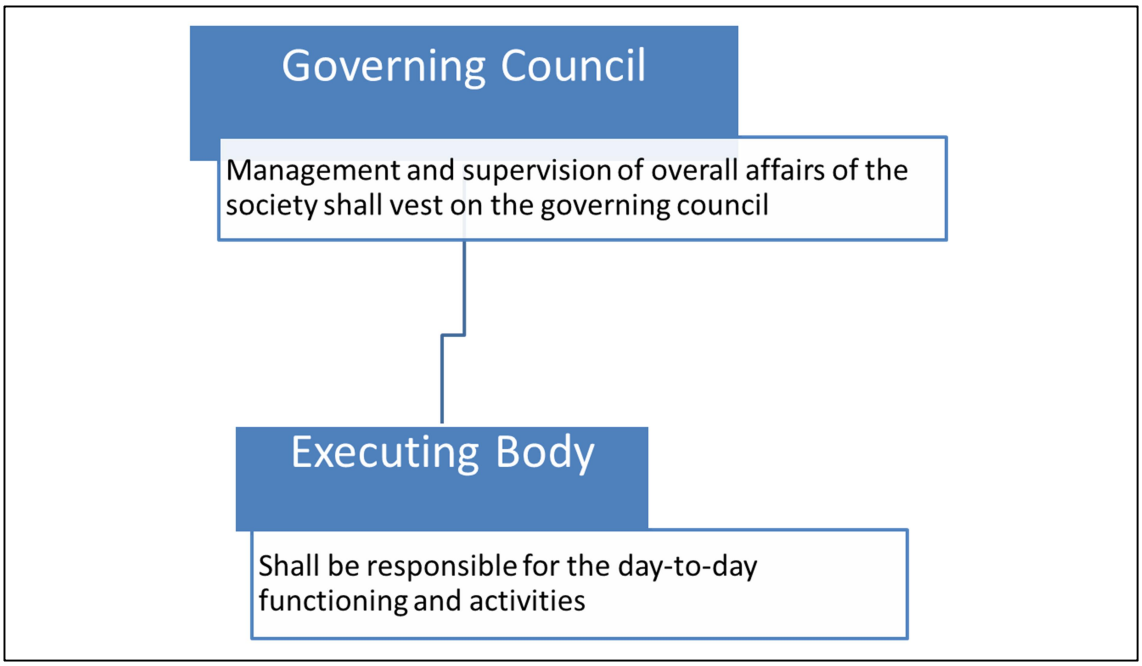


Figure 10 - Overall Institutional Structure for the Maharashtra ICZMP Society (MICZMPS)

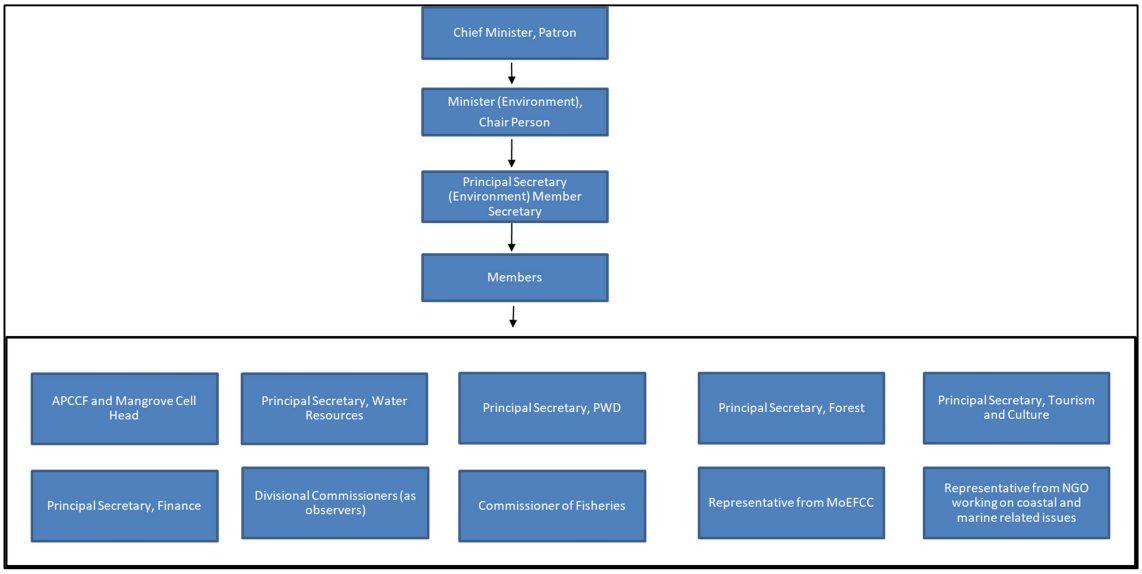


Figure 11 - Proposed structure of Governing Council

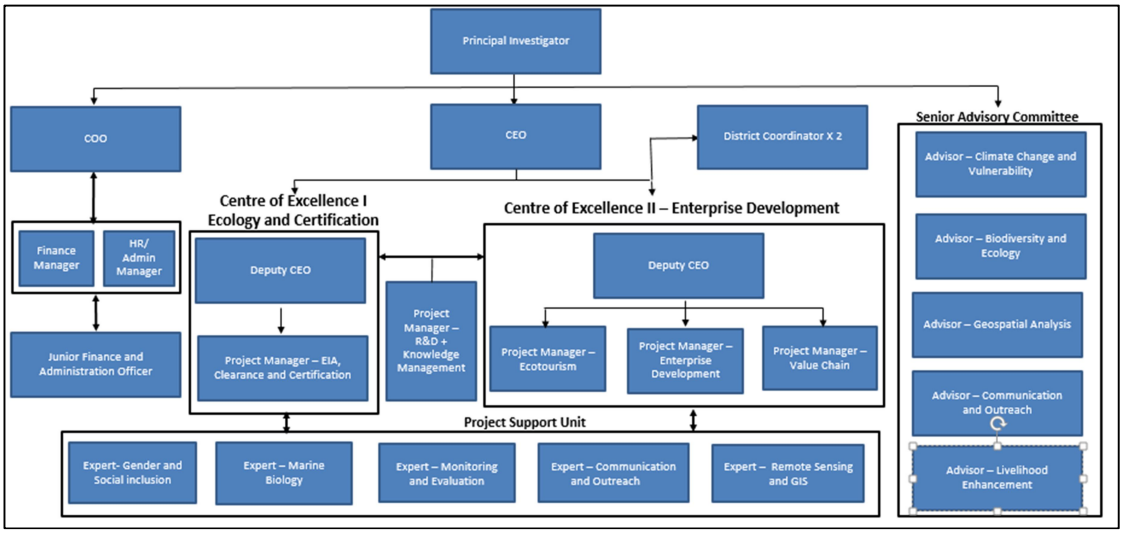


Figure 12 - Proposed structure of the Executing Body

The executing body is envisioned to have two Centers of Excellence (CoE) – one for Ecology and Certification and the other for Enterprise Development. Both the CoE's would be headed by a Deputy CEO with Project Managers reporting to them. All activities related to EIA, clearances and certification for all interventions undertaken by the MICZMPS would be under the aegis of the CoE for Ecology and Certification. The CoE on Enterprise Development would focus exclusively on strengthening the livelihood aspects of activities undertaken by the MICZMPS. This is to recognize the importance of livelihoods in the ICZMP. CoE II (Enterprise Development) would have three project managers focusing on Ecotourism, Enterprise Development and Value Chain Development respectively. Further, a Project Manager on Research and Development and Knowledge Management would be common to both CoEs and look at interlinking activities undertaken by both respective CoE. The CoE's would be advised by a Senior Advisory Committee. Further, both the CoEs would be supported by a Project Support Unit on a day-to-day basis.

6 Project Components

The Integrated Coastal Zone Management Plan for Maharashtra has been divided into four components – Coastal Resource Management and Conservation; Coastal Environment Monitoring and Pollution Management; Livelihood Enhancement and Socio-Economic Development; and Capacity Development, Communication and Awareness. The subsequent section provides an overview of each component and their envisaged impacts.

6.1 Conservation of Coastal and Marine Ecological Resources

Coastal zones are dynamic in nature and provide a wide range of services. The loss of coastal landscapes resulting from urban sprawl has become a growing concern. Rapid urbanization has led to severe changes such as loss of mangrove and coastal wetlands. For instance, 36% of mangrove area has been lost in Mumbai to urban land since 1973[49]. Proper management and conservation of such regions are of prime importance for the continued sustainability of all eco-system services. Interventions proposed within this component are described below.

- 61% of the Maharashtra coast is prone to erosion. Mitigation of the impacts of coastal erosion require a multi-dimensional approach, including both off-shore and on-shore interventions. In lieu of the same, an analysis of the status of current interventions and their gaps would be analyzed. On the basis of the gap analysis, proper off-shore (construction of sea walls, groynes, etc.) and on-shore (conservation, protection and restoration of vegetation cover) interventions would be implemented to mitigate impacts of coastal erosion.
- Rapid urbanization and lack of knowledge on the benefits of mangrove ecosystems has led to their decline in the recent past. Assisted natural regeneration (ANR) will be carried out at sites where mangroves are degrading or have degraded (less than 40% canopy cover).
- Human activities and urbanization cause disturbances to sea turtles (some being an endangered species like Olive Ridley) during their nesting period. This leads to early departure of sea turtles from the sites during the breeding seasons. Illegal trade of turtles is also often reported which further leads to their population decline. To address this issue, turtle nesting sites will be identified and maintained with the help of relevant organizations and local communities.

6.2 Coastal Pollution Management and Related Infrastructure Upgrade

Climate change is expected to exacerbate current stresses on resources resulting from population growth, economic factors and land use changes, including urbanization. Coastal zones being dynamic in nature, require the constant monitoring of various parameters such as coastal erosion, water quality and groundwater level among others. Further, increased urbanization has led to increased discharge of untreated sewage into waterbodies which has numerous health impacts. Within the aegis of this component of ICZMP the project envisages to –

- Establish a sewage treatment facility to provide scientific collection, treatment and disposal of sewage from residential areas.

[49] http://www.sciencedirect.com/science/article/pii/S0964569114001689

- Increase in population has led to an increase in groundwater extraction. Unsustainable groundwater extraction is one of the primary causes of seawater intrusion in coastal aquifers. The maintenance of the dynamic equilibrium between saline sea water and freshwater in coastal aquifers is of prime importance. In lieu of the same, the ICZMP envisages to strengthen the network of piezometers in the study area.

6.3Livelihood Security of Coastal Communities

Changes in coastal zones can have significant impact on livelihood sources for local communities. Thermal pollution from urban and industrial centers are a major cause of reduction in fish catch near the shoreline. Local communities are heavily dependent on the fish industry. In lieu of the same, ICZMP for Maharashtra envisages to diversify livelihood sources for coastal communities. Within the aegis of this component the project envisages to –

- Promotion of seaweed cultivation among coastal communities would aid in providing alternative livelihood sources for small and marginal coastal fishing communities. Further, seaweed cultivation is excellent from climate change perspective as it can be utilized for carbon sequestration.
- Coastal areas in the state have an untapped potential of opportunities for eco-tourism. Potential for water sports like SCUBA diving and snorkeling will be explored in unexplored areas so that the local communities have less dependency on fisheries for their livelihood. Sustainable tourism in mangrove ecosystems will also be introduced which will result in double-pronged benefits of livelihood generation as well as mangrove preservation by the local communities.
- Large tracks of land in coastal Maharashtra has been lost to soil salinity owing to sea water intrusion. In lieu of the same, restoration of such areas through Khar Land development is proposed under ICZMP. Such an intervention would further aid in improving livelihood through agricultural pursuits in such regions

6.4 Capacity Building and Implementation of ICZM Plans

Capacity development of all stakeholders is crucial for the sustainability and replicability of ICZMP. Further, awareness and communication strategy would be developed as part of the project for dissemination of knowledge. In particular, the component of ICZMP would provide a platform for –

- The development of a multi-stakeholder platform for enhanced climate resilient planning and decision making in coastal districts. At present, institutional capacity for integration of climate change considerations into local and state-level economic and sectoral planning and decision-making is inadequate to fully address the impacts of climate change. The project envisages to enhance linkages between existing institutions, in order to strengthen institutional arrangements and facilitate dialogue and collaboration on coastal climate resilience by establishing a multi-stakeholder platform.
- Set-up a coastal erosion database management system for near-real time monitoring of coastal erosion and understand pre and post impacts of various interventions.

6.5Project Implementation Schedule

The project will be implemented in three phases:

Phase 1: Detailed project implementation plan under PMU (6 months)

Phase 2: Piloting the interventions in select sites (12 months)

Phase 3: Full scale implementation (18 months)

Phase 1 will include establishment of the PMU, drawing up of the ToRs for each role and responsibility, drawing up the SoW for each action to be implemented. A detailed well laid out plan can be implemented with comparative ease. Hence we are devoting entire 6 months for this task. Phase 1 will be followed by phase 2, where each identified intervention will be piloted at select locations. This will help in full implementation to be taken up from 18th month of the ICZMP implementation.

Section III

7 Identified Interventions

Activities Proposed

This section explains in detail the specific activities proposed under the ICZM project in Maharashtra. The activities are arranged broadly in four categories: a) Conservation of Coastal and Marine Ecological Resources, b) Coastal Pollution Management and Related Infrastructure Upgrade, c) Livelihood Security of Coastal Communities, and d) Capacity Building and Implementation of ICZM Plans. For ease in management of these activities when implemented, each activity has also been parked under a specific component, so that the responsible agency for the component has complete control over successful implementation of that specific activity. Each component is discussed in the previous chapter.

These activities have been finalized after detailed consultations with various Government agencies, educational and research bodies, community members and private sector. Research and review of ongoing and closed projects on coastal belts in Maharashtra and in other Indian states have been made so as to identify scalable and replicable activities under the ICZM project. The identified activities are detailed in the sub-sections below.

<table>
<tr><th>Sl. No.</th><th colspan="2">Name of Intervention</th></tr>
<tr><td colspan="3">Component 1 – Conservation of Coastal and Marine Ecological Resources</td></tr>
<tr><td>1.1</td><td colspan="2">Land stabilization against coastal erosion through off-shore and on-shore interventions in 19.62 km in Ratnagiri district</td></tr>
<tr><td>1.2</td><td colspan="2">Community-based assisted natural regeneration, restoration and conservation of mangroves
in Malvan in Sindhudurg
In Ratnagiri district</td></tr>
<tr><td>1.3</td><td colspan="2">Conservation of breeding sites for sea turtle species such as Olive Ridley (Lepidochelys olivacea) and Green Turtle (Chelonia mydas) in selected locations-
Ratnagiri – Gaonnkhedi, Guhagar, Dabhol, Kolthare, Anjarla, Kelshi
Sindhudurg district – Shiroda, Vengurla</td></tr>
<tr><td>1.4</td><td colspan="2">Installation of modern monitoring devices in urban patches of mangrove to check encroachment</td></tr>
<tr><td colspan="3">Component 2 – Coastal Pollution Management and Related Infrastructure Upgrade</td></tr>
<tr><td rowspan="6">2.1</td><td colspan="2">Establishment of Sewage treatment facility and underground sewage systems in 4 towns and 6 creeks in Maharashtra</td></tr>
<tr><td>Place</td><td>Capacity</td></tr>
<tr><td>Mirkarwada, Ratnagiri</td><td>4 MLD</td></tr>
<tr><td>Dapoli, Ratnagiri</td><td>2 MLD</td></tr>
<tr><td>Guhagar, Ratnagiri</td><td>2 MLD</td></tr>
<tr><td>Rajapur, Ratnagiri</td><td>3 MLD</td></tr>
<tr><td></td><td colspan="2">6 creeks – Kolamb Creek, Karli Creek, Vijaydurg Creek, Rajapur Durg and Anjarle Creek</td></tr>
<tr><td>2.2</td><td colspan="2">Installation of treated water system to 16 villages highly prone to increased salinity in drinking water</td></tr>
</table>

2.3	Construction and installation of sewer lines (bandist katha) and sewage management and treatment in clusters in coastal and watershed villages in 6 identified creeks
Component 3 – Livelihood Security of Coastal Communities	
3.1	Promotion of coastal tourism by – • Community based beach clean-up in 20 beaches. • Development of infra such as toilets based on length of beach and footfall in 20 beaches. • Assisting communities to set-up business in alternative destinations for water sports in 12 places in Ratnagiri district. • Signboards and peripheral infrastructure improvement in tourist path in 5 culturally important sites.
3.2	Mangrove ecotourism and crab farming in three stretches for livelihood generation through women SHGs. • Ratnagiri • Sindhudurg
3.3	Promoting seaweed (marine microalgae) cultivation among coastal villages
3.4	Restoration of 352 ha saline infected land (Khar Land) and maintenance of 4,119 ha reclaimed Khar Land
3.5	Removal of marine litter and ghost nets from the ocean near coastal villages
Component 4 – Capacity Building and Implementation of ICZM Plans	
4.1	Network of institutions for enhanced climate resilient planning and knowledge management
4.2	Strengthening the Maharashtra Coastal Erosion Database Management System (MCEDMS)

Cross Sectoral Impacts of ICZMP Interventions

The interventions shortlisted in the Integrated Coastal Zone Management Plan have multi-sectoral impacts. The following table provides an overview of the cross-sectoral impacts of each intervention. The boxes highlighted in black represent the primary thematic impact of an intervention. On the other hand, the boxes highlighted in yellow provide the secondary thematic impacts of the interventions respectively.

Component / Intervention	Conservation of Coastal and Marine Ecological Resources	Coastal Pollution Management and Related Infrastructure Upgrade	Livelihood Security of Coastal Communities	Capacity Building and Implementation of ICZM Plans
Land stabilization against coastal erosion through off-shore and on-shore interventions in 19.62 km in Ratnagiri district	■			
Community-based assisted natural regeneration, restoration and conservation of mangroves	■			
Conservation of breeding sites for sea turtle species such as Olive Ridley (*Lepidochelys olivacea*) and Green Turtle (*Chelonia mydas*) in selected locations	■			
Installation of modern monitoring devices in urban patches of mangrove to check encroachment	■			
Establishment of Sewage treatment facility and underground sewage systems in 4 towns and 6 pilot creeks in Maharashtra		■		
Installation of treated water system to 16 villages highly prone to increased salinity in drinking water		■		
Construction and installation of sewer lines (bandist katha) and sewage management and treatment in clusters in coastal and watershed villages in 6 identified creeks		■		
Promotion of coastal tourism			■	
Mangrove ecotourism and crab farming in three stretches for livelihood generation through women SHGs			■	
Promoting seaweed (marine microalgae) cultivation among coastal villages			■	
Restoration of 352 ha saline infected land (Khar Land) and maintenance of 4,119 ha reclaimed Khar Land			■	
Removal of marine litter and ghost nets from the ocean near coastal villages			■	
Network of institutions for enhanced climate resilient planning and knowledge management				■
Strengthening the Maharashtra Coastal Erosion Database Management System (MCEDMS)				

■ Primary Impact

■ Secondary Impact

The ICZMP project envisages implementing the shortlisted interventions in selected stretches for achieving integrated long term impacts. The stretches shortlisted for the same are –

- Kolamb Creek to Karli Creek in Sindhudurg – 37.5 km
- Vijaydurg Creek to Rajapur Creek in Ratnagiri – 67 km
- Anjarle Creek in Ratnagiri – 9.57 km

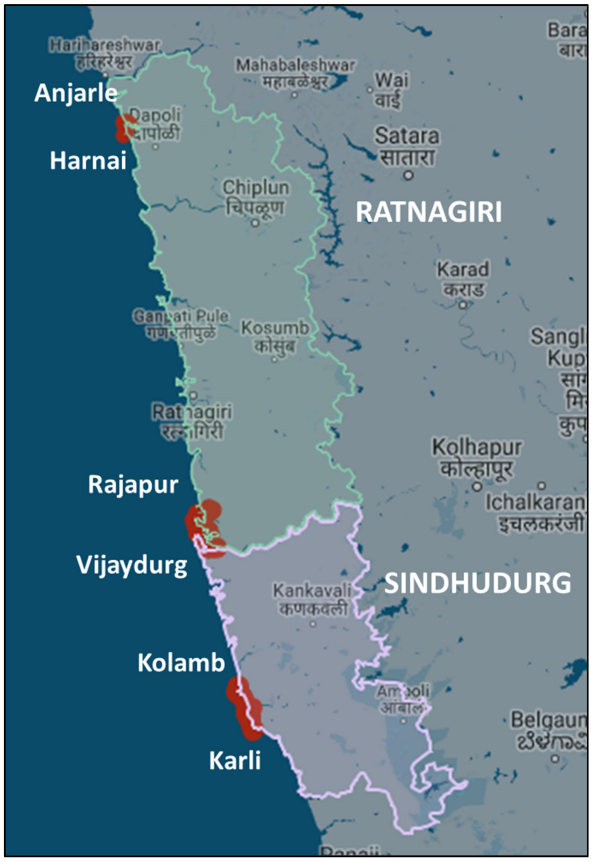


Figure 13 - Selected stretches for implementation of shortlisted interventions for ICZMP

The overarching objective of the interventions would be to link clean creeks with livelihood generation and biodiversity conservation. The rejuvenated creeks would have environmental, economic and social impacts.

Economic

- Ecotourism: Encourage more tourist footfalls in the creeks and adjoining beaches. Two beaches to be targeted to be certified as blue flag in 4 years.
- Bivalve farming: Clean water in the creeks are essential for ensuring export quality bivalve culturing. Bivalve farming also can be taken up in private lands with incursion of salty water and growth of mangroves. At present the products are being sold in the internal market only; and hence full market potential has not been realised.
- Farming ornamental fishes.

Environmental

- Creeks mapped as critical biodiversity spots (eg: Mirya creek) will be given priority in selection of the creeks.

Social

- Improvement in standard of living of local communities.

The following matrix provides an overview of the selected interventions in relation to the shortlisted stretches for implementation of ICZMP. Interventions that have implementation locations within the selected stretches have been marked with a cross. The other interventions currently have been identified in different sections of the coastline, but can be replicated in the selected coastal stretches. Such interventions have been marked with a circle.

Stretch / Intervention	Anjarle	Kolamb to Karli	Vijaydurg to Rajapur
1.1	X		X
1.2	0	0	0
1.3	X		
1.4	0	0	0
2.1	X	X	X
2.2	X		X
2.3	X	X	X
3.1	X	X	X
3.2	0	0	0
3.3	X	X	X
3.4			X
3.5	X	X	X
4.1	X	X	X
4.2	X	X	X

X	Proposed location present in shortlisted stretch
0	Intervention can be replicated in selected stretch

7.1.1 Land stabilization against coastal erosion through off-shore and on-shore interventions

Name of the intervention	Land stabilization against coastal erosion through off-shore and on-shore interventions in 19.62 km in Ratnagiri district
Project Location (Proposed)	Identified 43 stretches totaling 19.62 km in Ratnagiri district
Component	Conservation of Coastal and Marine Ecological Resources
Project Output	• Groyne construction and extension of such civil structures at selected locations. • Sea wall construction at selected locations. • Native species protection, conservation and restoration.

Project Outcome	Control of coastal erosion as compared to baseline at identified locations
Description of the action	The intervention involves a multi-dimensional approach towards mitigating coastal erosion in the district. The phased approach would involve – • Development of baseline, • Categorization of vulnerable sites, • Identification of priority areas, • Shortlisting actions in priority sites • Implementation of the intervention actions The baseline database will quantify the erosion that has happened over a time horizon of 10 years using high resolution remote sensing data and available field data. Existing data such as those maintained by CWPRS and ISRO will also be obtained. A survey of economic loss due to erosion will also be estimated to map the vulnerable areas and select the priority areas. Based on the baseline surveys and mapping, future projections of erosion will be made. The erosion sites will be categorized based on the weightage given to loss to human habitation and livelihood, infrastructure and habitat. Specific systemic interventions to control erosion will be drawn-up for each of the high priority sites. The exact location and the technique involved will be driven by geological viability, however each intervention shall be implemented following consultations with community which will be primary beneficiaries due to control in erosion. A Convergence matrix of existing schemes where these interventions can be implemented will be drawn by the PMU to avoid any duplication. At this stage, three interventions have been shortlisted – • Groyne construction and extension of such civil structures at selected locations. Groynes are structures built from the beach into the sea to control erosion and drifting. • Sea wall construction at selected locations. Sea walls are constructed away from the coast to dissipate the force of waves hitting the coastline. • Native species protection, conservation and restoration. Proper vegetation on the coastline would assist in reducing the extent of erosion. In lieu of the same, protection, conservation and restoration of native species would be undertaken in stretches where civil interventions are not viable.
Nodal agency (Proposed)	Harbor Engineering

Partner institutes (Proposed) (if any)	MRSAC, IIT Bombay, Forest Department, Local municipality/village panchayat			
Implementation plan	**Activity**	**Start**	**End**	**Responsible Agency**
	Development of baseline	Month 3	Month 9	TBD
	Mapping of the coastal zone	Month 3	Month 6	MRSAC/TBD
	Categorization of vulnerable sites	Month 9	Month 12	Agency which does the baseline study
	Identification of priority areas	Month 9	Month 12	Office of the district collector through the district disaster management cell
	Shortlisting actions in priority sites	Month 9	Month 15	Office of the district collector through the district disaster management cell
	Identification of status of any existing off-shore interventions in identified locations	Month 3	Month 12	Office of the district collector
	Identification of status of on-shore vegetation cover	Month 3	Month 12	Forest Department
	Implementation of the intervention actions			
	Renovation of existing (if any) off-shore interventions	Month 15	Month 24	PWD
	Construction of new structures	Month 15	Month 24	PWD
Sustainability and replicability	The multi-dimensional approach to limit coastal erosion is easily replicable in other coastal landscapes.			
Expected Climate Change benefits	Reduced coastal erosion will lead to preservation and restoration of native coastal biodiversity. Multiple benefits in			

	adaptation as well as mitigation.

7.1.2 Community-based assisted natural regeneration, restoration and conservation of mangroves

Name of the intervention	Community-based assisted natural regeneration, restoration and conservation of mangroves[50]
Project Location (Proposed)	Targeting existing mangrove forests: 487 ha in Sindhudurg District and 1,436 ha in Ratnagiri • in Malvan in Sindhudurg • In Ratnagiri district Exact location to be identified in consultation with Mangrove Cell
Component	Conservation of Coastal and Marine Ecological Resources
Project Output	• Restoration of existing mangrove forests through integrated approach of ensuring free tidal flows and seeding where required. • ANR of areas identified as deforested/degraded mangrove sites.
Project Outcome	Regeneration and restoration of mangroves has many proven benefits on conservation of coastal land as well as safeguarding livelihood. Mangrove conservation is one of the major aspects of building coastal resilience to climate change, with strong climate change mitigation aspects of carbon sequestration. The ecosystem goods and services enhanced or sustained from this activity include livelihood options with better fish and crustacean catch in the coastal belt, storm protection, and maintaining stability of the shoreline and preventing release of toxic wastes into the coastal waters .
Description of the action	30,000 ha land is under mangroves forests in Maharashtra, which supports 20 different species of mangroves, making the state the richest State in species diversity in the Western Coast of India. Even though, this is just 4% of India's mangrove forests, the State recognizing the criticality of conserving these forests has declared 15,088 ha of mangrove forests as Reserve Forests[51]. Maharashtra has been a leader in mangrove conservation, and has pioneered many innovative solutions to conserve mangroves. One of them has been under the UNDP-

[50] http://www.nabard.org/auth/writereaddata/File/FINAL_DPR_GUJARAT.pdf
[51] Vasudevan, N, Goenka, Debi, The Mangrove Cell, Maharashtra Forest Department, History of Mangrove Management in Maharashtra, 2017, http://cat.org.in/wp-content/uploads/2017/07/HISTORY-OF-MANGROVE-MANAGEMENT-IN-MAHARASHTRA.pdf

GEF.

Project on “Mainstreaming of Coastal and Marine Biodiversity in Sindhudurg District”, under which emphasis was placed on ‘Mangrove conservation through livelihood promotion’. Scalable and replicable activities from such programs will be taken up under ICZM project. Similarly, replicable actions from the GIZ India supported “Sustainable Management of Coastal land Marine Protected Areas” (SM-CMPA) initiatives on ecosystem conservation, especially in on Flamingo at Thane creek will be taken up in the ICZM project.

For restoring a degraded mangrove area, following two methods are proposed.

1. Fish Bone Canal Method
2. Desilting and Removing blocks in the natural canals in the sparse mangroves to facilitate natural regeneration

Major objective in these two methods is to restore tidal flushing to degraded mangrove sites or enabling regeneration of mangroves in areas with sparse mangroves. There are no fixed rules to use these different methods and it is the judgement and experience of the personnel involved in restoration activities to decide which method is best suited to restore mangroves in a particular coastal belt. Each site condition will warrant different approaches and methods.

Fish Bone Canal Method

Fish Bone canal or trench method was extensively used to restore degraded mangrove areas to restore large tract of degraded mangroves. In this method, canals constructed like a fish bone with a main canal and alternating branching canals extend tidal water reach in areas which were not flushed adequately earlier. New channels create new flushing regime thereby improving stand structure and density of mangroves. In many mangrove formations, trough shaped intertidal belt where removal of mangroves and further sediment subsidence led to water stagnation was successfully restored using fishbone canal method. The main canal is connected to a creek system which supplies water to the main canal and other branching canals. This system of canals creates suitable condition for regeneration of mangroves. Fish bone canal method could be applied to restore degraded areas up to 50 ha with different topography which is not properly inundated. This method could also be applied in sparse mangrove stands where mangroves are stunted and sparse due to poor tidal flushing.

Fish bone canal will produce better results where the intertidal belt has become trough shaped either due to clear felling of mangrove trees or in intertidal belts where sparse mangroves

	are present. In this area, ground level of degraded portion is below Mean Water Level (MSL). Canal method will adequately flush the area and create conducive condition for regeneration of mangroves. This method could also be applied successfully in areas where the periphery of the mangrove belt is an elevated landmass preventing free exchange of tidal currents. Areas beyond the intertidal belt where tidal flow does not reach is not suitable for fish bone canal method. Similarly, canal method is not suitable in sandy intertidal belt since the canals will collapse easily during monsoonal rains and get closed very fast due to heavy sedimentation. Likewise, accreting coastal belt where heavy siltation will close the mouth of the main canal is also not suitable for canal method. Hence, utmost care is to be taken before applying this method. **Desilting, Removing Blocks in Natural Canals** Thoroughly surveying the sparse mangroves and identifying reasons for its sparseness and efforts to remove the physical blocks that render the mangroves sparse would be a best method to restore sparse mangroves to a dense condition. Tidal flushing in majority of the sparse mangroves could be improved by desilting minor creeks that form a network within the sparse mangroves. Desilting, removing blocks along its path, slightly altering the course of the minor canals and widening/ deepening its mouth has proved to produce excellent results in some sparse mangrove formations. Besides being simple, this method is highly cost and labour effective and takes lesser time. Regeneration and restoration of mangroves will provide ecosystem goods and services to the coastal communities, thus helping them with better fish and crustacean (prawns and crabs) catch in the coastal belt, storm protection and provide fodder for livestock during very lean seasons. Restoring mangroves has high co-benefits, such as conserving biodiversity, carbon sequestration etc.			
Nodal agency (Proposed)	Mangrove Cell, Maharashtra Forest Department			
Partner institutes (Proposed) (if any)	Central Marine Fisheries Research Institute (CMFRI) BNHS and other Research institutes, conservation bodies with experience in mangrove restoration, protection and plantation. Civil societies and PPP models with the help of industries in Maharashtra (eg: Soonabai Pirojsha Godrej Marine Ecology Centre)			
Implementation Plan	**Activity**	**Start**	**End**	**Responsible Agency**

	Development of baseline	Month 2	Month 4	TBD
	Mapping of identified mangrove areas of 500 ha	Month 2	Month 5	MRSAC/TBD
	Identification of priority areas	Month 4	Month 6	Office of the district collector through the district disaster management cell
	Identification of status of any existing off-shore interventions in identified locations	Month 6	Month 8	Office of the district collector
	Restoration work using Fish Bone Canal Method; Desilting and Removing blocks in the natural canals	Month 8	Month 48	Mangrove Cell/TBD
	Training program fine-tuned for focus groups on mangrove conservation and various aspects of marine biodiversity conservation conducted for forest staff, personnel from fisheries department, fishers' community, and other stakeholders in the coastal environment.	Month 8	Month 36	TBD
	Monitoring blue carbon sequestration to mitigate climate change by development of an MRV system.	Month 8	Month 60	Mangrove Cell/MRSAC/TBD
	• Priority for mangrove restoration will be given to those areas close to the identified coastal villages for seaweed farming and polyculture. • 500 ha from these locations will be selected after detailed discussions with partner organizations; and weighing the potential community participation in the restoration efforts. • Apart from restoration work, training to coastal community shall also be provided on mangrove restoration/regeneration so that conservation activities are continued even after the project. • A series of training program fine-tuned for focus groups			

	like fisher folk, snorkeling guides, farmers, dolphin tour operators, homestay owners, rural women groups, and exposure visits on mangrove conservation and various aspects of marine biodiversity conservation conducted for forest staff, personnel from fisheries department, fishers' community, and other stakeholders in the coastal environment. • Subjects like mangrove ecology, mangrove nursery and plantation techniques along with training on a wide range of subjects such as wildlife crime control (with specific reference to marine protected species), beaching and stranding of marine mammals, identification of marine mammals, turtle conservation, SCUBA diving, etc. • For restoring a degraded mangrove area, following two methods are proposed - Fish Bone Canal Method; Desilting and Removing blocks in the natural canals in the sparse mangroves to facilitate natural regeneration • Major objective in these two methods is to restore tidal flushing to degraded mangrove sites or enabling regeneration of mangroves in areas with sparse mangroves.
Sustainability and replicability	Coastal communities will be trained to ensure protection. Mangroves restored will continue to be in the same condition even after the project. The incentive for community is the increased yield of fish catch (prawns and crabs) from the mangroves. Activities undertaken by the Mumbai Mangrove Conservation Unit (MMCU), established in 2014 under the Mangrove Cell, can be replicated in this project. Different agencies under the Corporate Social Responsibility (CSR) will be willing to undertake mangroves restoration work under more area apart from mangrove replantation.
Expected Climate Change benefits	Mangroves have huge carbon sequestration co-benefits apart from biodiversity enrichment as they are able to absorb almost eight times more carbon dioxide from the atmosphere than any other ecosystem.[52] They also maintain the stability of the shoreline and prevent the release of toxic wastes into the coastal waters. In times of natural calamities like tsunami, cyclones and storm surges, they act as barriers or shock absorbers.

[52] Seervai, S., "The Importance of Mumbai's Mangroves", The Wall Street Journal (2013) https://blogs.wsj.com/indiarealtime/2013/04/30/the-importance-of-mumbais-mangroves/

7.1.3 Conservation of breeding sites for sea turtle species such as Olive Ridley (*Lepidochelys olivacea*) and Green Turtle (*Chelonia mydas*)

<table>
<tr><td>Name of the intervention</td><td colspan="4">Conservation of breeding sites for sea turtle species such as Olive Ridley (Lepidochelys olivacea) and Green Turtle (Chelonia mydas) at selected locations</td></tr>
<tr><td>Project Location (Proposed)</td><td colspan="4">• Sindhudurg district – Shiroda, Vengurla
• Ratnagiri – Gaonnkhedi, Guhaghar, Dabhol, Kolthare, Anjarla, Kelshi</td></tr>
<tr><td>Component</td><td colspan="4">Conservation of Coastal and Marine Ecological Resources</td></tr>
<tr><td>Project Output</td><td colspan="4">Conservation of sea turtle species such as Olive Ridley, an endangered species.</td></tr>
<tr><td>Project Outcome</td><td colspan="4">Conservation of endangered sea turtle species, study of their migratory patterns, awareness and livelihood generation amongst local residents through setting up eco-tourism avenues.</td></tr>
<tr><td>Description of the action</td><td colspan="4">Protection of endangered sea turtles like Olive Ridley and green turtles by protecting their nesting sites from human and animal intrusion during nesting season, community training on rescue activities, awareness campaigns on the significance of sea turtles in the marine and coastal ecosystem, etc.

The major threats to marine turtles include degradation of nesting habitats, disturbances to nesting habitats due to beach lighting, recreational activities and incidental catching. The conservation measures include monitoring nesting sites, avoiding infrastructure development close to the shore and tracking their migration through tagging initiatives.</td></tr>
<tr><td>Nodal agency (Proposed)</td><td colspan="4">State Mangrove Cell (Maharashtra Forest Department)</td></tr>
<tr><td>Partner institutes (Proposed) (if any)</td><td colspan="4">Sahyadri Nisarga Mitra, Dakshin Foundation</td></tr>
<tr><td>Implementation Plan</td><td>Activity</td><td>Start</td><td>End</td><td>Responsible Agency</td></tr>
<tr><td></td><td>Identification of turtle nesting sites in selected districts.</td><td>Month 2</td><td>Month 4</td><td>TBD</td></tr>
<tr><td></td><td>Mapping of identified turtle nesting sites</td><td>Month 2</td><td>Month 5</td><td>MRSAC/TBD</td></tr>
<tr><td></td><td>Identification of priority areas</td><td>Month 4</td><td>Month 6</td><td>Office of the district collector through the district disaster</td></tr>
</table>

				management cell
	Collaboration with local NGOs, volunteers, and forest officers to develop localized turtle conservation programs.	Month 6	Month 8	Office of the district collector
	Raising awareness among relevant stakeholders (forest personnel, communities, etc.) on the significance of sea turtle conservation	Month 8	Month 12	Forest Dept/TBD
	Involving the State Forest Department to avoid infrastructure development at and near the nesting sites.	Month 6	Month 10	Forest Dept
	Protection of nesting sites and turtle eggs during the season through community efforts.	Nesting season		TBD
	Geotagging turtles to study their migratory pattern	Nesting season	Hatching season	TBD
	Undertaking studies through specialized institutes on mortality patterns of infant turtles	Hatching season	Month 60	TBD
	Promotion of eco-tourism facilities in order to raise awareness and gather volunteers for conservation efforts	Month 12	Month 36	
Sustainability and replicability	With the involvement of local NGOs and active participation from local communities in developing local eco-tourism models, conservation efforts will also lead to income generation for the locals. Sustainability of turtle conservation efforts will thus be ensured. Velas village in Ratnagiri district has seen success in turtle conservation efforts led by Sahyadri Nisarga Mitra (SNP). This remains the only site in western India where organized turtle			

	nesting site conservation is being implemented. This model could be scaled for the proposed and future activities in the State.
Expected Climate Change benefits	• Beaches and dune systems lack nutrients essential for vegetation. All the unhatched nests, eggs and trapped hatchlings are very good sources of nutrients for the dune vegetation. • Dune plants use the nutrients from turtle eggs to grow and become stronger. As the dune vegetation grows stronger and healthier, the health of the entire beach/dune ecosystem becomes better. Healthy vegetation and strong root systems hold the sand in the dunes and protect the beach from erosion. • Sea grass beds grazed by green sea turtles are more productive than those that aren't. Hawksbill turtles eat sponges, preventing them from out-competing slow-growing corals. Both of these grazing activities maintain species diversity and the natural balance of fragile marine ecosystems.

7.1.4 Installation of modern monitoring devices in urban patches of mangrove to check encroachment

Name of the intervention	Installation of modern monitoring devices in urban patches of mangrove to check encroachment
Project Location (Proposed)	Targeting existing mangrove forests in periphery of urban agglomerations • In Sindhudurg district • In Ratnagiri district Exact location to be identified in consultation with Mangrove Cell
Component	Conservation of Coastal and Marine Ecological Resources
Project Output	Installation of night vision enabled HD modern monitoring devices in the periphery of mangrove forests in urban patches to assist in conservation activities
Project Outcome	Regeneration and restoration of mangroves has many proven benefits on conservation of coastal land as well as safeguarding livelihood. Mangrove conservation is one of the major aspects of building coastal resilience to climate change, with strong climate change mitigation aspects of carbon sequestration. The ecosystem goods and services enhanced or sustained from this activity include livelihood options with better fish and crustacean catch in the coastal belt, storm protection, and maintaining stability of the shoreline and preventing release of

<table>
<tr><td></td><td colspan="4">toxic wastes into the coastal waters .</td></tr>
<tr><td>Description of the action</td><td colspan="4">Industrial activity worldwide has grown over the past six or seven decades. Developing countries like India characterized by large working populations and significantly lower costs of capital have become hotbeds of manufacturing activities. This has resulted in large scale expansion of urban regions. India’s urban population in the last decade alone has grown by 31.8%. Rapid unplanned development has led to depletion of natural resources, increasing pollution and issues with waste management. In wake of such challenges it is important to inculcate innovative concepts to mitigate escalating pressures on resources.</td></tr>
<tr><td>Nodal agency (Proposed)</td><td colspan="4">Mangrove Cell</td></tr>
<tr><td>Partner institutes (Proposed) (if any)</td><td colspan="4">MCZMA, CPCB</td></tr>
<tr><td>Implementation Plan</td><td>Activity</td><td>Start</td><td>End</td><td>Responsible Agency</td></tr>
<tr><td></td><td>Identification of stretches where mangrove areas are surrounded by urban agglomerations or industries</td><td>Month 2</td><td>Month 5</td><td>TBD</td></tr>
<tr><td></td><td>Mapping of identified mangrove areas</td><td>Month 2</td><td>Month 5</td><td>MRSAC/TBD</td></tr>
<tr><td></td><td>Identification of priority areas</td><td>Month 4</td><td>Month 6</td><td>Office of the district collector through the district disaster management cell</td></tr>
<tr><td></td><td>Construction of boundary wall/fences around priority conservation zones</td><td>Month 6</td><td>Month 10</td><td>TBD</td></tr>
<tr><td></td><td>Additional CCTV installations on high priority zones for 24*7 monitoring of mangrove belts</td><td>Month 8</td><td>Month 10</td><td>Mangrove Cell/TBD</td></tr>
<tr><td></td><td>Training programmes fine-tuned for focus groups on mangrove conservation and various aspects of marine biodiversity conservation conducted for forest staff, personnel from fisheries department, fishers’ community, and other</td><td>Month 8</td><td>Month 18</td><td>TBD</td></tr>
</table>

	stakeholders in the coastal environment.			
Sustainability and replicability	Modern technology would be used to supplement existing conservation efforts by providing 24*7 monitoring of critical patches. Further, coastal communities will be trained to ensure protection. Funds through Corporate Social Responsibility (CSR) can be channelized for sustainability of the intervention post the project period.			
Expected Climate Change benefits	Mangroves have huge carbon sequestration co-benefits apart from biodiversity enrichment as they are able to absorb almost eight times more carbon dioxide from the atmosphere than any other ecosystem.[53] They also maintain the stability of the shoreline and prevent the release of toxic wastes into the coastal waters. In times of natural calamities like tsunami, cyclones and storm surges, they act as barriers or shock absorbers.			

7.2.1 Establishment of Sewage treatment facility and underground sewage systems in 4 towns and 6 pilot creeks in Maharashtra

Name of the intervention	Establishment of Sewage treatment facility and underground sewer system in 4 towns and 4 pilot creeks in Maharashtra
Project Location (Proposed)	As mentioned in the beginning of this section, the envisaged design is to integrate various aspects on coastal zone management so that the collective positive outcomes can be demonstrated. STP are crucial to maintain hygiene of coastal water for tourism and aquaculture. These STPs will help in the beaches associated with the creeks being eligible for blue flag certification. The bivalve farming in these area can fetch higher value as they would now be eligible for being exported. Hence the STPs are to be installed in those stretches in such a fashion that the following points are considered: 1. Target places in Sindhudurg where bivalve culture has been promoted under the UNDP funded project so that higher value for the product can be achieved. 2. Target places near urban conglomeration and fishing/tourism sites so as to decrease discharge on untreated water.

[53] Seervai, S., "The Importance of Mumbai's Mangroves", The Wall Street Journal (2013) https://blogs.wsj.com/indiarealtime/2013/04/30/the-importance-of-mumbais-mangroves/

	Based on these, 4 locations in Ratnagiri District have been identified for construction of sewage treatment plant and underground sewer system; which are – • Mirkarwada (with an installed capacity of 4 MLD) • Dapoli (with an installed capacity of 2 MLD) • Guhagar (with an installed capacity of 2 MLD) • Rajapur (with an installed capacity of 3 MLD) However these are within the three stretches identified and discussed earlier; and shall feed into cleaner creeks and cleaner beaches.
Component	Coastal Pollution Management and Related Infrastructure Development
Project Output	Establishment of sewage network and sewage treatment facility in 4 regions in Ratnagiri district. Further, 6 creeks would be selected for improvement of their ecology through pollution abatement by removal of point and non-point pollution sources.
Project Outcome	Improvement in water quality released into water body from selected clusters. Improved health due to reduced exposure to untreated wastewater. Creek improvement through abatement of pollution load discharged into creek through point and non-point sources would have a multi-dimensional impact. Improved creek health would lead to improved marine flora and fauna. This would assist in enhancing polyculture and aquaculture related activities in the selected creeks thus aiding in improving socio-economic condition of surrounding population.
Description of the action	Unscientific management and exposure to raw sewage has numerous health impacts. Further, the dumping of sewage in water bodies that are ultimately used for different usages have significant impact on human health. In lieu of the same, a scientific sewage collection, treatment and disposal system is envisaged to be developed for 4 regions in Ratnagiri with a cumulative treatment capacity of 11 MLD. The objective is to link clean creeks, livelihood generation and biodiversity conservation in a seamless fashion. Clean creeks will also have a domino effect in the environmental, economic, and social aspects. **Economic**: • Ecotourism: Encourage more tourist footfalls in the creeks and adjoining beaches. Two beaches to be targeted to be certified as blue flag in 4 years. • Bivalve farming: Clean water in the creeks are essential for ensuring export quality bivalve culturing. Bivalve farming also can be taken up in private lands with

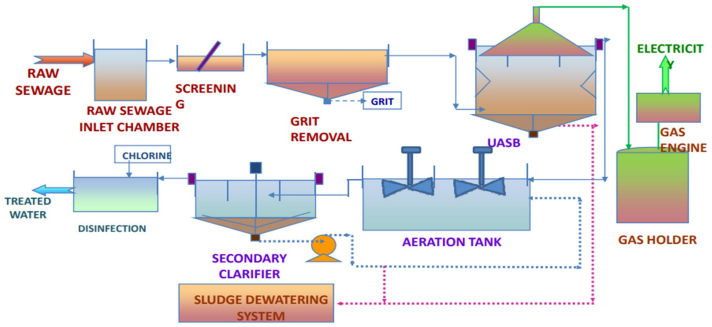
incursion of salty water and growth of mangroves. At present the products are being sold in the internal market only; and hence full market potential has not been realised.
- Farming ornamental fishes.

Environmental:
- Creeks mapped as critical biodiversity spots (eg: Mirya creek) will be given priority in selection of the creeks.

Social:
- Improvement in standard of living.

Decrease in infections from untreated sewage

Below figure provides a schematic of a typical Up-flow Anarobic Sludge Blanket Reactor (UASB) STP with sludge removal and electricity generation[54].



Nodal agency (Proposed)	Maharashtra Pollution Control Board, Village Panchayat
Partner institutes (Proposed)	Maharashtra Jeevan Pradhikaran

Implementation Plan

Activity	Start	End	Responsible Agency
Identification of site	Month 1	Month 3	Village Panchayat/Municipality
Pre-feasibility study	Month 3	Month 9	Consultant appointed by village panchayat/municipality
Obtaining of permissions	Month 1	Month 9	Village Panchayat/Municipality
Construction of STP	Month 9	Month 15	Contractor appointed by village panchayat/municipality
Laying of sewer	Month 9	Month 15	Contractor appointed

54 https://phedharyana.gov.in/WriteReadData/Notice/2%20STP%20(1)%20%5BCompatibility%20Mode%5D.pdf

	lines			by village panchayat/municipality
	Trial and completion	Month 15	Month 24	Village Panchayat/Municipality
Sustainability and Replicability	Proper management of the STP would lead to revenue generation through sale of sludge to farmers and electricity from methane combustion. Revenue generated from such steps would assist in reducing the cost of running the STP. Coastal communities will be trained to avoid open defecation, which is an important non-point pollution source of creeks. The incentive for community is the increased yield of fish catch (prawns and crabs) from the creeks. Livelihood enhancement of coastal communities through improvement of creek ecology would in turn impart long term sustainability of the intervention beyond the project period.			
Expected Climate Change benefits	Population growth and urbanization has increased the generation and release of sewage from urban centres. Unscientific management of raw sewage leads to generation of greenhouse gases such as NH_3, CO_2, N_3O and CH_4 in various stages of collection and disposal. A scientifically managed STP would reduce the release of such greenhouse gases.			
Financial Outlay	Cost depends on type of technology used. Indicative cost INR 2.5 – 11 million per MLD[55]			

7.2.2 Installation of treated water system to 16 villages highly prone to increased salinity in drinking water

Name of the intervention	Installation of treated water system in 16 villages highly prone to increased salinity in drinking water
Project Location (Proposed)	16 villages in Ratnagiri District.
Component	Coastal Pollution Management and Related Infrastructure Upgrade
Project Output	• Construction of treated water system in 16 villages
Project Outcome	• Improved health of local communities • Reduction in cost of water for local communities • Improved tourist footfall to the selected villages
Description of the action	Excessive groundwater extraction in coastal aquifers is the primary cause of saline water intrusion. Further, a sea level rise

[55] http://www.cseindia.org/userfiles/arunabha.pdf

<table>
<tr><td></td><td colspan="4">of 0.13 – 2 cm has been observed in the Maharashtra coast based on historical analysis of 100-year tide gauge data and 17-year satellite data[56]. Sea level rise coupled with excessive groundwater extraction increase the risk of saline water intrusion in coastal aquifers. Some instances of the same are observed in certain stretches of coastal aquifers in Maharashtra. For instance, in the coastal alluvium in Palghar district, quality of ground water is brackish to saline (EC up to 4,000 µ S/cm) in the lowlands. In Raigad district ground water in shallow dug wells is fresh to brackish. In the coastal alluvium of Sindhudurg district south of Achra creek in Malvan - Devgad - Kelus - Shiroda area the quality of water is fresh to brackish. Similarly, in the beach sands of Ratnagiri district the quality of water is slightly brackish near the creeks [57]. In lieu of the same, it is of paramount importance to improve the quality of drinking water in 16 selected coastal villages of Ratnagiri district.</td></tr>
<tr><td>Nodal agency (Proposed)</td><td colspan="4">Village Panchayat</td></tr>
<tr><td>Partner institutes (Proposed) (if any)</td><td colspan="4">Water Supply and Sanitation Organization (WSSO)</td></tr>
<tr><td rowspan="5">Implementation Plan</td><td>Activity</td><td>Start</td><td>End</td><td>Responsible Agency</td></tr>
<tr><td>Identification of villages</td><td>Month 1</td><td>Month 3</td><td>Village Panchayat/WSSO</td></tr>
<tr><td>Water quality testing</td><td>Month 3</td><td>Month 6</td><td>Consultant appointed by Village Panchayat</td></tr>
<tr><td>Selection of Technology Provider</td><td>Month 6</td><td>Month 9</td><td>Village Panchayat</td></tr>
<tr><td>Installation of desalination plant</td><td>Month 9</td><td>Month 12</td><td>Technology provider selected through bidding</td></tr>
<tr><td>Sustainability and replicability</td><td colspan="4">Improved health of communities will help sustain this activity in the long run. This will also lead to its replicability in other villages with similar socio-economics.</td></tr>
<tr><td>Expected Climate Change benefits</td><td colspan="4">Salinity in coastal aquifers is a combined impact of sea level rise due to climate change and increased groundwater withdrawal. Installation of treated water system is an important climate change adaptation mechanism for local communities.</td></tr>
</table>

[56] http://www.moef.gov.in/sites/default/files/Maharashtra%20Climate%20Change%20Final%20Report.pdf

[57] http://www.cgwb.gov.in/WQ/Costal%20Report.pdf

7.2.3 Construction and installation of sewer lines (bandist katha) in coastal and watershed villages in 6 identified creeks

<table>
<tr><td>Name of the intervention</td><td colspan="4">Construction and installation of sewer lines (bandist katha) and sewage management and treatment in clusters in coastal and watershed villages in 6 identified creeks</td></tr>
<tr><td>Project Location (Proposed)</td><td colspan="4">Coastal villages and watershed villages of 6 creeks in three stretches along the Sindhudurg and Ratnagiri districts.</td></tr>
<tr><td>Component</td><td colspan="4">Coastal Pollution Management and Related Infrastructure Upgrade</td></tr>
<tr><td>Project Output</td><td colspan="4">• Sewer line and proper treatment of sewerage in clusters</td></tr>
<tr><td>Project Outcome</td><td colspan="4">• Improved sewage disposal in coastal villages
• Improved health of coastal communities due to decreased exposure to untreated sewage
• Improved air quality in villages
• Improved livelihood of local communities</td></tr>
<tr><td>Description of the action</td><td colspan="4">Untreated sewage and</td></tr>
<tr><td>Nodal agency (Proposed)</td><td colspan="4">Village Panchayat</td></tr>
<tr><td>Partner institutes (Proposed) (if any)</td><td colspan="4">Maharashtra Jeevan Pradhikaran</td></tr>
<tr><td rowspan="8">Implementation Plan</td><td>Activity</td><td>Start</td><td>End</td><td>Responsible Agency</td></tr>
<tr><td>Identification of creeks and villages in watershed</td><td>Month 1</td><td>Month 3</td><td>Village Panchayat</td></tr>
<tr><td>Pre-feasibility study</td><td>Month 3</td><td>Month 9</td><td>Consultant appointed by village panchayat</td></tr>
<tr><td>Obtaining of permissions</td><td>Month 1</td><td>Month 9</td><td>Village Panchayat</td></tr>
<tr><td>Construction of STP</td><td>Month 9</td><td>Month 15</td><td>Contractor appointed by village panchayat</td></tr>
<tr><td>Laying of sewer lines</td><td>Month 9</td><td>Month 15</td><td>Contractor appointed by village panchayat</td></tr>
<tr><td>Trial and completion</td><td>Month 15</td><td>Month 24</td><td>Village Panchayat</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Sustainability and replicability</td><td colspan="4">Livelihood enhancement of coastal communities through improvement of creek ecology would in turn impart long term sustainability of the intervention beyond the project period.</td></tr>
<tr><td>Expected Climate Change benefits</td><td colspan="4">Proper management and disposal of domestic sewage from coastal villages would aid in abating GHG emissions.</td></tr>
</table>

7.3.1 Promotion of Coastal Tourism

<table>
<tr><td>Name of the intervention</td><td colspan="3">Promote coastal tourism by identifying by:
I. Community based beach clean-up in 20 beaches in Ratnagiri and Sindhudurg.
II. Development of infra such as toilets based on length of beach and footfall in 20 beaches.
III. Assisting communities to set-up business in alternative destinations for water sports in 12 places in Ratnagiri district.
IV. Signboards and peripheral infrastructure improvement in tourist path in 5 culturally important sites.</td></tr>
<tr><td rowspan="6">Project Location (Proposed)</td><td>Intervention</td><td>District</td><td>Location (Proposed)</td></tr>
<tr><td rowspan="2">I</td><td>Ratnagiri</td><td>Ganpatipule, Bhatye, Mandvi, Guhagar, Budhal-Guhagar, Velneshwar, Murud-Harne, Velas, Kelshi, Karde-Dapoli, Ganeshgule, Anjrle, Ladghar, Dapoli, Harne, Are-ware, Gavkhadi, Vetye</td></tr>
<tr><td>Sindhudurg</td><td>To be identified</td></tr>
<tr><td rowspan="2">II</td><td>Ratnagiri</td><td>Ganpatipule, Bhatye, Mandvi, Guhagar, Budhal-Guhagar, Velneshwar, Murud-Harne, Velas, Kelshi, Karde-Dapoli, Ganeshgule, Anjrle, Ladghar, Dapoli, Harne, Are-ware, Gavkhadi, Vetye</td></tr>
<tr><td>Sindhudurg</td><td>To be identified</td></tr>
<tr><td>III</td><td>Ratnagiri</td><td>Tiwari Beach (5), Newre Beach (5), Bhatgav Beach (4), Velneshwar Beach (5), Dabhol Crick (4), Anjarla Beach (3), 7.Palnde Beach (3), Burondi Beach (2), Ladghar Beach (5), Harne to Suwarndurg Fort (8), Kelshi Beach (2), Bankot Crick (4)
* In bracket – Maximum number of agencies to be permitted (as suggested by MTDC)</td></tr>
<tr><td>IV</td><td>Ratnagiri</td><td>To be identified</td></tr>
<tr><td>Component</td><td colspan="3">Livelihood Security of Coastal Communities</td></tr>
<tr><td>Project Output</td><td colspan="3">• Awareness raising and capacity building of local</td></tr>
</table>

	resident on beach clean-up activities • Income generation of local businesses due to increased tourist inflow • Infrastructure improvement in tourist paths in 5 culturally important sites. • Installation of signage in 5 culturally important sites			
Project Outcome	• Cleaner beaches will help flourish coastal and marine biodiversity as well as minimize losses for coastal communities in terms of tourism, shipping, and fishing. • Income generation of local businesses due to increased tourist inflow.			
Description of the action	Marine litter can cause serious economic damage: losses for coastal communities, tourism, shipping and fishing. While litter is a key marine environment and biodiversity challenge, its generation and prevention are linked to a variety of human activities and policy areas, such as waste and wastewater management, product design, shipping, fisheries policies, consumption and behavioral patterns. Marine litter can be prevented efficiently through improved waste, in particular plastic waste, management, increased recycling, avoidance of single use products and product eco-design (e.g. to minimize release of micro plastics in the marine environment) and through intensive education and awareness actions and campaigns.[58] Alternative destinations, relatively pristine with wide range of marine biodiversity, for aquatic sports like Scuba diving and snorkeling will attract domestic as well as foreign tourists alike. This will also open up new avenues of livelihood generation for coastal communities. These opportunities will create a monetary value of local coastal and marine ecosystem services. This will lead the dependent communities to keep the sites in pristine condition as that will keep attracting tourists, in turn keeping their livelihood secure.			
Nodal agency (Proposed)	MTDC			
Partner institutes (Proposed) (if any)	UNDP, Versova Resident Volunteers, Indian Institute of Scuba Diving and Aquatic Sports, Archaeological Survey of India (ASI), Indian National Trust for Art and Cultural Heritage (INTACH)			
Implementation Plan	**Activity**	**Start**	**End**	**Responsible**

[58] http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/index_en.htm

				Agency
	Identification of sites with less tourist footprint and accessible marine biodiversity	Month 2	Month 4	Department of Tourism
	Identification of 20 beaches for cleaning activities	Month 2	Month 4	Department of Tourism
	Mapping of identified areas	Month 2	Month 5	MRSAC/TBD
	Identification of priority areas	Month 4	Month 6	Department of Tourism
	Obtaining relevant licenses from authorities for water sports such as scuba diving	Month 6	Month 10	Office of the district collector/Dept. of Tourism
	Setting up water sports facilities at the finalized coastal areas	Month 10	Month 24	TBD
	Training local stakeholders for maintaining the facilities and also taking certified courses for further guiding tourists.	Month 18	Month 24	TBD
	Organizing campaigns for local communities, schools and colleges to take up beach cleaning activities	Month 4	Month 6	TBD
Sustainability and replicability	**Sustainability:** The benefits of clean beaches in terms of more income generation through tourism, fishing, etc., will encourage local communities to keep the beaches clean and take up clean-up drives themselves at regular intervals. Further, the involvement specialized organizations and active participation from local communities in developing local eco-tourism models, alternative water sports destinations will lead to income generation for the locals. Sustainability of the project will thus be ensured. Results from the project are likely to impact the way			

	marine biodiversity conservation governance is framed within the evolving sustainable development paradigm, in which India is emerging as a leader in the South. **Replicability:** The Clean Beach Programme in Sindhudurg organized by MoEFCC, Department of Forests (Govt. of Maharashtra) and UNDP in 2013 involving nearly 4000 school children can be replicated under this project.[59] Community level beach clean-up drive can be taken up on the lines of the Versova Beach Clean-up drive, labeled world's largest clean-up drive by the United Nations[60], undertaken between 2015 and 2017.
Expected Climate Change benefits	Enhancement in marine and coastal biodiversity

7.3.2 Mangrove Ecotourism and crab farming in three stretches for Livelihood Generation through women SHGs

Name of the intervention	Mangrove ecotourism and crab farming in three stretches for livelihood generation through women SHGs
Project Location (Proposed)	Sindhudurg and Ratnagiri
Component	Livelihood Security of Coastal Communities
Project Output	• Sustainable ecotourism projects in selected mangrove stretches in the project area. • Creation of women SHGs • Crab farming
Project Outcome	Alternative livelihoods for communities dependent on mangroves, thereby reducing stress on limited natural resources and ensuring sustenance of mangroves and biodiversity.
Description of the action	Mangrove ecotourism will play a crucial role in the way local communities benefit from mangrove ecosystem. Indiscriminate and unsustainable use of natural resources will be checked due to introduction of tourism-based livelihood options. Mangrove mud crabs (*Scylla serrata*) are in great demand and get a high price in international markets where large quantities of crabs for consumption are imported. The real benefit of crab farming lies in conservation of the mangrove resource, through such income generating activities as mariculture of crabs in pens and ponds. Furthermore, crab farming serves as a resilient

[59] http://www.in.undp.org/content/india/en/home/ourwork/environmentandenergy/successstories/4000-school-students-join-the-launch-of-the-clean-beach-programme-in-sindhudurg.html
[60] http://edition.cnn.com/2017/05/22/asia/mumbai-beach-dramatic-makeover/index.html

<table>
<tr><td></td><td colspan="4">livelihood option for the coastal communities over traditional fisheries, which is declining day by day due to various factors including overexploitation of fish stock, destructive fishing practices and climate change. Crab farming is thus playing an important role in conservation of mangroves, while meeting the livelihood needs of the coastal communities.[61]

About 11 types of crab products are being exported from India with an average unit value realization of US$ 3.73 kg^{-1}, highlighting its importance in the foreign exchange earnings.[62]

All activities would be undertaken with consultation with Mangrove Cell to avoid duplication of efforts in stretches where similar interventions have been already implemented. The focus would be to take up these activities in stretches/regions where such activities have not been implemented or to strengthen the ones where they have been implemented.</td></tr>
<tr><td>Nodal agency (Proposed)</td><td colspan="4">Mangrove Cell, Government of Maharashtra</td></tr>
<tr><td>Partner institutes (Proposed) (if any)</td><td colspan="4">Indian Life Service Federation, Marine Products Export Development Authority (MPEDA)</td></tr>
<tr><td rowspan="6">Implementation Plan</td><td>Activity</td><td>Start</td><td>End</td><td>Responsible Agency</td></tr>
<tr><td>Identification of sites with low tourist footfall and moderate to dense mangrove cover.</td><td>Month 2</td><td>Month 4</td><td>MRSAC/TBD</td></tr>
<tr><td>Mapping of identified mangrove areas</td><td>Month 2</td><td>Month 5</td><td>MRSAC/TBD</td></tr>
<tr><td>Obtaining relevant licenses from authorities for ecotourism activities.</td><td>Month 4</td><td>Month 10</td><td>Office of the district collector through the district disaster management cell</td></tr>
<tr><td>Identification of status of any existing off-shore interventions in identified locations</td><td>Month 6</td><td>Month 8</td><td>Office of the district collector</td></tr>
<tr><td>Restoration work using Fish Bone Canal Method; Desilting and Removing blocks in the natural canals</td><td>Month 8</td><td>Month 48</td><td>Mangrove Cell/TBD</td></tr>
</table>

[61] Vasudevan, N, Goenka, Debi, The Mangrove Cell, Maharashtra Forest Department, History of Mangrove Management in Maharashtra, 2017, http://cat.org.in/wp-content/uploads/2017/07/HISTORY-OF-MANGROVE-MANAGEMENT-IN-MAHARASHTRA.pdf

[62] https://repository.seafdec.org.ph/handle/10862/3206

	Training programmes fine-tuned for focus groups on mangrove conservation, mangrove crab farming, and various aspects of marine biodiversity conservation conducted for forest staff, personnel from fisheries department, fishers' community, and other stakeholders in the coastal environment.	Month 8	Month 36	TBD
	Monitoring blue carbon sequestration to mitigate climate change by development of an MRV system.	Month 8	Month 60	Mangrove Cell/MRSAC/TBD
	• Setting up of women SHGs in surrounding villages through capacity building activities at the village level. • Setting up ecotourism facilities such as hotels, restaurant cultural and educational centers to raise awareness on mangrove ecosystem conservation. • Providing training and employment to local community in making of boats, managing home stays, cooking, serving as guides, involving in rescue operations, maintenance of premises and monitoring, acting as guides to bird lovers, etc.[63] • Providing training to women SHGs on mud crab farming, setting up mud crab hatchery, and providing market linkage for the same.			
Sustainability and replicability	With the involvement specialized organizations and active participation from local communities in developing local eco-tourism models, mangrove ecotourism destinations will lead to income generation for the locals. Sustainability of the project will thus be ensured. The activities can be replicated from the already functioning ecotourism venture in Vengurla (Sindhudurg) by a women self-help group "Swamini". The group was trained under the UNDP-GEF Project on Coastal and Marine Biodiversity Conservation in Sindhudurg district.			
Expected Climate	The resulting conservation of rich mangrove ecosystems will			

63 http://www.teriuniversity.ac.in/mct/pdf/new/assignment/Karuna_Priya_ecotourism_oppurtunities_for_cons_and_dev_final.pdf

Change benefits	lead to enhanced carbon sequestration and biological diversification.

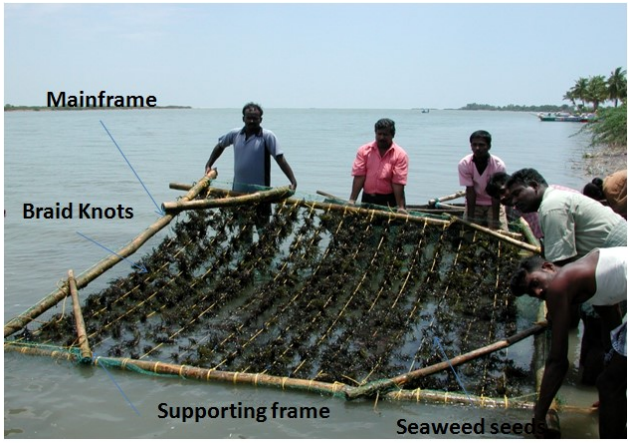
7.3.3 Promoting seaweed (marine microalgae) cultivation among coastal villages

Name of the intervention	Promoting seaweed (marine microalgae) cultivation among coastal villages
Project Location (Proposed)	Three sites may be chosen on a pilot basis after further consultations with the community and the nodal agencies. The sites may be chosen from the shortlisted sites given below: • Kolamb Creek • Karli Creek • Vijaydurg Creek • Rajapur Creek • Anjarle Creek Final site selection will also be influenced by viable PPP models that can be forged with food processing industry.
Component	Livelihood Security of Coastal Communities
Description of the problem	• Declining fish-catch due to climate variations is affecting the livelihood of coastal communities. • Livelihood options are limited under the prevailing scenario for the coastal communities. Consequently, there is a need for alternative livelihood options to enhance their socio-economic standards.
Description of the solution	Seaweeds, or marine microalgae, are large plants growing in the sea, especially various marine algae like the rockweeds, kelps, sea lettuce and dulses. Dried or fresh seaweeds and liquid extracts have been increasingly employed by horticulturists, gardeners, farmers, and orchadists as a fertilizer.[64] Due to improved technological intervention in fishing, fisher folk with larger vessel get more benefits, which necessitated alternative livelihood options for small and marginal fisher folk. There are many examples of the promotion of alternative livelihoods for coastal communities and small-scale fishers, especially the introduction of seaweed culture. The main objective for the promotion of alternative livelihood is to raise the economic standard of fishers and coastal communities, and reduce the fishing effort. Smith (1979) recommended that alternative income

[64] *Seaweeds As a Biofertilizer*. Available from: https://www.researchgate.net/publication/281477200_Seaweeds_As_a_Biofertilizer

	source from seaweed farming is reduce fishing pressure as long as they are attractive to reduce full-time fishing. However, he has also reported that only 50% of fishers are willing to change their occupation due to poor fish catches. The demand for seaweed is immense. For example, Agar Agar is a jelly-like substance obtained from algae. Much of the world's production of agar-bearing seaweeds is from production of agar products; major genera involved include *Ahnfeltiopsis, Gelidium, Gelidiella, Gracilaria, Pterocladiella and Pterocladia.*[65] Seaweed extracts are also used as nutrient supplements, biostimulants and or biofertilizers as an alternative to chemical fertilizers in agriculture. Seaweed culture will help to revolutionize the rural economy along the coastal region through training and demonstration. The training part includes an initial orientation training, subsequent training at the appropriate time for the different phases of culture operations, post-harvest technology and final refresher training. The second set of training will be offered for entrepreneurs who can interest to invest money for seaweed and seaweed by-products. Providing alternative livelihood to marginal fishers that simultaneously improves their economic standard as well as reduces the fishing pressure in some instances. However, in few cases where fishers do not fully exit the fishery and a shift from full time to part time fishing is likely, a limited degree of effort reduction can result, at least temporarily. Whether seaweed cultivation leads to entry or exit from fishing depends to some extent on world market and prices for seaweed. However, non-economic factors often keep fishers in the occupation of fishing. The viewpoint of supplemental livelihood rather than alternative livelihood makes better sense as this strategy attempts to reduce household dependence on fishing but acknowledges that some fishers may still like to engage in fishing. However, with population growth and low employment, exit from fishing does not prevent entry as well, so even if some fishers leave to take up alternative employment, there will be new entrants. These new entrants will still be faced with the same dilemma of previous fishers, too many fishers and not enough fish, exacerbating the over fishing problem and driving down earnings per fisher. Without some form of limited entry, the fishery will tend to move to the economic equilibrium point of opportunity wages. As previously noted, there may be several reasons why the fishery moves below the open access equilibrium point as predicted by classic bio-economic model of a fishery. In addition, while some fishers may do well, others will do poorly as some degree of income variability and

[65] http://www.seaweed.ie/uses_general/agars.php

	non-equity will always exist. Only if regional employment and wages increase can overall wages of fishers increase.
Project Output	Seaweed cultivation as an alternative livelihood option for small and marginal fishing communities; reduced effort in fishing.
Project Outcome	Increased income of coastal communities and effective carbon sequestration as a climate change mitigation measure.
Description of the technology and action	The main objective for the promotion of alternative livelihood is to raise the economic standard of coastal communities, and reduce the fishing effort. The demand for seaweed is immense. This seaweed culture will help to revolutionize the rural economy along the coastal region through training and demonstration. **Chosen Model:** Four numbers of 12 feet (mainframe) and 6 feet (supporting frame) bamboo poles will be used for the construction of bamboo raft with the help of nylon ropes. The interior part of mainframe will be 3 x 3m in size. Fish nets will be attached under the bamboo rafts to avoid the fish grazing. In seeding rope, roughly, 20 braid knots present in single rope and in each braid knot, approximately 40 grams of seed materials will be inserted; thus, 400 seed materials present in a single raft. Stones or anchors to be used for anchoring the raft, usually 10 mm breadth with 10 m length ropes are to be used for this study (Figure 14).  **Figure 14: Small scale seaweed raft culture model** **Methodology:** The initial investment would be Rs. 4,000/raft and the raft could be extensively used for more than 6 years. Raft technology, would be an ideal technique in Indian coastal waters. The environmental condition of Ratnagiri coast is suitable for seaweed cultivation.

The present study 150 households will be selected from few coastal villages from along the Ratnagiri coast and involve them in seaweed farming. Each family will maintain 31 rafts, if one or two members from a family involved in seaweed farming in a day other members can do their regular fishing activity. An alternative member in a family involved in seaweed farming, this model provides viable income for marginal fishers and coastal dwellers. Duration of the culture period is 45 days for each cycle, after that farming and harvest is a regular process in a day. This technique would generate a minimum income of Rs. 14,000 to 15,000 a month per family. If, they involved in regular part time fishing activity, they can also earn a minimum of 10,000 to 12,000 additional incomes per month per family. If members of a family handle more rafts, amount will be automatically multiplied.

What is Raft Culture?

Floating raft culture is recent advance model in aquaculture. This cultivation method is suitable for Indian coastal waters. Normally, a floating construction or raft (typically a 3×3 m square bamboo frame with polypropylene ropes stretched parallel in one direction between the bamboos) is used to suspend the seaweed about 50-cm below the surface. The seedling is inserted to the ropes and the rafts are anchored in the bottom. The off-bottom line method allows easier access since the farmer can walk around the lines at low tide, but the floating lines have the advantage that they can be easily moved to another place if necessary, and removed from the water altogether in bad weather.

Why Raft Culture

1. Capital investment is very less as compared to other culture techniques.
2. Raft installation is very simple.
3. Inspection is feasible during all low tides.
4. Fish nets attached under raft aids in avoiding the fish grazing.
5. Processing and harvesting are very simple techniques as compared to other culture activities.

Culture Species:

Gracilaria sp., *Hypnea, Caulerpa* is the most common species of India. It grows very fast and has high agar content. Field culture of seaweed is an established practice in many parts of Indian coastal waters. The seed materials of seaweed would yield on an average 8kg/m^2 in raft culture within 45 days. Six harvests could be made in a year. Some of the following advantages of seaweed is as follows:

1. It is very fast growing aquaculture species.

2. Culture period could be as short as 45 days under optimal conditions.
3. Culture is easy and not complicated.
4. Culture technique is eco-friendly; it does not need fertilizer for their growth.
5. Capitalization is less than any other aquaculture species and a profitable one.
6. Demand for seaweed is high in the local and international markets.

Market Value and Demand

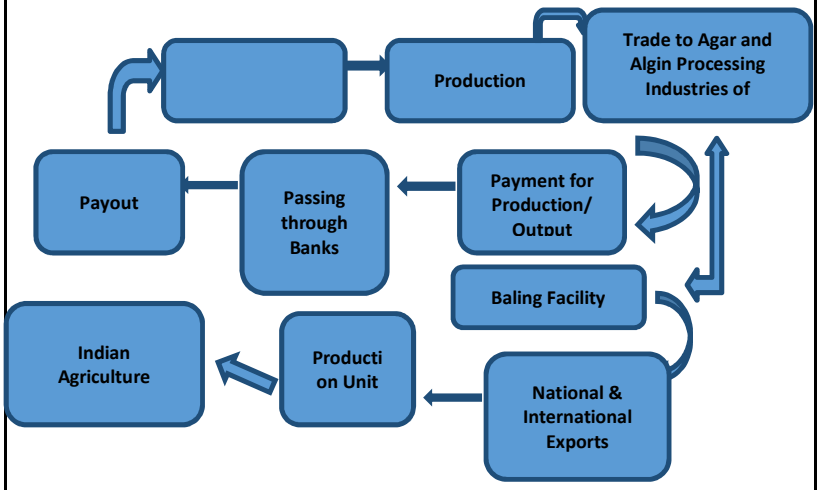
Seaweed raw materials are used produce three hydrocolloids like agar, alginate and carrageenan. A hydrocolloid is a non-crystalline substance with very large molecules and which dissolves in water to give a thickened (viscous) solution. Agar, alginate and carrageenan are water-soluble carbohydrates that are used to thicken (increase the viscosity) aqueous solutions, to form gels (jellies) of varying degrees of firmness, to form water-soluble films, and to stabilize some products, such as ice cream (they inhibit the formation of large ice crystals so that the ice cream can retain a smooth texture). The alginate products are used as binders, stabilizers, emulsifiers, and moulding materials in the pharmaceutical industry, cosmetics and soaps, dental and food technology, bakery and candy products, dairy products, and fish, meat, sausage and beverage processing. They are also used in a wide range of industrial products including dyes, paints and other coatings, binding briquettes and explosives, producing paper and cardboard products, filters and absorbents, textile production, pesticides, polishes and lubricants, fire retardants and extinguishers, enamelling, ceramics and other miscellaneous applications.

Demand for seaweedis excellent, because this seaweed yields agar-agar. It is a non-crystalline substance with very large molecules dissolving in water to give a thickened (viscous) solution. Agar-agar is water-soluble carbohydrates that are used to thicken (increase the viscosity) aqueous solutions, to form gels (jellies) of varying degrees of firmness, to form water-soluble films, and to stabilize some products, such as ice cream (they inhibit the formation of large ice crystals so that the ice cream can retain a smooth texture). The products from *Gracilaria* is used as binders, stabilizers, emulsifiers, and molding materials in the pharmaceutical industry. It also used in cosmetics, soaps, bakery, candy and dairy products. They are also used in a wide range of industrial products including dyes, paints and other coatings, binding briquettes and explosives.

Potential Buyer

Dried seaweed is exported to foreign countries for usage in many industries like food, fertilizer and pharmaceutical industries. Local market in Maharashtra is to be explored with the inputs from industries.

Marketing Channels of Seaweed farmers in Maharashtra



It is estimated that the Indian industry currently requires around 400 tonnes of agar annually, but only 30 percent of this total is being produced domestically.

- Mumbai and Ahmedabad, the textile hubs of India, are the major purchasers of textile-grade alginate.
- Erode, the hosiery hub, is also supplied by alginate producers in Tamil Nadu.
- Food-grade alginates are mainly supplied to the ice cream industry. Pharmaceutical and food-grade alginate, which are manufactured according to Indian and international standards, are priced around Rs 275-300/kg.

Estimated harvestable potential of wild seaweeds in India, by State

State	Potential (tonnes)
Gujarat	250,000
Maharashtra	5,000
Kerala	100,000
Tamil Nadu	250,000
Andhra Pradesh	100,000
Andaman & Nicobar Islands	300,000

Source of above information: Modayil (2004)

<table>
<tr><td>Nodal agency (Proposed)</td><td colspan="4">College of Fisheries, Shirgaon, Ratnagiri (DBSKKV)</td></tr>
<tr><td>Partner institutes</td><td colspan="4">Department of Fisheries</td></tr>
<tr><td>Implementation Plan</td><td>Activity</td><td>Start</td><td>End</td><td>Responsible Agency</td></tr>
<tr><td></td><td>Appropriate site selection for seaweed culture</td><td>Month 2</td><td>Month 4</td><td>TBD</td></tr>
<tr><td></td><td>Mapping of identified areas</td><td>Month 2</td><td>Month 5</td><td>MRSAC/TBD</td></tr>
<tr><td></td><td>Selection fisher folks from nearest coastal villages</td><td>Month 4</td><td>Month 6</td><td>TBD</td></tr>
<tr><td></td><td>Awareness creation Programme among the fisher folks including inventory and procurement of required capacity building materials</td><td>Month 6</td><td>Month 10</td><td>TBD</td></tr>
<tr><td></td><td>Raft installation and seed stocking</td><td>Month 8</td><td>Month 10</td><td>CMFRI/TBD</td></tr>
<tr><td></td><td>Physico-Chemical Analysis during culture period</td><td colspan="2">Culture period</td><td>CMFRI/TBD</td></tr>
<tr><td></td><td>Harvest, drying and processing the Seaweed</td><td colspan="2">Harvest period</td><td>CMFRI/TBD</td></tr>
<tr><td></td><td colspan="4">• Trading for harvested seaweed materials
• Re-installing seaweed seed materials in regular interval for next cycle (45 days/cycle)
• Harvest, drying and processing of seaweed in regular interval
• Evaluate the community experiences in seaweed culture
• Monitoring blue carbon sequestration to mitigate climate change by development of a MRV</td></tr>
<tr><td>Sustainability and replicability</td><td colspan="4">Market for seaweed exists in India and abroad (example, food and pharmaceutical industries). An industry linkage will be formed for this activity to be sustainable in the future.

Since demand for seaweed exists, beneficiaries of the interventions will continue seaweed cultivation even after the project. Any investment required in the form of frames can be borne by the beneficiaries themselves, which are relatively less costly and can be bought through the earning from seaweed cultivation activity. Success of this intervention depends on the demand and market price of seaweed, which is not expected to decline in the coming decade.</td></tr>
</table>

Expected Climate Change benefits	Seaweed farming can positively reduce CO_2 from the atmosphere relating to the role of ocean ecosystem on blue carbon context (Erlania et al., 2013; Nellemann et al., 2009). It is attractive to note that 3.5 tons of seaweed production utilizes 1.27 tons of carbon, about 0.22 tons of nitrogen and 0.03 tons of phosphorus (Sinha et al., 2001). Seaweed farming can reduce a huge amount of CO2 from the atmosphere and assist to mitigate global climate change. Large scale seaweed farming could be used to absorb CO_2 very proficiently. It is also used to produce methane for energy production and substitute for natural gas and nutrient cycling. Additional uses include decreasing in ocean acidification and increasing primary productivity and biodiversity (Tim Flannery, 2015).

7.3.4 Restoration of 352 ha saline infected land (Khar Land) and maintenance of 4,119 ha reclaimed Khar Land

Name of the intervention	Restoration of 352 ha saline infected land (Khar Land) and maintenance of 4,119 ha
Project Location (Proposed)	The list below gives the sites identified for restoration. However, under this ICZMP proposal all activities that includes restoration of Khar Land shall be taken up only after due process of validating by Mangrove Cell, Maharashtra that the site considered can be taken up for restoration. No activity on ground shall be initiated without obtaining no-objection from the mangrove cell, Maharashtra as applicable.

S. No.	Location
	New Construction
1	Majgaon – Lat-17^{0}3’ N, Log-73^{0}19’ E
2	Tembhye – Lat-16^{0}58’41’’ N, Log-73^{0}22’11’’ E
3	Tonade – Lat-16^{0}56’ N, Log-73^{0}22’ E
4	Varvade – Lat-17^{0}12’14’’ N, Log-73^{0}15’36” E
5	Chinchkhari Phatakwadi – Lat-17^{0}19’05’’ N, Log-73^{0}57’05” E
6	Peve Umbershet – Lat-17^{0}04’ N, Log-73^{0}19’ E
7	Ambavali – Lat-17^{0}01’ N, Log-73^{0}05’ E
8	Bhatgaon – Lat-17^{0}13’59’’ N, Log-73^{0}22’17’’ E
9	Waghiware – Lat-17^{0}33’51’’ N, Log-73^{0}20’43’’ E

	10	Karul – Lat-17^{0}34'19'' N, Log-73^{0}15'23'' E
	11	Upale – Lat-16^{0}32' N, Log-73^{0}32' E
	12	Taral – Lat-16036' N, Log-73030' E
	Maintenance	
	1	Malgund – Lat-17^{0}15'43" N, Log-73^{0}27'11'' E
	2	Umberwadi – Lat-17^{0}07'81" N, Log-73^{0}30'83" E
	3	Kelye – Lat-17^{0}03' N, Log-73^{0}19' E
	4	Shipole – Lat-17^{0}50' N, Log-73^{0}56' E
	5	Govindshetwadi – Lat-17^{0}36' N, Log-73^{0}11' E
	6	Sawanas Tumbad – Lat-17^{0}37' N, Log-73^{0}24' E
	7	Panderi – Lat-18^{0}30' N, Log-73^{0}16' E
	8	Remajewadi – Lat-17^{0}37' N, Log-73^{0}25' E
	9	Musalmanwadi No.2 – Lat-17^{0}34'13" N, Log-73^{0}22'53" E
	10	Jambhulwadi – Lat-17^{0}34'05" N, Log-73^{0}27'35" E
	11	Kondsar Khurd – Lat-16^{0}45' N, Log-73^{0}21' E
	12	Nate – Lat-16^{0}37' N, Log-73^{0}20' E
	13	Harche – Lat-16^{0}55' N, Log-73^0 28' E
Component	Livelihood Security of Coastal Communities	
Project Output	• Construction of bunds	
Project Outcome	• Reduction in soil erosion • Prevention of salinity ingress • Livelihood enhancement of coastal communities	
Description of the action	Salinity intrusion in agriculture land is an issue in coastal Maharashtra. This is caused by a combination of factors such as excessive groundwater extraction and sea level rise. A sea level rise of 0.13 – 2 cm has been observed in the Maharashtra coast based on historical analysis of 100-year tide gauge data and 17-year satellite data[66]. Sea level rise coupled with excessive groundwater extraction increase the risk of saline water intrusion in coastal aquifers.	

66 http://www.moef.gov.in/sites/default/files/Maharashtra%20Climate%20Change%20Final%20Report.pdf

<table>
<tr><td></td><td colspan="4">Further, large tracks of Khar Land have been inundated by sea water due to poor maintenance of bunds constructed under previous Khar Land schemes. In lieu of the same, the current intervention proposes the construction of 12 bunds for 352 ha agricultural land. Further, it looks at the maintenance of 13 existing structures for reclamation of 4,119 ha land for agriculture and allied activities.</td></tr>
<tr><td>Nodal agency (Proposed)</td><td colspan="4">Khar Land Development Circle</td></tr>
<tr><td>Partner institutes (Proposed) (if any)</td><td colspan="4">PWD, CWC, State Agriculture Ministry</td></tr>
<tr><td>Implementation plan</td><td colspan="4">• Identification of priority project locations from existing list of proposed intervention areas
• Ground survey of priority areas for delineation of actions
• Implementation of civil works related to Khar Land reclamation.
• Capacity building activities for local communities for maintenance of bunds</td></tr>
<tr><td rowspan="8">Implementation Plan</td><td>Activity</td><td>Start</td><td>End</td><td>Responsible Agency</td></tr>
<tr><td>Identification of sites requiring maintenance</td><td>Month 1</td><td>Month 3</td><td>Khar Land Development Circle</td></tr>
<tr><td>Identification of sites requiring construction</td><td>Month 1</td><td>Month 3</td><td>Khar Land Development Circle</td></tr>
<tr><td>Ground surveys to identify priority sites</td><td>Month 3</td><td>Month 6</td><td>Khar Land Development Circle</td></tr>
<tr><td>Implementation of Civil works</td><td>Month 6</td><td>Month 12</td><td>Contractor appointed by Khar Land Development Circle</td></tr>
<tr><td>Implementation of maintenance works</td><td>Month 12</td><td>Month 15</td><td>Contractor appointed by Khar Land Development Circle</td></tr>
<tr><td>Capacity Building of local community for sustainability of efforts</td><td>Month 12</td><td>Month 18</td><td>Khar Land Development Circle</td></tr>
<tr><td></td><td colspan="4"></td></tr>
<tr><td>Sustainability and replicability</td><td colspan="4">Coastal communities will be trained to ensure sustainability of intervention post the project period. Land restored for agricultural and allied activities would be maintained through</td></tr>
</table>

	local cooperation. The incentive for community is the increased agricultural yield from the Khar land. Further, the impact of Khar Land on mangroves would be studied as part of the intervention.
Expected Climate Change benefits	Reduced salinity intrusion will lead to less groundwater extraction and also check seal level rise.

7.3.5 Removal of marine litter and ghost nets from the ocean near coastal villages

Name of the intervention	Removal of marine litter and ghost nets from the ocean near coastal villages
Project Location (Proposed)	• Kolamb Creek • Karli Creek • Vijaydurg Creek • Rajapur Creek • Anjarle Creek
Component	Livelihood Security of Coastal Communities
Project Output	• Removal of ghost nets from the ocean near the coastline • Training and certification of local community in scuba diving
Project Outcome	Removal of ghost nets would assist in improving the health of marine organisms.
Description of the action	"Ghost fishing" is a part of the global marine debris issue that impacts marine organisms and the environment. Ghost nets are fishing nets that are abandoned or lost by fishermen in the ocean. Owing to improved quality of fishing nets, these nets take years to disintegrate. Often invisible in dim light, these nets become a menace for fish, dolphins, turtle, shark and other marine animals. Ghost fishing can impose a variety of harmful impacts, including: the ability to kill target and non-target organisms, including endangered and protected species; causing damage to underwater habitats such as coral reefs and benthic fauna; and contributing to marine pollution[67]. Ghost fishing contributes to increased mortalities in a wide variety of marine organisms and is especially damaging to endangered and protected marine species, such as marine mammal and sea turtle populations. The intervention looks at training of youth from local communities as certified scuba divers, well-versed in

[67] https://marinedebris.noaa.gov/sites/default/files/publications-files/Ghostfishing_DFG.pdf

<table>
<tr><td></td><td colspan="4">responsible marine tourism best practices. These certified locals can make livelihood as marine tour guides and serve as agents of change in their communities, spreading their knowledge of marine conservation and its importance. The trainee divers further contribute to the restoration of degraded habitats by removing discarded fishing nets from the sea bottom, and performing rescue and release of animals that have become trapped in these ghost nets.</td></tr>
<tr><td>Nodal agency (Proposed)</td><td colspan="4">Indian Institute of Scuba Diving and Aquatic Sports</td></tr>
<tr><td>Partner institutes</td><td colspan="4">Mangrove Cell</td></tr>
<tr><td>Implementation plan</td><td colspan="4">• Identification of youth from local communities for scuba diving certification
• Capacity development on marine conservation and its importance to local communities
• Scuba diving training and certification to youth from local communities through IISD
• Provision of boats and equipment to the certified scuba divers for undertaking removal of ghost nets from the coast</td></tr>
<tr><td>Implementation Plan</td><td>Activity</td><td>Start</td><td>End</td><td>Responsible Agency</td></tr>
<tr><td></td><td>Workshop I.I - Identification of youth</td><td>Month 1</td><td>Month 2</td><td>Mangrove Cell/IISDAS</td></tr>
<tr><td></td><td>Workshop I.II - Orientation of youth</td><td>Month 2</td><td>Month 3</td><td>Mangrove Cell/IISDAS</td></tr>
<tr><td></td><td>Training of youth - Year I</td><td>Month 3</td><td>Month 11</td><td>IISDAS</td></tr>
<tr><td></td><td>Workshop I.III - Final Capacity Development</td><td>Month 11</td><td>Month 12</td><td>Mangrove Cell/IISDAS</td></tr>
<tr><td></td><td>Workshop II.I - Identification of youth</td><td>Month 13</td><td>Month 14</td><td>Mangrove Cell/IISDAS</td></tr>
<tr><td></td><td>Workshop II.II - Orientation of youth</td><td>Month 14</td><td>Month 15</td><td>Mangrove Cell/IISDAS</td></tr>
<tr><td></td><td>Training of youth - Year II</td><td>Month 15</td><td>Month 23</td><td>IISDAS</td></tr>
<tr><td></td><td>Workshop II.III - Final Capacity</td><td>Month 23</td><td>Month 24</td><td>Mangrove</td></tr>
</table>

	Development			Cell/IISDAS
	Workshop III.I - Identification of youth	Month 25	Month 26	Mangrove Cell/IISDAS
	Workshop III.II - Orientation of youth	Month 26	Month 27	Mangrove Cell/IISDAS
	Training of youth - Year III	Month 27	Month 35	IISDAS
	Workshop III.III - Final Capacity Development	Month 35	Month 36	Mangrove Cell/IISDAS
	Workshop IV.I - Identification of youth	Month 37	Month 38	Mangrove Cell/IISDAS
	Workshop IV.II - Orientation of youth	Month 39	Month 40	Mangrove Cell/IISDAS
	Training of youth - Year IV	Month 40	Month 47	IISDAS
	Workshop IV.III - Final Capacity Development	Month 47	Month 48	Mangrove Cell/IISDAS
	Workshop V.I - Identification of youth	Month 49	Month 50	Mangrove Cell/IISDAS
	Workshop V.II - Orientation of youth	Month 50	Month 51	Mangrove Cell/IISDAS
	Training of youth - Year V	Month 51	Month 59	IISDAS
	Workshop V.III - Final Capacity Development	Month 59	Month 60	Mangrove Cell/IISDAS
Sustainability and replicability	As part of the initiative, capacity development of local communities, especially the fishing community, would be conducted to create awareness and spread the knowledge of marine conservation and its importance. Further, local communities would be trained in scuba diving and allied activities for sustainability of the intervention post the project period.			

	The activities can be replicated from the already functioning removal of ghost net intervention in Sindhudurg by UNDP-GEF.
Expected Climate Change benefits	Conservation of coastal and marine biodiversity

7.4.1 Network of institutions for enhanced climate resilient planning and knowledge management

Name of the intervention	Network of institutions for enhanced climate resilient planning and knowledge management
Project Location (Proposed)	Ratnagiri and Sindhudurg
Component	Capacity Development and Implementation of ICZM Plans
Project Output	Provide a Multi-stakeholder Platform (MSP) for enhanced inter-sectoral coordination between stakeholders
Project Outcome	Enhanced coordination between stakeholders for coordinated effort on climate resilient planning and knowledge management
Description of the action	At present, institutional capacity for integration of climate change considerations into local and state-level economic and sectoral planning and decision-making is inadequate to fully address the impacts of climate change. The project envisages to enhance linkages between existing institutions, in order to strengthen institutional arrangements and facilitate dialogue and collaboration on coastal climate resilience. The intervention would focus on [68] - • **Risk data and reporting** – improving risk assessment and adaptation planning processes and reporting on adaptation measures • **Community engagement** – focusing on relocation, inclusion and equity in assessing and planning for climate risks • **Private sector engagement –** working with the private sector, PPPs and possible partnerships to boost cities' climate risk assessment capabilities • **Governance coordination –** bringing all sectors of the city government together for climate change risk assessment and adaptation response planning
Nodal agency (Proposed)	To be housed under the ICZMP Society
Implementation plan	• Stakeholder analysis to understand different actors

[68] http://www.c40.org/networks/climate_change_risk_assessment

working on the selected ecosystems
- Establishing multi-stakeholder platform for dialogue and coordination of climate-resilient development planning and co-management of coastal ecosystems.
- Supporting the proposed National Coastal Mission in integrating climate change adaptation – and particularly EbA – into its programme of work

Activity	Start	End	Responsible Agency
District Level Workshop I.I	Month 1	Month 3	TBD
District Level Workshop I.II	Month 3	Month 5	TBD
State Level Workshop I.I	Month 5	Month 6	TBD
District Level Workshop I.III	Month 7	Month 9	TBD
District Level Workshop I.IV	Month 9	Month 11	TBD
State Level Workshop I.II	Month 11	Month 12	TBD
District Level Workshop II.I	Month 13	Month 15	TBD
District Level Workshop II.II	Month 15	Month 17	TBD
State Level Workshop II.I	Month 17	Month 18	TBD
District Level Workshop II.III	Month 19	Month 21	TBD
District Level Workshop II.IV	Month 21	Month 23	TBD
State Level Workshop II.II	Month 23	Month 24	TBD
District Level Workshop III.I	Month 25	Month 27	TBD
District Level Workshop III.II	Month 27	Month 29	TBD
State Level Workshop III.I	Month 29	Month 30	TBD

	District Level Workshop III.III	Month 31	Month 33	TBD
	District Level Workshop III.IV	Month 33	Month 35	TBD
	State Level Workshop III.II	Month 35	Month 36	TBD
	District Level Workshop IV.I	Month 37	Month 39	TBD
	District Level Workshop IV.II	Month 39	Month 41	TBD
	State Level Workshop IV.I	Month 41	Month 42	TBD
	District Level Workshop IV.III	Month 43	Month 45	TBD
	District Level Workshop IV.IV	Month 45	Month 47	TBD
	State Level Workshop IV.II	Month 47	Month 48	TBD
	District Level Workshop V.I	Month 49	Month 51	TBD
	District Level Workshop V.II	Month 51	Month 53	TBD
	State Level Workshop V.I	Month 53	Month 54	TBD
	District Level Workshop V.III	Month 55	Month 57	TBD
	District Level Workshop V.IV	Month 57	Month 59	TBD
Sustainability and replicability	Capacity building of stakeholders would assist in sustaining the MSP over a longer period of time. MSP structure can be replicated over varied landscapes.			
Expected Climate Change benefits	Enhanced coordination between stakeholders would improve resource allocation towards climate resilience activities. Further, it would assist in reducing duplication of efforts by stakeholders. Such initiatives would assist in better resource utilization towards adaptation and mitigation efforts.			

7.4.2 Strengthening the Maharashtra Coastal Erosion Database Management System (MCEDMS)

Name of the intervention	Strengthening the Maharashtra Coastal Erosion Database Management System (MCEDMS)
Project Location (Proposed)	Ratnagiri and Sindhudurg
Component	Capacity Building and Implementation of ICZM Plans
Project Output	• The district wise maps of erosion and deposition pattern along the entire coast of districts of Maharashtra will be generated. • Study of behavioral changes in shoreline post interventions for a period of ten years in selected stretches based on the observed data. • Periodic monitoring and integration of databases maintained by various agencies.
Project Outcome	The Database Management System would lead to improved understanding of shoreline changes pre and post interventions. Further, it would enable policy-makers and implementation partners to have a dynamic management system to track near-real time impacts and make appropriate changes to future interventions.
Description of the action	Coastal eco-systems are highly dynamic in nature. 61% of the Maharashtra coastline is prone to erosion[69]. Constant monitoring of such landscapes are of prime importance to promote climate resilient interventions. The project envisages developing a holistic understanding of coastal eco-systems through the establishment of a MRV system. The MRV system would be established on the basis of an analysis of historical tide gauge data and high resolution satellite data. Existing tide gauge network would be examined and strengthened for future monitoring. High resolution satellite imagery would be analyzed with through partner institutes such as Maharashtra Remote Sensing Application Centre.
Nodal agency (Proposed)	To be housed under the ICZMP Society
Partner institutes (Proposed) (if any)	CWPRS, Maharashtra Remote Sensing Application Centre, Maharashtra State Disaster Management Authority, National Institute of Oceanography, Goa, SAC Ahmedabad.

[69] http://cwc.gov.in/CPDAC-Website/Data/Other%20Data%20files/New%20Coastal%20Status%20data%20from%20Shoreline%20Change%20Atlas.pdf

Implementation plan	• Identification of status of existing reference pillars along the coast. • Reconstruction of damaged reference pillars and providing new reference pillars along the Coast • Construction of Database center at Ratnagiri. • Construction of permanent Coastal Model Tray including wave pad arrangements. • Study of behavioral changes in shoreline pre and post interventions through multi-temporal satellite images • Finalizing a MRV system for coastal erosion • Prediction of shoreline changes through coastal erosion modelling • Capacity building of concerned stakeholders to ensure sustainability of intervention
Sustainability and replicability	Capacity building of all concerned stakeholders would be undertaken to ensure sustainability of the intervention. Further, the intervention would be linked to the Maharashtra State Disaster Management Authority to strengthen the Disaster Management Information System. This would assist in linking the threat of sea level rise and its allied impacts into the Disaster Management system for the state.
Expected Climate Change benefits	A sea level rise of 0.13 – 2 cm has been observed in the Maharashtra coast based on historical analysis of 100-year tide gauge data and 17-year satellite data[70]. By the end of the twenty-first century, global mean sea level is projected to increase by 30 to 55 cm for a medium range climate change scenario (RCP 4.5). 68% of the world's coastlines are projected to experience sea level rise of within ±20% of this range for this scenario. This corresponds to a range of about 24 cm to 66 cm for the Maharashtra coastline. Further, sea level rise could also lead to salinization of coastal aquifers. The project would assist in developing a deeper understanding of climate change impacts on coastal ecosystems. Further, pre and post intervention behavioral changes would enable stakeholders to change future interventions

70 http://www.moef.gov.in/sites/default/files/Maharashtra%20Climate%20Change%20Final%20Report.pdf

Section IV

8 Result Framework

The following table provides a list of the interventions shortlisted for Integrated Coastal Zone Management Plan for Maharashtra.

<table>
<tr><th>Sl. No.</th><th>Name of Intervention</th></tr>
<tr><td colspan="2">Component 1 – Conservation of Coastal and Marine Ecological Resources</td></tr>
<tr><td>1.1</td><td>Land stabilization against coastal erosion through off-shore and on-shore interventions in 19.62 km in Ratnagiri district</td></tr>
<tr><td>1.2</td><td>Community-based assisted natural regeneration, restoration and conservation of mangroves
in Malvan in Sindhudurg
In Ratnagiri district</td></tr>
<tr><td>1.3</td><td>Conservation of breeding sites for sea turtle species such as Olive Ridley (Lepidochelys olivacea) and Green Turtle (Chelonia mydas) in selected locations-
Ratnagiri – Gaonnkhedi, Guhagar, Dabhol, Kolthare, Anjarla, Kelshi
Sindhudurg district – Shiroda, Vengurla</td></tr>
<tr><td>1.4</td><td>Installation of modern monitoring devices in urban patches of mangrove to check encroachment</td></tr>
<tr><td colspan="2">Component 2 – Coastal Pollution Management and Related Infrastructure Upgrade</td></tr>
<tr><td>2.1</td><td>Establishment of Sewage treatment facility and underground sewage systems in 4 towns and 6 pilot creeks in Maharashtra
<table>
<tr><th>Place</th><th>Capacity</th></tr>
<tr><td>Mirkarwada, Ratnagiri</td><td>4 MLD</td></tr>
<tr><td>Dapoli, Ratnagiri</td><td>2 MLD</td></tr>
<tr><td>Guhagar, Ratnagiri</td><td>2 MLD</td></tr>
<tr><td>Rajapur, Ratnagiri</td><td>3 MLD</td></tr>
</table>
6 creeks – Kolamb Creek, Karli Creek, Vijaydurg Creek, Rajapur Durg and Anjarle Creek</td></tr>
<tr><td>2.2</td><td>Installation of treated water system to 16 villages highly prone to increased salinity in drinking water</td></tr>
<tr><td>2.3</td><td>Construction and installation of sewer lines (bandist katha), sewage management and treatment system in cluster coastal villages within the watershed of 6 identified creeks</td></tr>
<tr><td colspan="2">Component 3 – Livelihood Security of Coastal Communities</td></tr>
<tr><td>3.1</td><td>Promotion of coastal tourism by –
Community based beach clean-up in 20 beaches.
Development of infra such as toilets based on length of beach and footfall in 20 beaches.
Assisting communities to set-up business in alternative destinations for water sports in 12 places in Ratnagiri district.
Signboards and peripheral infrastructure improvement in tourist path in 5 culturally important sites.</td></tr>
<tr><td>3.2</td><td>Mangrove ecotourism and crab farming in three stretches for livelihood generation through women SHGs.
Ratnagiri
Sindhudurg</td></tr>
<tr><td>3.3</td><td>Promoting seaweed (marine microalgae) cultivation among coastal villages</td></tr>
<tr><td>3.4</td><td>Restoration of 352 ha saline infected land (Khar Land) and maintenance of 4,119 ha reclaimed Khar Land</td></tr>
<tr><td colspan="2">Component 4 – Capacity Building and Implementation of ICZM Plans</td></tr>
<tr><td>4.1</td><td>Network of institutions for enhanced climate resilient planning and knowledge management</td></tr>
<tr><td>4.2</td><td>Strengthening the Maharashtra Coastal Erosion Database Management System (MCEDMS)</td></tr>
</table>

The tables below explain the results framework.

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
Component 1 – Conservation of Coastal and Marine Ecological Resources					
Intervention 1.1: Land stabilization against coastal erosion through off-shore and on-shore interventions in 19.62 km in Ratnagiri district.					
Outcome: Control of coastal erosion at identified locations in Ratnagiri District **Output:** Groyne construction and extension at selected locations, Sea wall construction at selected locations, Native species protection, conservation and restoration at identified locations	Improved resilience to coastal erosion, decrease in loss of coastal area through erosion, total length of sea wall constructed, total number of groyne constructed, total area brought under vegetation cover	Existing status of coastal erosion control structures present with Harbour Engineering Department	Restoration of all existing structures in identified locations.	Field visit observations, project implementation reports	**Risk:** Excessive erosion of coastline before project implementation might hamper envisaged project impact **Assumption:** willingness for inter-agency sharing of data
Intervention 1.2: Community-based assisted natural regeneration, restoration and conservation of mangroves					
Outcome: Provision of ecosystem goods and services to the coastal communities, thus helping them with better fish and crustacean (prawns and crabs) catch in the coastal belt, storm protection and	Mangroves in the selected area classified as medium to high dense mangrove forests, area brought under mangrove	Sparsely / low dense mangrove forests	Sparsely dense mangrove in the selected 3 districts in Maharashtra	Mangrove Cell has 1:5,000 scale maps of mangrove areas in Maharashtra. Mangrove restoration report, if	**Risks:** Not allowing any harvesting of mangroves leaves as fodder, which might result in decrease of enthusiasm among community to conserve mangroves.

provide fodder for livestock during very lean seasons. **Output:** Restoration of mangroves leading to co-benefits such as conserving biodiversity, carbon sequestration etc.	plantation,			available, geo-spatial data can be used for analysis, FSI data (ISFR reports) also can be used for verification.	Incursions of sea before start of the restoration activity can hamper the final results. **Assumptions:** Community will be interested in conserving mangroves.
Intervention 1.3: Conservation of breeding sites for sea turtle species such as Olive Ridley (*Lepidochelys olivacea*) and Green Turtle (*Chelonia mydas*) in selected locations					
Outcome: Conservation of endangered sea turtle species, study of their migratory patterns, awareness and livelihood generation amongst local residents through setting up eco-tourism avenues. **Output:** Conservation of sea turtle species such as Olive Ridley, an endangered species.	Increase in the number of sea turtles spotted, Regular turtle nesting at target sites, percentage increase of income of local community through eco-tourism activities	Prior turtle conservation activities need to be incorporated. UNDP-GEF project had component of turtle conservation in Sindhudurg District	**Ratnagiri** – Gaonnkhedi, Guhagar, Dabhol, Kolthare, Anjarla, Kelshi **Sindhudurg** – Shiroda, Vengurla	Field visit observations, project implementation reports.	**Risks:** Voluntary manpower for maintenance and conservation of turtle nesting sites may not be as easy. Intensive coordination between many stakeholders is required **Assumptions:** People will be willing to sea turtles recognizing their risk of extinction
Intervention 1.4: Installation of modern monitoring devices in urban patches of mangrove to check encroachment					

Outcome: Installation of monitoring devices in the periphery of mangrove area **Output:** Protection of mangroves leading to co-benefits such as conserving biodiversity, carbon sequestration etc.	Number of devices installed, area covered by monitoring devices	-	Mangrove areas in the periphery of urban clusters	Project implementation report, field reports	**Assumption:** Proper usage of monitoring devices for mangrove conservation **Risk:** non-maintenance of monitoring devices post project period.
Component 2 – Coastal Pollution Management and Related Infrastructure Upgrade					
Intervention 2.1: Establishment of Sewage treatment facility and underground sewage systems in 4 towns and 6 pilot creeks in Maharashtra					
Outcome: construction and installation of STP in selected locations **Output:** improvement in quality of sewerage, health of communities and environment	Water quality parameters (such as pH, temperature, BOD, COD, DO, TDS and TSS among others) pre and post treatment.	Needs to be determined through pre-feasibility study in project locations	Mirkharwada, Dapoli, Guhagar and Rajapur in Ratnagiri District	Field visit observations, project implementation reports.	**Risk:** **Assumption:**
Intervention 2.2: Installation of treated water system to 16 villages highly prone to increased salinity in drinking water					
Outcome: improved health of local communities, reduced cost of water for local communities, increased tourist footfall **Output:** construction of treated water system in 16 villages	Assessment of drinking water quality based on DO, BOD, COD, TSS, TC, FC, pH, temperature, turbidity, EC, Major ions (such as K^+,	Current groundwater quality is brackish to saline in several pockets (EC up to 4000 µ S/cm)	100% coverage of all household with drinking water connection	Field visit observation, project implementation reports	**Risk:** labs might not be properly equipped to analyse heavy metals, old equipment might increase error in measured values **Assumption:** field officers are properly

	Na^{+}, Ca^{++}, Mg^{++}, CO_3, HCO_3, Cl, $SO_{4)}$ and organics (such as F, B and other location specific parameter (if any))				trained for collection of samples
Intervention 2.3: Construction and installation of sewer lines (*bandist katha*) and sewage management and treatment in clusters in coastal and watershed villages in 6 identified creeks					
Outcome: improved health of coastal communities, improved livelihood of local communities, improved treatment of sewerage **Output:** construction of sewer lines, sewerage treatment in selected clusters	Water quality of sewerage, length of sewerage network laid, percentage of HH covered with sewage collection facility, amount of sludge sold to farmers		5 selected villages and households within catchment of selected creeks	Field visit observations, project implementation reports	**Risk:** **Assumption:**
Component 3 – Livelihood Enhancement/SE Development					
Intervention 3.1: Promotion of coastal tourism by – • Community based beach clean-up in 20 beaches. • Development of infra such as toilets based on length of beach and footfall in 20 beaches. • Assisting communities to set-up business in alternative destinations for water sports in 12 places in Ratnagiri district. • Signboards and peripheral infrastructure improvement in tourist path in 5 culturally important sites.					
Outcome: Cleaner beaches will help flourish coastal and marine biodiversity as well as	Percentage increase in income of local	No baseline conducted for tourism potential of	Selected sites in Ratnagiri and Sindhudurg	Annual Reports of companies operating	**Risks:** Unwillingness of people to get into ecotourism business

minimise losses for coastal communities in terms of tourism, shipping and fishing. Income generation of local businesses due to increased tourist inflow **Output:** Alternative water sports activities like scuba diving and snorkelling. Awareness raising and capacity building of local resident on beach clean-up activities	communities, percentage increase in number of tourist, increase in bio-diversity, number of awareness and capacity development activities conducted	alternative destinations	district	ecotourism activities, Project implementation reports. Project report, geo-spatial analysis	Voluntary manpower for maintenance beaches may not be as easy. Intensive coordination between many stakeholders is required **Assumption:** Locals will show interest in having an alternative source of livelihood generation People will be willing to volunteer for beach cleaning drives
Intervention 3.2: Mangrove ecotourism and crab farming in three stretches for livelihood generation through women SHGs.					
Outcome: Alternative livelihoods for communities dependent on mangroves, thereby reducing stress on limited natural resources and ensuring sustenance of mangroves and biodiversity. Creation of women SHGs **Output:** Sustainable ecotourism projects in selected mangroves in the project area.	Percentage increase in number of tourist to selected sites, percentage increase in income of local communities	INR 15 crore set aside by Maharashtra government in 2017 to set up Mangrove Co-management Committees in coastal districts of the state.	Sites to be identified in Sindhudurg and Ratnagiri districts	Reports by Mangrove Cell and Mangrove Co-management Committees set up by the Maharashtra government	**Risks:** Unwillingness of people to get into mangrove ecotourism business **Assumption:** Locals will show interest in having an alternative source of livelihood generation

Intervention 3.3: Promoting seaweed (marine microalgae) cultivation among coastal villages					
Outcome: Increased income of coastal communities and effective carbon sequestration as a climate change mitigation measure. **Output:** Seaweed cultivation as an alternative livelihood option for small and marginal fishing communities; reduced effort in fishing.	Percentage increase in income of coastal communities, amount of additional carbon sequestration through seaweed cultivation, Number of industries procuring seaweed from project locations	Dependency on fish catch, no seaweed cultivation.	Malvan (Sindhudurg District)	Training and implementation reports, CMFRI Annual Reports	**Risks:** Drop in prices, inadequate market linkage, abandoning the technique in high yield seasons. These risks are abated through phased awareness campaigns, targeting most vulnerable sections of the coastal community and handholding by technical lead. Fisheries department will also be instrumental in forging an industry linkage. **Assumptions:** Proper market linkage and appropriate revenue will be garnered.
Intervention 3.4: Restoration of 352 ha saline infected land (Khar Land) and maintenance of 4,119 ha reclaimed Khar Land					
Outcome: improvement in agricultural productivity in restored land **Output:** construction of bunds	Agricultural productivity in restored land, percentage change	Khar Land board maintains status of bunds and area maintained by bunds	Restoration of 353 ha of land in Ratnagiri district.	Field visit observations, project implementation	**Risk:** **Assumption:**

to control sea water intrusion	in income of local communities		Maintenance of 4,119 ha of land in Ratnagiri district.	reports	
Intervention 3.5: Removal of marine litter and ghost nets from the ocean near coastal villages					
Outcome: improvement in marine health due to removal of ghost nets. **Output:** removal of ghost nets from the coastline, training and certification of local communities in scuba diving	Number of ghost nets removed, number of organisms freed from ghost nets, number of individuals provided with scuba diving certification	-	Local communities in Ratnagiri and Sindhudurg district	Field visit observation, project implementation reports	**Risk:** **Assumption:**
Component 4 – Capacity Building and Implementation of ICZM Plans					
Intervention 4.1: Network of institutions for enhanced climate resilient planning and knowledge management					
Outcome: Enhanced coordination between stakeholders for coordinated effort on climate resilient planning and knowledge management **Output:** Provide a Multi-stakeholder Platform (MSP) for enhanced inter-sectoral coordination between	Number of meetings conducted under the aegis of the Multi-Stakeholder Platform, number of participating entities,			Project implementation reports	**Risk:** unwillingness of institutions to collaborate, **Assumption:** Good working relationship between different stakeholders

stakeholders					
Intervention 4.2: Strengthening the Maharashtra Coastal Erosion Database Management System (MCEDMS)					
Outcome: Improved understanding of shoreline changes to enable appropriate future interventions **Output:** District-wise coastal erosion and deposition maps to be generated, Study of behavioural changes in shoreline post interventions for a period of five years in selected stretches based on the observed data. Establishment of a MRV system for coastal erosion	Number of maps generated, area eroded pre and post intervention, establishment of MRV system		Maps to be generated for all three districts. Pre and post evaluations for all project sites under ICZMP	Project implementation reports	**Assumption:** Willingness for inter-departmental information exchange, executing agency would undertake constant monitoring of MRV system **Risk:** MRV system would require constant updating to provide constant information to stakeholders

9 Project Financing and Budget

The budget has been estimated based on costing assumptions obtained from the departments and Standard of Rates. The budget has been broken into two components. The first component is for the PMU and the second component is for the costing of individual interventions.

10 Stakeholder Consultations

ICZMP team visited the districts to finalize the plan in the month of January for stakeholder consultations; details are given in the table below.

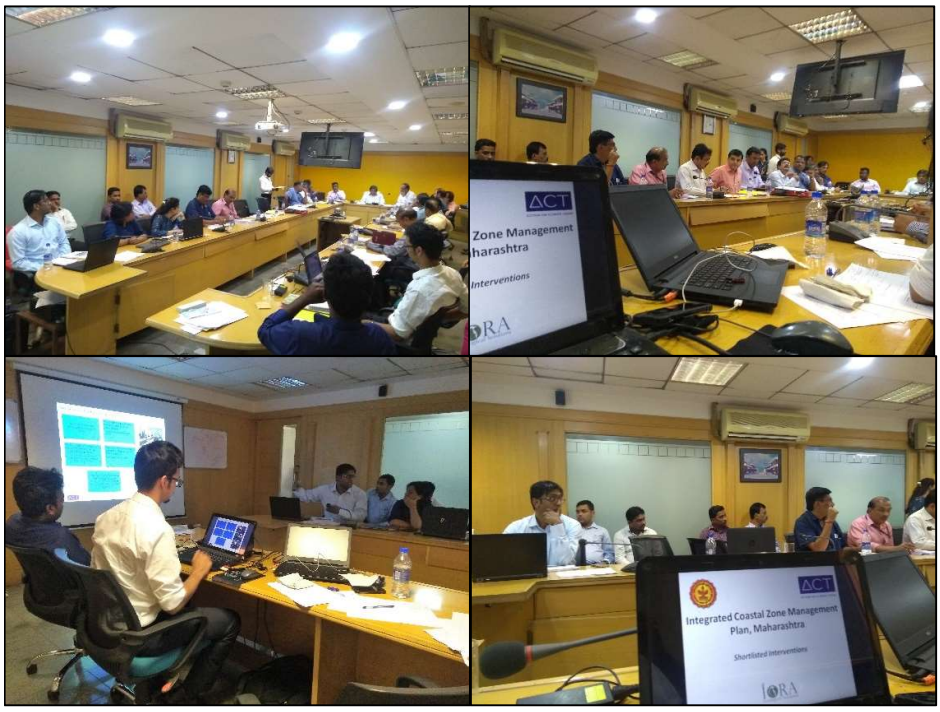
S. No.	Date	Location
1	18 – 20 January 2018	Ratnagiri
2	19 – 20 January 2018	Sindhudurg
3	22 January 2018	Palghar
4	23 January 2018	Maharashtra Coastal Zone Management Authority, Mumbai
5	24 January 2018	Mangrove Cell, Mumbai

11 Annexures

Annexure I - Photographs

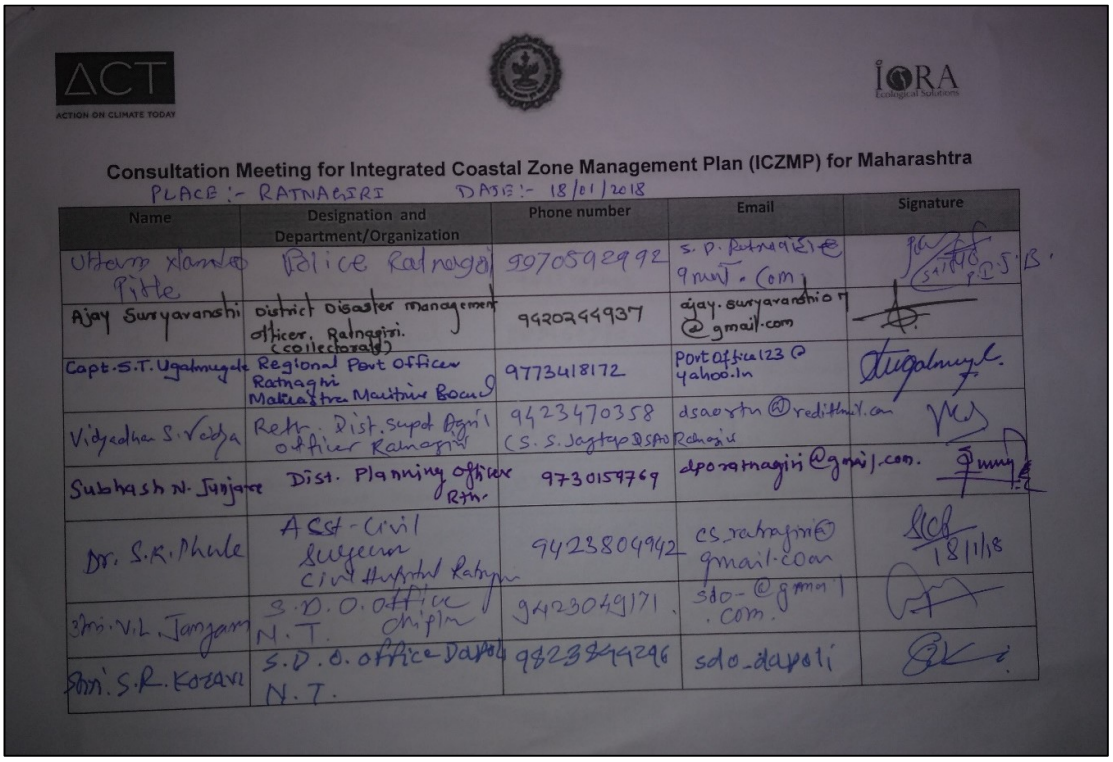
Pictures of Consultations conducted at district level

Presentation to Maharashtra Coastal Zone Management Authority



Annexure II – Attendance sheet

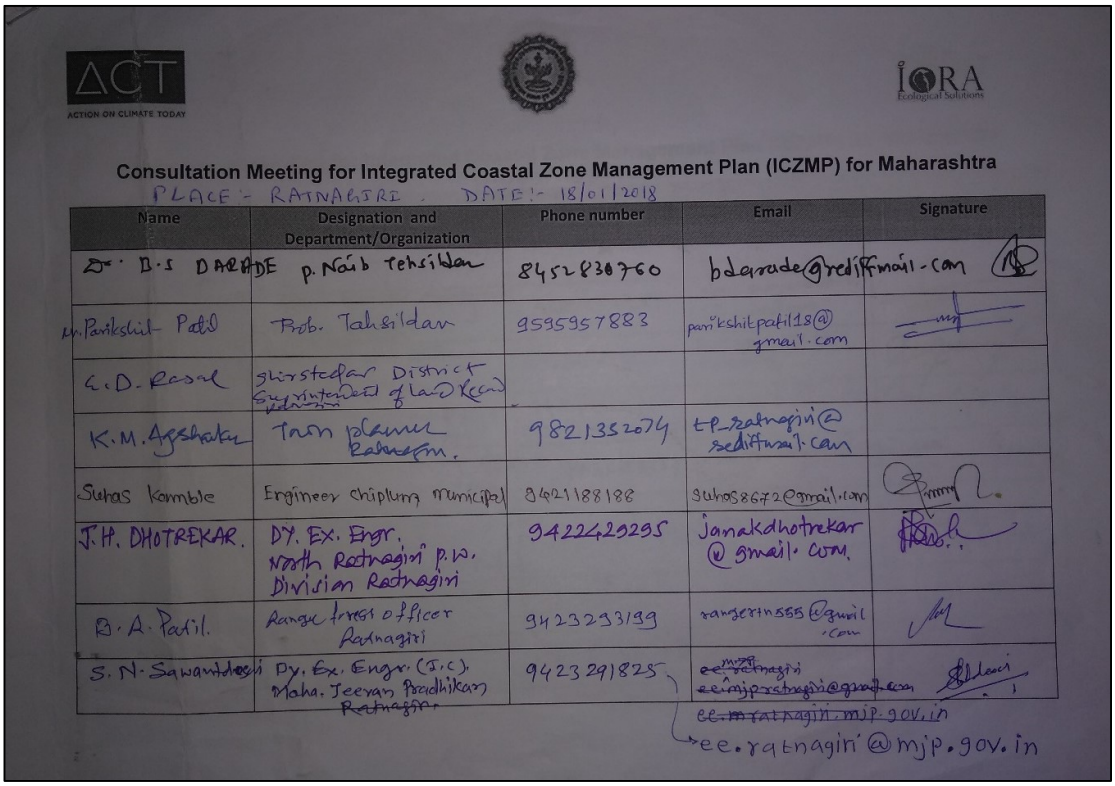
Attendee List of Consultation at Ratnagiri (18-20 January, 2018)



Consultation Meeting for Integrated Coastal Zone Management Plan (ICZMP) for Maharashtra

PLACE :- RATNAGIRI DATE :- 18/01/2018

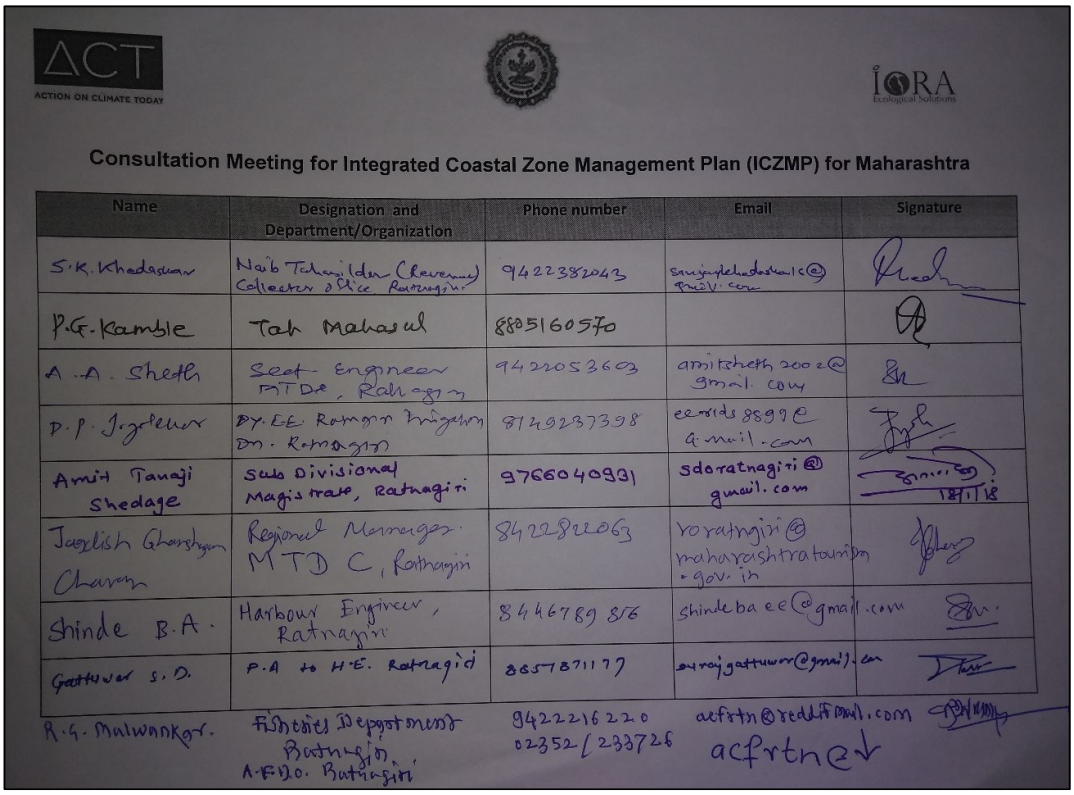
Name	Designation and Department/Organization	Phone number	Email	Signature
Uttam Kamlakar Pitle	Police Ratnagiri	9970592992	s.p.ratnagiri@gmail.com	
Ajay Suryavanshi	District Disaster management officer, Ratnagiri. (collectorate)	9420244937	ajay.suryavanshi@gmail.com	
Capt. S.T. Ugalmugale	Regional Port Officer Ratnagiri Maharashtra Maritime Board	9773418172	PortOffice123@yahoo.in	
Vidyadhar S. Vaidya	Retd. Dist. Supdt Agril officer Ratnagiri	9423470358	dsaoratn@rediffmail.com	
Subhash N. Jujjare	Dist. Planning officer Rtn.	9730154769	dporatnagiri@gmail.com.	
Dr. S.K. Phule	Asst-Civil Surgeon Civil Hospital Ratnagiri	9423804942	cs_ratnagiri@gmail.com	18/1/18
Shri. V.L. Janjam	S.D.O. office N.T. Chiplun	9423049171	sdo-@gmail.com.	
Shri. S.R. Kolavi	S.D.O. office Dapoli N.T.	9823849296	sdo_dapoli	



Consultation Meeting for Integrated Coastal Zone Management Plan (ICZMP) for Maharashtra

PLACE :- RATNAGIRI DATE :- 18/01/2018

Name	Designation and Department/Organization	Phone number	Email	Signature
Dr. D.S DARADE	p. Naib tehsildar	8452830760	bdarade@rediffmail.com	
Mr. Parikshit Patil	Prob. Tahsildar	9595957883	parikshitpatil18@gmail.com	
C.D. Rasal	Superintendent District Superintendent of Land Records			
K.M. Agashe	Town planner Ratnagiri.	9821352074	tp_ratnagiri@rediffmail.com	
Suhas Kamble	Engineer chiplun municipal	9421188188	suhas8672@gmail.com	
J.H. DHOTREKAR.	DY. EX. Engr. North Ratnagiri P.W. Division Ratnagiri	9422429295	janakdhotrekar@gmail.com.	
B.A. Patil.	Range forest officer Ratnagiri	9423233199	rangerrtn555@gmail.com	
S.N. Sawantdesai	Dy. Ex. Engr. (J.C.) Maha. Jeevan Pradhikaran Ratnagiri.	9423291825	~~eeratnagiri~~ ~~eemjpratnagiri@gmail.com~~ ~~ee.ratnagiri.mjp.gov.in~~ ee.ratnagiri@mjp.gov.in	



Consultation Meeting for Integrated Coastal Zone Management Plan (ICZMP) for Maharashtra

Name	Designation and Department/Organization	Phone number	Email	Signature
S.K. Khadaswar	Naib Tahasildar (Revenue) Collector Office Ratnagiri	9422382043	sanjaykhadaswar@rediffmail.com	
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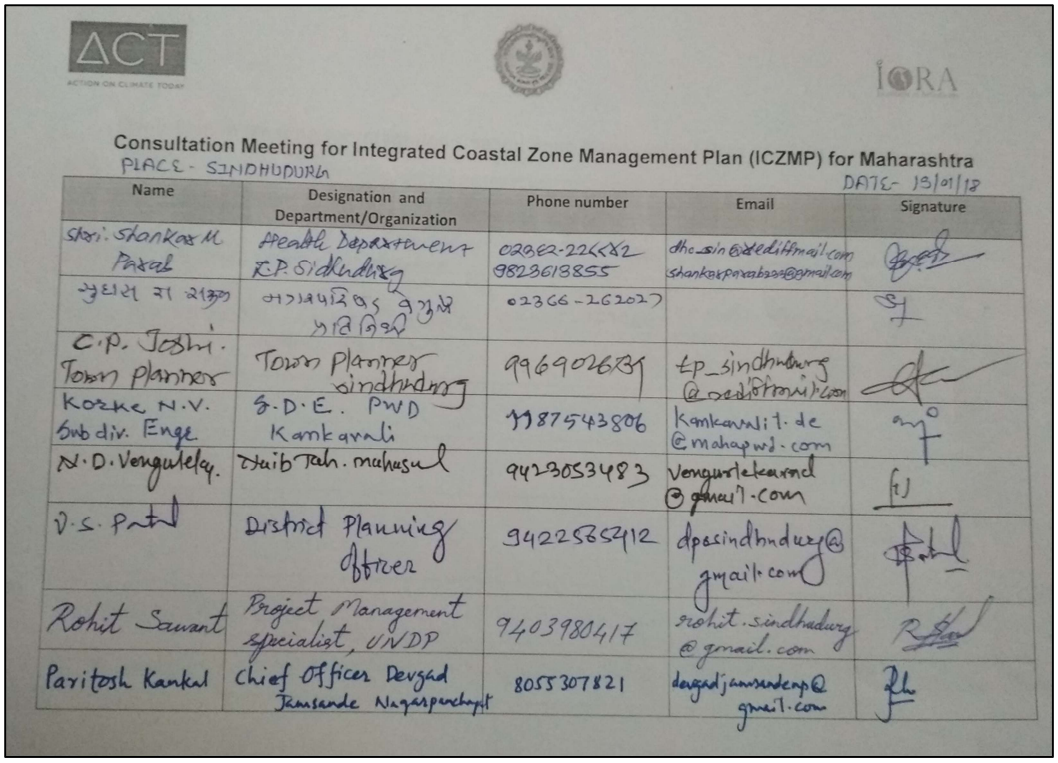
D.P. Jadhav	Dy. EE Ratnagiri Irrigation Dn. Ratnagiri	8149237398	eeratnagiri8899@gmail.com	
Amit Tanaji Shedage	Sub Divisional Magistrate, Ratnagiri	9766040931	sdoratnagiri@gmail.com	18/1/18
Jaylish Ghanshyam Chavan	Regional Manager MTDC, Ratnagiri	8422822063	roratnagiri@maharashtratourism.gov.in	
Shinde B.A.	Harbour Engineer, Ratnagiri	8446789856	shindebaee@gmail.com	
Gattuwar S.D.	P.A to H.E. Ratnagiri	8055871177	suraj gattuwar@gmail.com	
R.G. Malwankar	Fisheries Deputy Director Ratnagiri, A.F.D.O. Ratnagiri	9422216220 02352 233726	acfrtn@rediffmail.com acfrtnet	

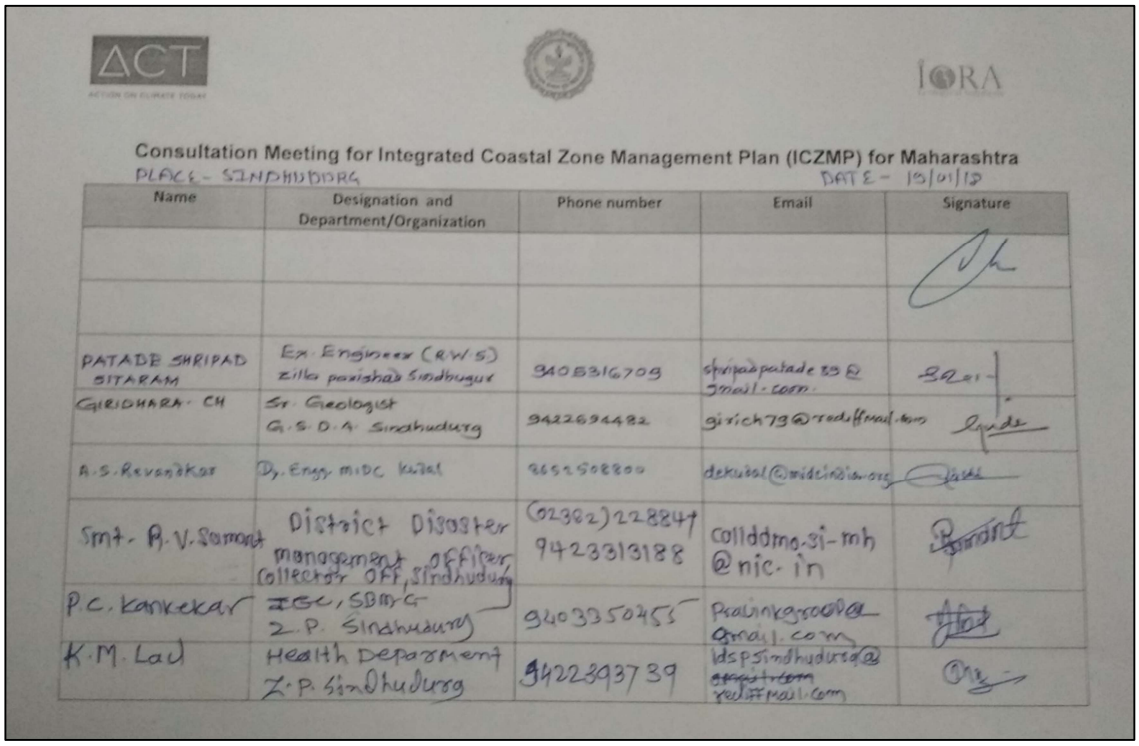
Attendee List of Consultation at Sindhudurg (19-20 January, 2018)



Consultation Meeting for Integrated Coastal Zone Management Plan (ICZMP) for Maharashtra

PLACE - SINDHUDURG DATE - 19/01/18

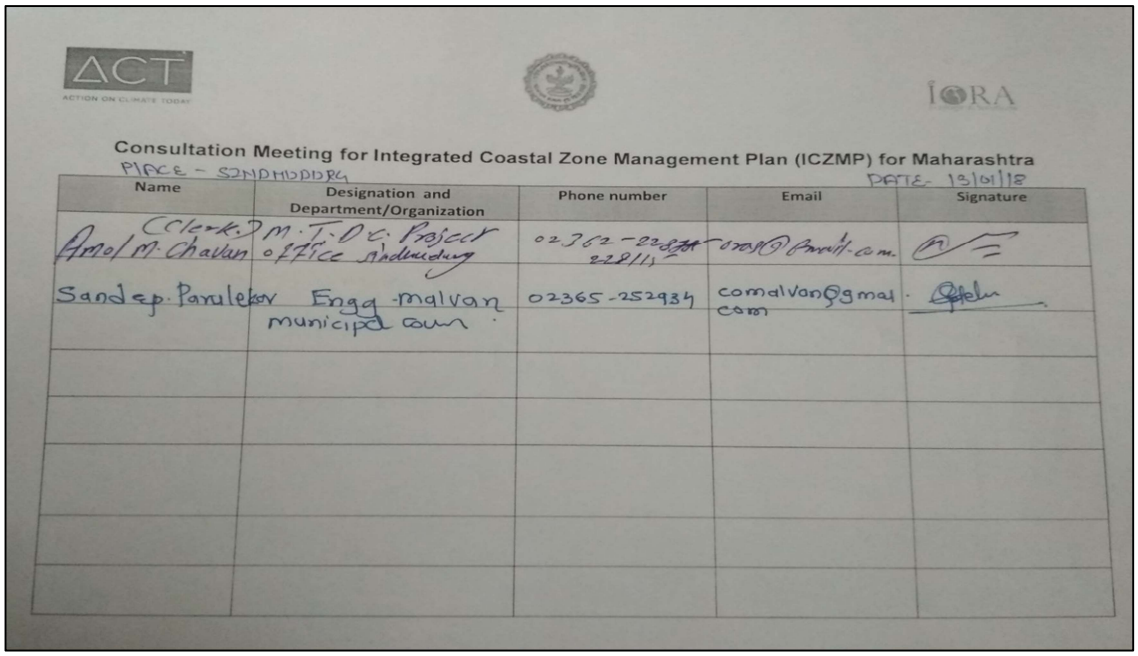
Name	Designation and Department/Organization	Phone number	Email	Signature
Shri. Shankar M. Parab	Health Department K.P. Sindhudurg	02362-226282 9823618855	dhosin@rediffmail.com shankarparab22@gmail.com	
[illegible]	[illegible]	02366-262027		
C.P. Joshi. Town planner	Town Planner Sindhudurg	9969026234	tp_sindhudurg@rediffmail.com	
Kozke N.V. Sub div. Engg.	S.D.E. PWD Kankavali	7387543806	kankavali1.de@mahapwd.com	
N.D. Vengurlekar.	Naib Tah. Mahasul	9423053483	Vengurlekarnd@gmail.com	
V.S. Patil	District Planning Officer	9422585212	dpasindhudurg@gmail.com	
Rohit Sawant	Project Management specialist, UNDP	9403980417	rohit.sindhudurg@gmail.com	
Paritosh Kankal	Chief Officer Devgad Jamsande Nagarpanchayat	8055307821	devgadjamsandenp@gmail.com	



Consultation Meeting for Integrated Coastal Zone Management Plan (ICZMP) for Maharashtra

PLACE - SINDHUDURG DATE - 13/01/18

Name	Designation and Department/Organization	Phone number	Email	Signature
PATADE SHRIPAD SITARAM	Ex. Engineer (RWS) Zilla parishad Sindhurg	9405316709	shripadpatade53@gmail.com	
GIRIDHARA. CH	Sr. Geologist G.S.D.A Sindhudurg	9422694482	girish79@rediffmail.com	
A.S. Revankar	Dy. Engg MIDC Kudal	9552508800	dekudal@midcindia.org	
Smt. A.V. Samant	District Disaster management officer Collector Off, Sindhudurg	(02362) 228847 9423313188	collddmo.si-mh@nic.in	
P.C. Kankekar	IGC, SBMG Z.P. Sindhudurg	9403350455	Pralinkg@gmail.com	
K.M. Lad	Health Department Z.P. Sindhudurg	9422893739	idspsindhudurg@rediffmail.com	

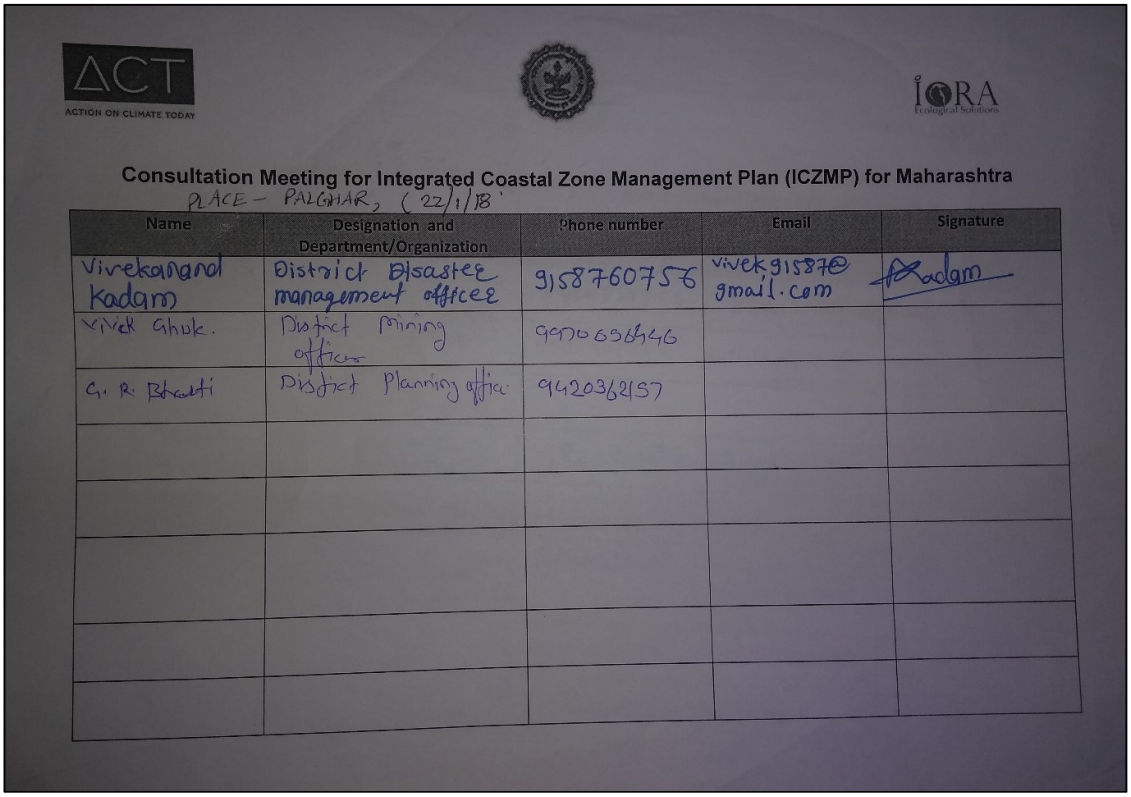


Consultation Meeting for Integrated Coastal Zone Management Plan (ICZMP) for Maharashtra

PLACE - SINDHUDURG DATE - 13/01/18

Name	Designation and Department/Organization	Phone number	Email	Signature
Amol M. Chavan	(Clerk) M.T.D.C. Project office Sindhudurg	02362-228111		
Sandep Parulekar	Engg-malvan municipal coun.	02365-252934	comalvan@gmail.com	

Attendee List of Consultation at Palghar (22 January, 2018)



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ACTION ON CLIMATE TODAY

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Ecological Solutions

Consultation Meeting for Integrated Coastal Zone Management Plan (ICZMP) for Maharashtra

PLACE – PALGHAR, (22/1/18

Name	Designation and Department/Organization	Phone number	Email	Signature
Vivekanand Kadam	District Disaster management officer	9158760756	vivekg1587@gmail.com	Kadam
Vivek Ghuk.	District Mining officer	9970696946		
G. R. Bharati	District Planning office	9420362157		

Annexure III – Tentative TOR for PMU Personnel

S. No.	Position	Qualification
1	Project Director	Minimum 20 years of experience of working in the government in the rank of Secretary or equivalent Preferably experience of working on implementation, monitoring and evaluation of projects in the state Responsible for administration and financial management of the project
2	CEO	Minimum 15 years of experience of working in the government Preferably experience of working at the position of Joint Secretary or similar from other services Experience of handling finances of large environmental and infrastructure projects or large bilateral/multilateral funded projects
3	COO	Minimum 10 years of experience of working in the government Experience of administration and financial management of large programmes Experience of dealing with bilateral and multilateral funded projects
4	Deputy CEO	Minimum 10 years of experience of working with the government, bilateral or multilateral organizations Experience of managing big programmes/ projects in the field of environment, natural resource management, climate change, livelihood or related areas
5	Project Manager - EIA, Clearance and Certification	Minimum 8 years of experience of handling EIA reporting and clearances
6	Project Manager - Ecotourism	Minimum 8 years of experience in tourism and allied sector
7	Project Manager - Enterprise Development	Minimum 8 years of experience in rural development, enterprise development, community participation and allied sector
8	Project Manager - Value Chain	Minimum 8 years of experience in value chain development for large corporates Preferably demonstrated experience of developing market linkages
9	Project Manager - R&D + Knowledge Management	Minimum 8 years experience in knowledge management and allied activities Preferably experience of working of working with government, bilateral and multilateral agencies
10	Finance Manager	Minimum 5-8 years of experience of working with the government or private sector Experience of handling finances of large infrastructure projects or large bilateral/multilateral funded projects
11	HR/ Administrative Manager	Minimum 7 years of experience of working in Human Resources and Administration related areas.
12	Junior Finance and Administration Officer	Minimum 3 years of experience of working in the fields related to finance and administration management

13	Advisor - Climate Change	Minimum 12 years experience in climate change, vulnerability and allied areas Experience of working on projects with government, bilateral and multilateral agencies
14	Advisor - Biodiversity and Ecology	Minimum 12 years experience in geospatial analysis Experience of working on projects related to climate change, water, coastal ecology, etc. Experience of working with government, bilateral and multilateral funding agencies
15	Advisor - Geospatial Analysis	Minimum 12 years experience in geospatial analysis Experience of working on projects related to climate change, water, coastal ecology, etc. Preferably experience of working on projects with funding from government, bilateral and multilateral agencies
16	Advisor – Communication and Outreach	Minimum 12 years experience in handling communication strategy for large corporates or international NGOs Preferably experience of working on projects with government, bilateral and multilateral agencies funding
17	Advisor – Livelihood Enhancement	Minimum 12 years experience in handling Livelihood Enhancement and Enterprise Development related activities for large corporates or international NGOs Preferably experience of working on projects with government, bilateral and multilateral agencies funding
18	Expert - Gender and Social Inclusion	Minimum 8 years minimum experience in gender and social inclusion related activities Post graduate or doctorate in social sciences or social work Preferably experience of working in NGO
19	Expert - Marine Biology	Minimum 8 years experience in Marine Biology or allied field Preferably a post graduate or doctorate in relevant field
20	Expert - Monitoring and Evaluation	Minimum 8 years experience in conducting Monitoring and Evaluation of projects Preferably experience of working on projects with funding from government, bilateral and multilateral agencies
21	Expert - Communication and Outreach	Minimum 8 years experience in handling communication strategy for large corporates or international NGOs Preferably experience of working on projects with government, bilateral and multilateral agencies funding
22	Expert - Remote Sensing and GIS	Minimum 8 years experience in geospatial analysis Experience of working on projects related to climate change, water, coastal ecology, etc. Preferably experience of working on projects with funding from government, bilateral and multilateral agencies

Annexure IV – ICZMP Budget

Sl. No.	Name of Intervention	Total Cost of Intervention (INR)
Component 1 – Conservation of Coastal and Marine Ecological Resources		
1.1	Land stabilization against coastal erosion through off-shore and on-shore interventions in 19.62 km in Ratnagiri district	2,38,24,00,000
1.2	Community-based assisted natural regeneration, restoration and conservation of mangroves • in Malvan in Sindhudurg • In Ratnagiri district	7,45,78,176
1.3	Conservation of breeding sites for sea turtle species such as Olive Ridley (*Lepidochelys olivacea*) and Green Turtle (*Chelonia mydas*) in selected locations- • Ratnagiri – Gaonnkhedi, Guhagar, Dabhol, Kolthare, Anjarla, Kelshi • Sindhudurg district – Shiroda, Vengurla	89,60,000
1.4	Installation of modern monitoring devices in urban patches of mangrove to check encroachment	6,00,000
Total: Component 1		2,46,65,38,176
Component 2 – Coastal Pollution Management and Related Infrastructure Upgrade		
2.1	Establishment of Sewage treatment facility and underground sewage systems in 4 towns and 4 pilot creeks in Maharashtra Mirkarwada (Ratnagiri) 4 MLD; Dapoli (Ratnagiri) 2 MLD; Guhagar (Ratnagiri) 2 MLD; Rajapur (Ratnagiri) 3 MLD; 4 pilot creeks (to be identified)	1,16,00,00,000
2.2	Installation of treated water system to 16 villages highly prone to increased salinity in drinking water	26,52,60,163
2.3	Construction and installation of sewer lines (bandist katha) and sewage management and treatment in clusters in coastal and watershed villages in 6 identified creeks	1,60,79,83,541
Total: Component 2		3,03,32,43,703
Component 3 – Livelihood Security of Coastal Communities		
3.1	Promotion of coastal tourism by – • Community based beach clean-up in 20 beaches. • Development of infra such as toilets based on length of beach and footfall in 20 beaches. • Assisting communities to set-up business in alternative destinations for water sports in 12 places in Ratnagiri district. • Signboards and peripheral infrastructure improvement in tourist path in 5 culturally important sites.	2,26,25,71,738
3.2	Mangrove ecotourism and crab farming in three stretches for livelihood generation through women SHGs. - Sindhudurg - Ratnagiri	80,00,000
3.3	Promoting seaweed (marine microalgae) cultivation among coastal villages	3,81,56,250
3.4	Restoration of 352 ha saline infected land (Khar Land) and maintenance of 4,119 ha reclaimed Khar Land	15,36,00,000
3.5	Removal of marine litter and ghost nets from the ocean near coastal villages	2,22,50,000
Total: Component 3		**2,48,45,77,988**
Component 4 – Capacity Building and Implementation of ICZM Plans		

4.1	Network of institutions for enhanced climate resilient planning and knowledge management in all the three coastal districts	13,00,00,000
4.2	Strengthening the Maharashtra Coastal Erosion Database Management System (MCEDMS)	4,12,00,000
Total: Component 4		**17,12,00,000**
Cost of PMU		**31,59,44,905**
Total Cost		**8,47,15,04,733**

Cost of PMU

					Expense/Salary					
S. No.	**Position**	**Number of Positions**	**Number of Months**	**Salary per month (in INR)**	**Year I**	**Year II**	**Year III**	**Year IV**	**Year V**	**Total**
1	Project Director	1	12	1,75,000	21,00,000	23,10,000	25,41,000	27,95,100	30,74,610	1,28,20,710
2	CEO	1	12	1,22,926	14,75,112	16,22,623	17,84,886	19,63,374	21,59,711	90,05,706
3	COO	1	12	62,012	7,44,144	8,18,558	9,00,414	9,90,456	10,89,501	45,43,074
4	Deputy CEO	2	12	62,012	14,88,288	16,37,117	18,00,828	19,80,911	21,79,002	90,86,147
5	District Coordinator	2	12	62,012	14,88,288	16,37,117	18,00,828	19,80,911	21,79,002	90,86,147
6	Project Manager - EIA, Clearance and Certification	1	12	62,012	7,44,144	8,18,558	9,00,414	9,90,456	10,89,501	45,43,074
7	Project Manager – Ecotourism	1	12	62,012	7,44,144	8,18,558	9,00,414	9,90,456	10,89,501	45,43,074
8	Project Manager - Enterprise Development	1	12	62,012	7,44,144	8,18,558	9,00,414	9,90,456	10,89,501	45,43,074
9	Project Manager - Value Chain	1	12	62,012	7,44,144	8,18,558	9,00,414	9,90,456	10,89,501	45,43,074
10	Project Manager - R&D + Knowledge Management	1	12	62,012	7,44,144	8,18,558	9,00,414	9,90,456	10,89,501	45,43,074
11	Finance Manager	1	12	62,012	7,44,144	8,18,558	9,00,414	9,90,456	10,89,501	45,43,074
12	HR/ Administrative Manager	1	12	59,352	7,12,224	7,83,446	8,61,791	9,47,970	10,42,767	43,48,199
13	Junior Finance and Administration Officer	1	12	39,402	4,72,824	5,20,106	5,72,117	6,29,329	6,92,262	28,86,638
14	Advisor - Climate Change	1	12	1,25,000	15,00,000	16,50,000	18,15,000	19,96,500	21,96,150	91,57,650
15	Advisor - Biodiversity and Ecology	1	12	1,25,000	15,00,000	16,50,000	18,15,000	19,96,500	21,96,150	91,57,650

16	Advisor - Geospatial Analysis	1	12	1,25,000	15,00,000	16,50,000	18,15,000	19,96,500	21,96,150	91,57,650
17	Advisor – Communication and Outreach	1	12	1,25,000	15,00,000	16,50,000	18,15,000	19,96,500	21,96,150	91,57,650
18	Advisor – Livelihood Enhancement	1	12	1,25,000	15,00,000	16,50,000	18,15,000	19,96,500	21,96,150	91,57,650
19	Expert - Gender and Social Inclusion	1	12	59,352	7,12,224	7,83,446	8,61,791	9,47,970	10,42,767	43,48,199
20	Expert - Marine Biology	1	12	59,352	7,12,224	7,83,446	8,61,791	9,47,970	10,42,767	43,48,199
21	Expert - Monitoring and Evaluation	1	12	59,352	7,12,224	7,83,446	8,61,791	9,47,970	10,42,767	43,48,199
22	Expert - Communication and Outreach	1	12	59,352	7,12,224	7,83,446	8,61,791	9,47,970	10,42,767	43,48,199
23	Expert - Remote Sensing and GIS	1	12	59,352	7,12,224	7,83,446	8,61,791	9,47,970	10,42,767	43,48,199
Sub - Total 1					**2,40,06,864**	**2,64,07,550**	**2,90,48,305**	**3,19,53,136**	**3,51,48,450**	**14,65,64,305**

Short Term Consultants (STC)					**Expense/Salary**					
S. No.	**Position**	**Number of Positions**	**Number of Months**	**Salary per month (in INR)**	**Year I**	**Year II**	**Year III**	**Year IV**	**Year V**	**Total**
1	STC: Climate Risk and Vulnerability	2	18	1,50,000	18,00,000	18,00,000	18,00,000	0	0	54,00,000
2	STC: Baseline Development	4	12	1,50,000	72,00,000	0	0	0	0	72,00,000
3	STC: DPR	8	12	1,25,000	60,00,000	60,00,000	0	0	0	1,20,00,000
4	STC: Monitoring and	4	44	1,50,000	24,00,000	24,00,000	72,00,000	72,00,000	72,00,000	2,64,00,000

	Evaluation									
5	STC: Geospatial analysis	4	24	1,00,000	19,20,000	19,20,000	19,20,000	19,20,000	19,20,000	96,00,000
6	STC: Communication products	2	24	1,50,000	0	18,00,000	18,00,000	18,00,000	18,00,000	72,00,000
Sub-total-2					1,45,20,000	1,27,20,000	91,20,000	73,20,000	73,20,000	**6,78,00,000**
Total cost of personnel (Sub-total 1+ subtotal 2)					**4,33,26,864**	**4,03,27,550**	**4,17,68,305**	**4,28,73,136**	**4,60,68,450**	**21,43,64,305**

Program Operational Costs

Sl. No.	**Component**	**Year I**	**Year II**	**Year III**	**Year IV**	**Year V**	**Total**
1	Software and Hardware including computers, laptops, licensed softwares	2,00,00,000	10,00,000	10,00,000	10,00,000	10,00,000	2,40,00,000
2	Office Establishment cost (cabins, furniture, office stationary, other equipment)	75,00,000	2,00,000	2,00,000	2,00,000	1,00,000	82,00,000
3	Office maintenance including lease, office support staff and security	60,00,000	66,00,000	72,60,000	79,86,000	87,84,600	3,66,30,600
4	Project vehicle X3	30,00,000	0	0	0	0	30,00,000
5	Organising 3 State level workshops, 10 regional/ district level workshops	9,50,000	9,50,000	9,50,000	9,50,000	9,50,000	47,50,000
6	Printing and publishing	10,00,000	10,00,000	10,00,000	10,00,000	10,00,000	50,00,000
7	Official tour, per diem	40,00,000	40,00,000	40,00,000	40,00,000	40,00,000	2,00,00,000
Sub-total-3		**4,24,50,000**	**1,37,50,000**	**1,44,10,000**	**1,51,36,000**	**1,58,34,600**	**10,15,80.600**
Grand Total		**8,57,76,864**	**5,40,77,550**	**5,61,78,305**	**5,80,09,136**	**6,19,03,050**	**31,59,94,905**

1.1 Land stabilization against coastal erosion through off-shore and on-shore interventions in 19.62 km in Ratnagiri district

Structure Type	Cost (INR per m)*	Total Length Required (m)	Total Cost (in Cr INR)
Anti-sea erosion bund	1,00,000	15,460	154.6
Anti-sea erosion bund with tetrapod	3,00,000	2,200	66
Protection Wall	90,000	1,960	17.64
Total		**19,620**	**238**

* Unit cost as obtained from Harbour Engineering Department

1.2 Community-based assisted natural regeneration, restoration and conservation of mangroves
in Malvan in Sindhudurg
In Ratnagiri district

Year-wise division of area to be brought under ANR

Total area under ANR (in ha)	Annual Area Under ANR (in ha)					
	2019	**2020**	**2021**	**2022**	**2023**	**2024**
1,509	151	151	377	453	302	75

Year-wise cost of intervention

	cost per unit (INR/Ha)	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Total cost (INR)**
Cost per hectare of mangrove restoration (INR/Ha) (I)	36,000	54,31,680	54,31,680	1,35,79,200	1,62,95,040	1,08,63,360	27,15,840	5,43,16,800
Travel charges (@10%) (II)	3,600	5,43,168	5,43,168	13,57,920	16,29,504	10,86,336	2,71,584	54,31,680
Expert Charges (@10%) (III)	3,600	5,43,168	5,43,168	13,57,920	16,29,504	10,86,336	2,71,584	54,31,680
Sub-total Cost of mangrove restoration (INR/ha) (I+II+III)	**43,200**	**65,18,016**	**65,18,016**	**1,62,95,040**	**1,95,54,048**	**1,30,36,032**	**32,59,008**	**6,51,80,160**
Institutional Charge (@10%) (IV)	4,320	6,51,802	6,51,802	16,29,504	19,55,405	13,03,603	3,25,901	**65,18,016**
Sub-total cost of intervention (I+II+III+IV)	**47,520**	**71,69,818**	**71,69,818**	**1,79,24,544**	**2,15,09,453**	**1,43,39,635**	**35,84,909**	**7,16,98,176**
Senior Research	40,000	4,80,000	4,80,000	4,80,000	4,80,000	4,80,000	4,80,000	28,80,0

Fellow (2 require for 6 months each year) (V)								00
Total Cost (I+II+III+IV+V)		**76,49, 818**	**76,49, 818**	**1,84,04, 544**	**2,19,89, 453**	**1,48,19, 635**	**40,64, 909**	**7,45,78, 176**

* Co-financing opportunities
Senior scientist (supported by Mangrove Cell)
Research Fellow (supported by Mangrove Cell)

1.3 Conservation of breeding sites for sea turtle species such as Olive Ridley (*Lepidochelys olivacea*) and Green Turtle (*Chelonia mydas*) in selected locations-

- Ratnagiri – Gaonnkhedi, Guhagar, Dabhol, Kolthare, Anjarla, Kelshi
- Sindhudurg district – Shiroda, Vengurla

Activities involved	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Capacity and awareness building	4,50,000	4,50,000	4,50,000	0	0	4,50,000
Improve tourism oriented aspects (boards etc.)	0	3,00,000	0	0	0	1,00,000
Procure scientific measuring devices	0	10,00,000	0	0	0	0
Hire 3 SRFs for detailed mapping and census of turtles in 9 sites	0	14,40,000	14,40,000	14,40,000	14,40,000	0
Total	**4,50,000**	**31,90,000**	**18,90,000**	**14,40,000**	**14,40,000**	**5,50,000**
Grand Total						**89,60,000**

* all costs in INR
* Co-financing opportunities
- Demarcation activities (supported by Forest Department)
- Fencing of mangrove area (supported by Forest Department)
- Guards (supported by Forest Department)
- Senior scientist allocation from other ongoing projects (supported by Forest Department)

1.4 Installation of modern monitoring devices in urban patches of mangrove to check encroachment

Number of CCTV cameras	25
Cost of CCTV camera system (in INR)	4,000
Other hardware including DVR, hard disks, monitor etc. (in INR)	3,00,000
Total cost (in INR)	**4,00,000**
Maintenance (in INR)	2,00,000
Grand Total (in INR)	**6,00,000**

* all costs in INR
* Co-financing opportunities
Personal for installation of devices, monitoring and reporting of activities (supported by Mangrove Cell)

2.1 Establishment of Sewage treatment facility and underground sewage systems in 4 towns and 6 creeks in Maharashtra

Range for cost of small size STP[71]

Cost (INR/KLD)	Capacity (KLD)
1,75,000	50
40,000	750

Since proposed plants are of sized >2MLD, unit cost for 750 KLD plant has been assumed.
Cost of STP – INR 4,00,000/MLD

Location	Capacity (in MLD)	Cost (INR)
Mirkarwada (Ratnagiri)	4	16,00,00,000
Dapoli (Ratnagiri)	2	8,00,00,000
Guhagar (Ratnagiri)	2	8,00,00,000
Rajapur (Ratnagiri)	3	12,00,00,000
6 pilot creeks	3	72,00,00,000
Total cost of construction		**1,16,00,00,000**

* Co-financing opportunities
Underground supply and sewer line (supported by Municipality/Government of Maharashtra)
Manpower (supported by Municipality/Government of Maharashtra)

2.2 Installation of treated water system to 16 villages highly prone to increased salinity in drinking water

Cost of desalination plants

Sl. No.	Capacity (MLD)	Cost (INR Cr)	Unit Cost (INR Cr/MLD)
1	400	4,070	10.2
2	100	550	5.5
3	41	173	4.2
Average Unit Cost			**6.6**

* capacity and cost obtained from The Mint, 2014 and The Hindu, 2016

Unit cost of desalination plants have been estimated from existing plants. The same has been used for estimating cost of intervention

10 L	per capita drinking water requirement (litre) as per WHO, 2013
25,000	Assumed population per desalination plant/village

[71] http://nopr.niscair.res.in/bitstream/123456789/41040/3/JSIR%2076%284%29%20249-254.pdf

16	Number of plants envisaged under ICZMP
4 MLD	Drinking water requirement
INR 27 Cr	Cost of Intervention

2.3 Construction and installation of sewer lines (bandist katha) and sewage management and treatment in clusters in coastal and watershed villages in 6 identified creeks

Costing for this intervention has been estimated in two parts –

Sl. No.	Component	Source
1	Cost of decentralized treatment	CSE, 2011[72]
2	Cost of sewer network	Nanded DPR, 2006 [73] *

* inflation adjusted to 2017

Cost of Component I

	Unit	Cost (INR)
Sewage Treatment Plant Cost	per KLD	30,000
	per MLD	3,00,00,000

6	Number of creek
135 (lpcd)	per capita water requirement (litre per capita per day)
0.60	Share of water converted to sewerage
50,000	Assumed population coverage per watershed/dependent on sewage treatment
24 (MLD)	MLD sewage generated
72,90,00,000 (INR)	**Cost of component 1**

Cost of Component II

According to DPR	Cost (INR in 2006 prices)	Cost (INR in 2017 prices)
Providing and laying of sewer network (105 km)	28,29,93,798	61,52,88,479

INR 58,59,890	Unit cost of sewer line (INR)
25 km	Network length per watershed (km)
6	Number of creek
INR 87,89,83,541	**Cost of component 2**

Total cost of 2.3 – INR 1,60,79,83,541

[72] http://www.cseindia.org/cost-estimation-for-planning-and-designing-of-decentralised-wastewater-treatment-system-2073

[73] http://www.nwcmc.gov.in/JNNURM/ilfs/NAD%2010/Sewerage%20Zone%20II.pdf

3.1 Promotion of coastal tourism by –

- Community based beach clean-up in 20 beaches.
- Development of infra such as toilets based on length of beach and footfall in 20 beaches.
- Assisting communities to set-up business in alternative destinations for water sports in 12 places in Ratnagiri district.
- Signboards and peripheral infrastructure improvement in tourist path in 5 culturally important sites.

Sl. No.	Sub-Intervention	Cost (INR)
I	**Community based beach clean-up in 20 beaches in Ratnagiri and Sindhudurg**	
	Projected Cost of Goa beach clean-up in 2016 (54 beaches) [74]	10,00,00,000
	Estimated cost of cleaning 20 beaches in Ratnagiri and Sindhudurg	**3,70,37,037**
II	**Development of infra such as toilets based on length of beach and footfall in 20 beaches**	
	Projected Cost of Baga Beach development (parking facilities beautification, viewing tower, seaside pathways, etc)	7,75,67,955
	Estimated cost of developing tourism facilities at 20 target beaches	1,55,13,59,090
	Total cost of intervention (after 3% contingencies, 4% consultancy charges, 7.25% centage charges)	**1,77,24,27,761**
III	**Assisting communities to set-up business in alternative destinations for water sports in 12 places in Ratnagiri district**	
IV	**Signboards and peripheral infrastructure improvement in tourist path in 5 culturally important sites**	
	Cost of setting up 10 signboards (2 at each site)[75]	1,00,00,000
	Peripheral infrastructure improvement in tourist path in 5 culturally important sites[76]	38,78,39,773
	Total cost of infrastructure improvement (after 3% contingencies, 4% consultancy charges, 7.25% centage charges)	44,31,06,940
	Total cost of Intervention IV	**45,31,06,940**
Total Cost of Intervention		**2,26,25,71,738**

[74] http://www.goatourism.gov.in/travel-news/details/46/248

[75] https://economictimes.indiatimes.com/wealth/invest/billboards-becoming-a-popular-mode-of-investment/articleshow/37926160.cms

[76] http://indianexpress.com/article/india/india-news-india/goa-tourism-may-scale-down-tender-price-for-beach-cleaning-2929640/

3.2 Mangrove ecotourism and crab farming in three stretches for livelihood generation through women SHGs.

- Sindhudurg
- Ratnagiri

Year-wise number of SHGs to be trained

	2019	2020	2021	2022	2023	2024	Total
Number of SHGs	5	5	10	0	0	0	**20**

	Unit Cost (INR)	2019	2020	2021	2022	2023	2024	Total
Training	50,000	2,50,000	2,50,000	5,00,000	0	0	0	**10,00,000**
Basic Infrastructure for Tourism	1,00,000	5,00,000	5,00,000	10,00,000	0	0	0	**20,00,000**
Infrastructure Development as Revolving Fund	5,00,000	50,00,000	0	0	0	0	0	**50,00,000**
Grand Total								**80,00,000**

3.3 Promoting seaweed (marine microalgae) cultivation among coastal villages

	2019	2020	2021	2022	2023	2024	Total
Total units of seaweed farming (no.)	25	25	25	25	25	25	**150**

		cost per unit (INR)	2019	2020	2021	2022	2023	2024	Total cost (INR)
	Cost of seaweed farm (INR) (I)	**1,56,250**	**39,06,250**	**39,06,250**	**39,06,250**	**39,06,250**	**39,06,250**	**39,06,250**	**2,34,37,500**
Component Breakup of Seaweed Farm	*Bamboo rafts*	*93,000*	23,25,000	23,25,000	23,25,000	23,25,000	23,25,000	23,25,000	1,39,50,000
	Seed Material Cost	*12,400*	3,10,000	3,10,000	3,10,000	3,10,000	3,10,000	3,10,000	18,60,000
	HDPE fish net	*17,050*	4,26,250	4,26,250	4,26,250	4,26,250	4,26,250	4,26,250	25,57,500
	Five toothed anchor	*4,000*	1,00,000	1,00,000	1,00,000	1,00,000	1,00,000	1,00,000	6,00,000
	HDPE braider rope cost	*24,800*	6,20,000	6,20,000	6,20,000	6,20,000	6,20,000	6,20,000	37,20,000
	Transportation charge for seed materials	*5,000*	1,25,000	1,25,000	1,25,000	1,25,000	1,25,000	1,25,000	7,50,000
	Travel (II)	**50,000**	**12,50,000**	**12,50,000**	**12,50,000**	**12,50,000**	**12,50,000**	**12,50,000**	**75,00,000**
	Expert charges (III)	**25,000**	**6,25,000**	**6,25,000**	**6,25,000**	**6,25,000**	**6,25,000**	**6,25,000**	**37,50,000**

Sub-total (I+II+III)	**2,31,250**	**57,81,250**	**57,81,250**	**57,81,250**	**57,81,250**	**57,81,250**	**57,81,250**	**3,46,87,500**
Institutional Charges @10% (for implementation agency)	23,125	5,78,125	5,78,125	5,78,125	5,78,125	5,78,125	5,78,125	**34,68,750**
Total	**2,54,375**	**63,59,375**	**63,59,375**	**63,59,375**	**63,59,375**	**63,59,375**	**63,59,375**	**3,81,56,250**

3.4 Restoration of 352 ha saline infected land (Khar Land) and maintenance of 4,119 ha reclaimed Khar Land

New Construction Of The Kharland Scheme				
Sl. No	**Project Location (Proposed)**	**Component**	**Estimated Cost (INR la)**	**Area Reclaimed (in ha)**
1	Majgaon 'B'	1)Earthen Bund-670 m	42	15
	Lat-17^{0}3' N	2) CD work- 3 Nos.		
	Log-73^{0}19' E			
2	Tembhye	1)Earthen Bund-750 m	35	12.82
	Lat-16^{0}58'41'' N	2) CD work- 2 Nos.		
	Log-73^{0}22'11''E			
3	Tonade	1)Earthen Bund-200 m	60	22
	Lat-16^{0}56' N	2) CD work- 1 Nos.		
	Log-73^{0}22'E			
4	Varvade 'B'	1)Earthen Bund-990 m	95	49.17
	Lat-17^{0}12'14''N	2) CD work- 3 Nos.		
	Log-73^{0}15'36"E			
5	Chinchkhari Phatakwadi	1)Earthen Bund-250 m	25	10
	Lat-17^{0}19'05''N	2) CD work-2 Nos.		
	Log-73^{0}57'05"E			
6	Peve Umbershet	1)Earthen Bund-1090 m	80	28.56
	Lat-17^{0}04' N	2) CD work-2 Nos.		
	Log-73^{0}19'E			
7	Ambavali	1)Earthen Bund-310 m	39	14
	Lat-17^{0}01' N	2) CD work-1 Nos.		
	Log-73^{0}05'E			
8	Bhatgaon	1)Earthen Bund-1110 m	105	37.35
	Lat-17^{0}13'59'' N	2) CD work-3 Nos.		
	Log-73^{0}22'17''E			

9	Waghiware	1)Earthen Bund-225 m	33	11.83
	Lat-17^{0}33'51''N	2) CD work-1 Nos.		
	Log-73^{0}20'43''E			
10	Karul	1)Earthen Bund-1230 m	63	22.57
	Lat-17^{0}34'19''N	2) CD work-2 Nos.		
	Log-73^{0}15'23''E			
11	Upale	1)Earthen Bund-725 m	75	31
	Lat-16^{0}32' N	2) CD work-1 Nos.		
	Log-73^{0}32'E			
12	Taral	1)Earthen Bund-1320 m	161	98
	Lat-16^{0}36'N	2) CD work-1 Nos.		
	Log-73^{0}30'E			
Total			**813**	**352**

Maintenance of Kharland Scheme				
Sl. No	**Project Location (Proposed)**	**Component**	**Estimated Cost (INR la)**	**Area Reclaimed (in ha)**
1	Malgund	1)Earthen Bund-1620 m	80	74.512
	Lat-17^{0}57'	2) CD work-2 Nos.		
	Log-73^{0}02'			
2	Umberwadi	1)Earthen Bund-520 m	70	40
	Lat-17^{0}57'	2) CD work-4 Nos.		
	Log-73^{0}02'			
3	Kelye	1)Earthen Bund-520 m	30	10
	Lat-17^{0}57'	2) CD work-4 Nos.		
	Log-73^{0}02'			
4	Ratnagiri Taluka	1)Earthen Bund	35	2,089
		2) CD work		
5	Shipole	1)Earthen Bund-315 m	20	19.03
	Lat-17^{0}50'	2) CD work-1 Nos.		
	Log-73^0 56'	200 m length of bund to be improved		
6	Govindshetwadi	1)Earthen Bund-1515 m	15	32.25
	Lat-17^{0}36'	2) CD work-2 Nos.		
	Log-73^0 11'	150 m length of bund is to be improve.		

7	Sawanas Tumbad	1)Earthen Bund-1940 m	70	57
	Lat-17^{0}37'	2) CD work-3 Nos.		
	Log-73^0 24'			
8	Panderi	1)Earthen Bund-2285 m	70	63
	Lat-18^{0}30'	2) CD work-1 Nos.		
	Log-73^0 16'			
9	Remajewadi	1)Earthen Bund-1524 m	12	39
	Lat-17^{0}37'	2) CD work-3 Nos.		
	Log-73^0 25'	250 m length of bund to be improved		
10	Musalmanwadi No.2	1)Earthen Bund-1140 m	120	46
	Lat-17^{0}34'13"	2) CD work-1 Nos.		
	Log-73^0 22'53"			
11	Jambhulwadi	1)Earthen Bund-2115 m	20	84
	Lat-17^{0}34'05"	2) CD work-1 Nos.		
	Log-73^0 27'35"	Construction Of New CD work		
12	Guhagar	1)Earthen Bund	35	645
		2) CD work		
13	Kondsar Khurd	1)Earthen Bund-1035 m	35	34
	Lat-16^{0}45'	2) CD work-1 Nos.		
	Log-73^0 21'	Pitching Work.		
14	Nate	1)Earthen Bund-140 m	56	93
	Lat-16^{0}37'	2) CD work-1 Nos.		
	Log-73^0 20'	Construction Of New CD work & Earthwork.		
14	Harche	1)Earthen Bund-750 m	20	26
	Lat-16^{0}55'	2) CD work-2 Nos.		
	Log-73^0 28'	Construction Of New CD work		
15	All Kharland schemes in Lanja & Rajapur Taluka who required maintainace of Earthen bund & New PPGL FRP gates	1)Earthen Bund	35	782
		2) CD work		
Total			**723**	**4,134**

3.5 Removal of marine litter and ghost nets from the ocean near coastal villages

Year-wise number of individuals to be trained

Year	2019	2020	2021	2022	2023
No. of locals to be trained	20	20	20	20	20

Cost of certification for Scuba Diving [77] - INR 2,00,000
Total cost of Scuba training – INR 2,00,00,000
Cost per workshop for Capacity Building – INR 1,50,000
Number of workshops per year – 3
Number of years – 5
Total cost of capacity building workshop – INR 22,50,000

Total cost of intervention – INR 2,22,50,000

4.1 Network of institutions for enhanced climate resilient planning and knowledge management

Sl. No.	Components	Quantity	Description
1	Workshop - District Level attended by all key agencies (government, civil society and research) for collaboration and data sharing at the district level	4	number of workshop per district per year
		4	number of districts
		5	years of intervention
		10,00,000	Cost per workshop (INR)
		8,00,00,000	**Total Workshop Cost - District Level (INR)**
2	Workshop - State Level attended by all key agencies (government, civil society and research) for collaboration and data sharing at the state level	2	number of workshop per year
		5	years of intervention
		50,00,000	Cost per workshop (INR)
		5,00,00,000	**Total Workshop Cost - State Level (INR)**
Total		**13,00,00,000**	**Total Intervention Cost (INR)**

4.2 Strengthening the Maharashtra Coastal Erosion Database Management System (MCEDMS)

Component	2019	2020	2021	2022	2023	2024	Total
Software	12,00,000	0	4,00,000	0	4,00,000	0	20,00,000
Hardware	18,00,000	0	6,00,000	0	6,00,000	0	30,00,000
Personnel cost	2,00,000	60,00,000	60,00,000	60,00,000	60,00,000	60,00,000	3,02,00,000
Other establishment cost	36,00,000	0	12,00,000	0	12,00,000	0	60,00,000
Total							**4,12,00,000**

[77] http://indianexpress.com/article/india/malvan-youth-now-scuba-divers-clean-up-coastline-of-ghost-fish-nets-4763901/