DRAFT REPORT ON

COASTAL ZONE MANAGEMENT PLAN (CZMP) FOR MALAPPURAM DISTRICT – KERALA

(Prepared as per CRZ Notification 2019)

Prepared for

Department of Environment

Government of Kerala

NATIONAL CENTRE FOR EARTH SCIENCE STUDIES

Ministry of Earth Sciences, Government of India

Thiruvananthapuram - 695 011, Kerala

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COASTAL ZONE MANAGEMENT PLAN (CZMP) FOR MALAPPURAM DISTRICT - KERALA

1. INTRODUCTION

Coastal zone is the transitional zone, where land meets the sea and is influenced by both terrestrial and marine components. Intense interaction characterizes the coastal zone which varies from open sea to semi closed (creeks, lagoons) coastal waters and they exhibit a substantial diversity in environmental and demographic features. Here, land and ocean-dominated global processes converge and interact, characterized by multiple biogeochemical environmental gradients. The balance of these relationships provides a distinct domain of gradient-dependent ecosystems, climate, geomorphology, human habitation and most crucially regimes of highly dynamic physical, chemical and biological processes. Terrestrial processes are primarily governed by hydrological regimes and horizontal flows which provide mechanisms for energy gradients and transfer of materials (nutrients, contaminants, sediments), offering a range of conditions for material transformations and biological sustenance. Oceanic processes are similarly dominated by hydrological and physical factors that regulate the transit of materials and energy regimes, often in contrast with the land-dominated factors. The resultant equilibrium of terrestrial and oceanic processes yields regional and local heterogeneity in physical and ecological structure and supports the dynamics of ecosystem function and biogeochemical cycling in the coastal domain. Thus, mass and energy are constantly exchanging and as a result of these interactions created a unique ecosystem (Shailesh Nayak, 2017).

Coastal zones throughout the world have historically been among the most heavily exploited areas because of their rich resources. Coastal regions provide fish, shellfish, seaweeds and host ports for trading and commerce. In addition, several biota are sources of fertilizer, drugs, cosmetics and household products. Moreover, coastal wetlands also store and cycle nutrients, filter pollutants and help in the protection of the shoreline against erosion and storms. Thus, the richness and diversity of resources found in coastal regions have led to a corresponding concentration of human activities

and settlement along coasts and estuaries throughout the world. In coastal countries today an estimated half of the total populations live in coastal zones and migration from inland areas to the coast is increasing. Not surprisingly, there is also a sharp conflict between the need for immediate consumption or use of coastal resources and the need to ensure the long-term supply of those resources. In many countries this conflict has already reached a critical stage, with large parts of the coastal zone polluted from local or upland sources, fisheries severely degraded or destroyed, wetlands drained, coral reefs dynamited and beaches long since ruined for human enjoyment. If these coastal resources are to be maintained and restored, effective action is urgently needed. It is also obvious that the coastal zone will be expected to sustain the livelihoods of a very large proportion of the human population and will remain an important asset to people worldwide for the foreseeable future. The sustainability of the coastal environment is continuously impacted by pollution, eutrophication, industrialization, urban development, land reclamation, agricultural production, overfishing and exploitation. Moreover, the poor understanding of the dynamics of land-ocean interactions, coastal processes and the impact of poorly planned and managed human interventions makes the sustainability of human economic and social progress vulnerable to natural and human-induced hazards. Humans are increasingly influencing these regions, which resulting in measurable changes directly within the coastal domain and through feedback, indirectly within the terrestrial, oceanic and atmospheric compartments of the Earth system (Steffen et al., 2004). So, the major challenge that humans face today is how to manage the use of this area so that future generations can also enjoy its visual, cultural and societal resources. We need to ensure robust health of coastal ecosystems through sustainable management, so that they continue to provide various goods and services for future generations, as well.

According to a recent evaluation of the impacts of marine pollution from land-based sources, the degradation of the marine ecosystem is still occurring and, in many places has intensified (GESAMP, 2001). Hence, policies and legislations to reduce conflicts over uses in the coastal zone, protect coastal resources and support livelihood activities of local communities as well as to address the development requirements of the coast to meet economic and societal requirements are essential. Integrating environmental, economic and human activities to ensure pollution-free coastal waters and healthy ecosystems to sustain livelihood and coastal economy necessitates effective integration of science and public policy is very much needed. Due to various development schemes of private

and public, legal and illegal, large-scale modifications and damages to coastal morphology and ecosystems by way of reclamation of tidal flats, destruction of mangroves, leveling of sand dunes, mining of beach sand, construction activities for settlement, establishment of industries, dumping of waste and discharge of pollutants. Rapidly changing landuse due to the immense pressure for development in the coastal zone has adversely affected the coastal ecosystems, coastal morphology and livelihood resources of the coastal areas.

Coastal zone management depends on the information available on various aspects of coastal habitats, coastal processes, natural hazards and their impacts, water quality and living resources. The effective management techniques depend on such information and suitable response by concerned government agencies. Keeping these facts in view, Government of India on the recommendation of Ministry of Environment and forest (MoEF) passed a legislation called Coastal Regulation Zone (CRZ) in the year 1991. Under this legislative act, one of the most cost-effective long - term solutions to control various ecologically destructive activities in the endangered coastal zone, is to invoke spatial buffers around coastal ecosystems. The Coastal Regulation Zone (CRZ) Notifications (MoEF, 2019; 2011; 1991) provides buffer zones in the coastal area is being considered as the pragmatic tool to control, minimize and protect environmental damages to sensitive coastal stretches from unplanned human interference. Management of coastal ecosystems through CRZ requires identification and mapping of the regulation lines and the spatial extent of the ecosystems and morphologies in appropriate scales. Implementation and enforcement of the provisions of CRZ on the ground require extensive coastal mapping and continuous monitoring.

The National Centre for Earth Science Studies (NCESS), Thiruvananthapuram is an agency authorized by Government of India to prepare/update CZMP for the coastal stretches of our Country (OM F. No. J-17011/8/92-IA-III dated 08-08-2019). So, the Government of Kerala entrusted National Centre for Earth Science Studies (NCESS), Thiruvananthapuram for the preparation of Coastal Zone Management Plan (CZMP) for the State of Kerala following the guidelines in CRZ Notification 2019, vide G.O. (Rt) No. 80/2019/ENVT dated 28.08.2019. High Tide Line (HTL), Low Tide Line (LTL), Ecologically Sensitive Areas (ESAs) and Critically Vulnerable Coastal Areas (CVCAs) demarcated by the National Centre for Sustainable Coastal Management (NCSCM), Chennai, and the 'Hazard line' as demarcated by the Survey of India (SoI) have been made use for the preparation of CZMP.

1.1 CZMP Planning Process

The landmark Coastal Regulation Zone (CRZ) Notification, which was first issued on 19th February 1991, has been the most important legislative instrument in the country for coastal governance by considering the livelihood of fisherman and local people residing along the coast. The Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India has issued a revised CRZ Notification on 6th January 2011under Section 3(1) and Section 3(2)(v) of the Environment (Protection) Act, 1986 and Rule5(3)(d) of Environment (Protection) Rules, 1986 in supersession of CRZ 1991 except as respect to things done or omitted to be done before such supersession. Subsequently, in June 2014, the MoEFCC constituted a committee under the chairpersonship of Dr. Shailesh Nayak, the erstwhile Secretary of the Ministry of Earth Sciences, to address the concerns raised by the state governments, eliminating ambiguities and simplifying certain provisions in CRZ Notification 2011. The committee held consultations with the state governments over the following six months and submitted its report to MoEFCC in January 2015. Ultimately, on 18thJanuary 2019, in supersession of the CRZ Notification of 2011, the Government of India brought out the CRZ Notification 2019.

The CRZ is a critical regulation for conservation and livelihood protection on the coast. All developmental activities in the CRZ are regulated through the CRZ Notification. Accordingly, the CRZ has been declared as 'the coastal stretches of the country and the water area up to its territorial water limit'. The Coastal Regulation Zone Notification (MoEF&CC, 2019;2011; 1991) which provides buffer zones in the coastal area is being used as the best tool to control, minimize and protect environmental damages to sensitive coastal stretches from unplanned human interference. Thus, the CRZ Notification promote development in a sustainable manner based on scientific principles considering the dangers of natural hazards in the coastal areas and sea level rise due to global warming.

1.2 Development of a coastal database and information system

In the recent times, the availability of digital spatial data for the world coasts has vastly increased as a result of advancements in data capture and input techniques. The large increase in global data availability has had a significant impact on coastal science. The way in which coastal observations are stored and integrated largely determines the degree to which spatial processes can be understood. Therefore, well-organized and designed data systems are needed to underpin our understanding of the processes taking place over large parts of coasts. The expected accelerated rise in global mean sea levels may cause several physical changes to the world's coasts and hence can endanger coastal populations and infrastructure, as well as threaten many coastal ecosystems. The sensitivity of the coastal zone to sea-level rise, in conjunction with its importance in terms of social, economic and ecological value, highlights the need for consistent national- to global-scale assessments of potential impacts along the coasts. However, the scope of these studies has been limited by the available data in terms of resolution, coverage, parameter availability, and dated sources: this is a generic problem for broad-scale coastal analysis. In addition to these limitations, data quality and integration constitute further problems; even in those cases where data and tools are available to coastal scientists for the analysis and modeling of coastal processes, these usually exist in fragmented forms. This fact compromises the consistency, reliability and versatility of evaluations based on such sources. It has long been recognized that appropriate and reliable information within organized, planned and coherent coastal databases is an essential prerequisite for coastal zone management.

In order to address the preceding issues and provide a consistent source of data for the Indian coast, the data collated digitally onto a GIS platform for the preparation of the CZMP come handy. This database contains physical, ecological and vulnerability parameters and covers the Indian coasts uniformly, probably for the first time on a digital platform permitting retrieval, portability and sharing in a seamless manner. For this reason, the database has been specifically designed to address the data requirements of the project and the needs of researchers in the area of vulnerability assessment of coastal zones. It is also expected to be used for wider assessment of regional and global coastal issues.

1.3 Generation of CZMP maps

Management of coastal ecosystems through CRZ requires identification and mapping of the regulation lines and the spatial extent of the ecosystems and morphologies in appropriate scales. Implementation and enforcement of the provisions of CRZ on the ground require extensive coastal mapping and continuous monitoring. As per the CRZ Notification 2019 issued vide Notification No.G.S.R.37(E), dated the 18th January, 2019, all coastal States and Union territory administrations shall revise or update their respective coastal zone management plan (CZMP) framed under CRZ Notification, 2011 number S.O. 19(E), dated 6th January, 2011, as per provisions of this notification and submit to the Ministry of Environment, Forest and Climate Change for approval at the earliest and all the project activities attracting the provisions of this notification shall be required to be appraised as per the updated CZMP under this notification and until and unless the CZMPs is so revised or updated, provisions of this notification shall not apply and the CZMP as per provisions of CRZ Notification, 2011 shall continue to be followed for appraisal and CRZ clearance to such projects. The Notification also directs the State to prepare or update the CZMP by engaging reputed and experienced scientific institution(s) or the agencies and in consultation with the concerned stakeholders. Consequently, the Government of Kerala entrusted National Centre for Earth Science Studies (NCESS), Ministry of Earth Sciences, Thiruvananthapuram for the preparation of Coastal Zone Management Plan for the State of Kerala following the guidelines in CRZ Notification, 2019.

Accordingly, preparation of the draft CZMP in 1:25,000 scale map identifying and classifying the CRZ areas within the respective territories in accordance with the guidelines given in Annexure-IV to the CRZ Notification 2019 has been taken up by NCESS, which involve public consultation. The subsequent guidelines issued by the MoEF&CC based on Office Memorandum 12-1/2019-1A III dated 26-06-2020 is to facilitate the State Government in updation of the CZMPs. As per the new guidelines, The CZMP database (shapefiles etc.) prepared as per the CRZ Notification, 2011 which have been scrutinized by the Technical Scrutiny Committee, finalized by the National Centre for Sustainable Coastal Management (NCSCM) and approved by the MoEFCC, shall be used as the base for revision or updation of the CZMP, as per the provisions contained in the CRZ Notification, 2019. The guidelines brought out clarity in the case of the Data to be provided

by the States/UTs to the authorized agencies, CRZ buffers, Processing of Census data, CRZ Classifications, Public consultation of draft CZMP updated or revised based on CRZ Notification 2019, format for CZMP report, approval process of CZMP etc.

2. THE STATE OF KERALA

Kerala, the Gods own Country lies in the southwest corner of Peninsular India and positioned between 8°17'30"N and 12°47'40"N latitudes and 74°27'47"E and 77°37'12"E longitudes. It is bound by the Western Ghats Mountain ranges to the east and the Arabian Sea to the west. The Ghats run parallel to the west coast at a distance ranging from 40-80 km. Kerala is spread over a total area of 38,863 sq.km, having significant stretches of water bodies. Altitudes ranges from below sea level (the Kuttanad area) to 2,695 m and the terrain falls into three well marked divisions: (a) the high ranges of the Western Ghats in the east with undulating hilly tracts, marked by long spurs, extensive ravines and dense forest, (b) the midland occupies with plantations and cultivated plains intersected by numerous rivers and streams, and (c) the coastal belt with dense settlements, coconut plantations and rice fields (Soman, 2002). The total population of Kerala is 33,406,061 (as per 2011 census) with a density of 859 per sq km. The density of coastal urban population is 4,228 per sq. km., as compared to the average urban density of 2,097 in the state. The coastal rural population density is 1700, far above the state average rural population density of 603 (Geevan, 1996). The coastline length of Kerala is about 590 km. Kerala, despite its small land area with long coastline studded with world's best string of beaches. It is bestowed with a vast network of backwaters, lagoons, natural lakes, rivers and canals.

The wetlands of the state are categorized into two primary groups namely inland and coastal wetlands. The total area calculated as wetlands was 127930.07 ha, of which the inland wetlands cover approximately 34199.57 ha and the coastal wetlands estimated 93730.50 ha (MoEF, 1990). According to recent estimates by different agencies on wetland categories such as water spread area, aquatic vegetation and turbidity, it is around 1762 wetlands in the state. Moreover, 2592 wetlands smaller than 2.25 ha had been also identified. As a result, the total wetland area estimated was 160590 ha (Anon, 2010). CED, 2003 had suggested the major wetland classification system for Kerala based on different parameters like location, physical extend, depth, salinity, biodiversity etc

(Kokkal, 2008).

Kerala is rich with 44 rivers (41 west flowing and 3 east flowing) cut across Kerala with their numerous tributaries. The rivers either debouch into the Arabian Sea through inlets directly or drained to the sea through estuaries/lagoons (backwater). There are 48 inlets along the Kerala coast out of which 20 are permanent, whereas the remaining 28 are seasonal (remain open only during the monsoon period of June – September). The seasonal inlets mostly remain closed during the fair season due to the development of spit along the inlets due to deposition from longshore sediment transport. Seasonal inlets are normally cut open during monsoon for discharging storm- water accumulated from rainfall reducing the coastal inland from flooding risk. Reduction in the supply of riverine sediments might have affected the stability of the south-west coast in recent years.

The backwaters as a part of wetlands which running parallel to the coastline is a characteristic feature of the Kerala coast. It can be described as a body of brackish, marine or hypersaline water impounded by a sandy barrier and having an inlet connecting it with the open sea. Backwaters form an attractive and economically valuable and ecologically significant feature of Kerala. During monsoon, the backwaters overflow into the sea, discharging sizeable quantities of sediments, whereas in summer sea water flows into the backwater over considerable distances. The Kerala Public Works Department (Water Resources of Kerala, 1974) has identified 27 backwaters and 7 lagoons in Kerala. Kerala State has fourteen districts of which 9 districts has seacoast on its west.

There are 14 District, 152 Block Panchayats, 941 Grama Panchayats, 87 Municipalities and 6 Municipal Corporations. Apart from this, Kerala has one Cantonment (Kannur). The fourteen districts in the state are distribute over 75 Taluks consisting of a total of 1535 Villages (1664 is including the Group Villages). It is interesting to note that 9 districts (Kasaragod, Kannur, Kozhikode, Malappuram, Thrissur, Ernakulam, Alappuzha, Kollam and Thiruvananthapuram) out of the 14 have Lakshadweep Sea as their western boundaries and therefore come under the purview of CRZ covering considerable parts of coastline. Apart from the 9 districts, some parts of Kottayam district are also under the purview of CRZ since its western boundary is along the banks of tidal influenced Vembanad Lake.

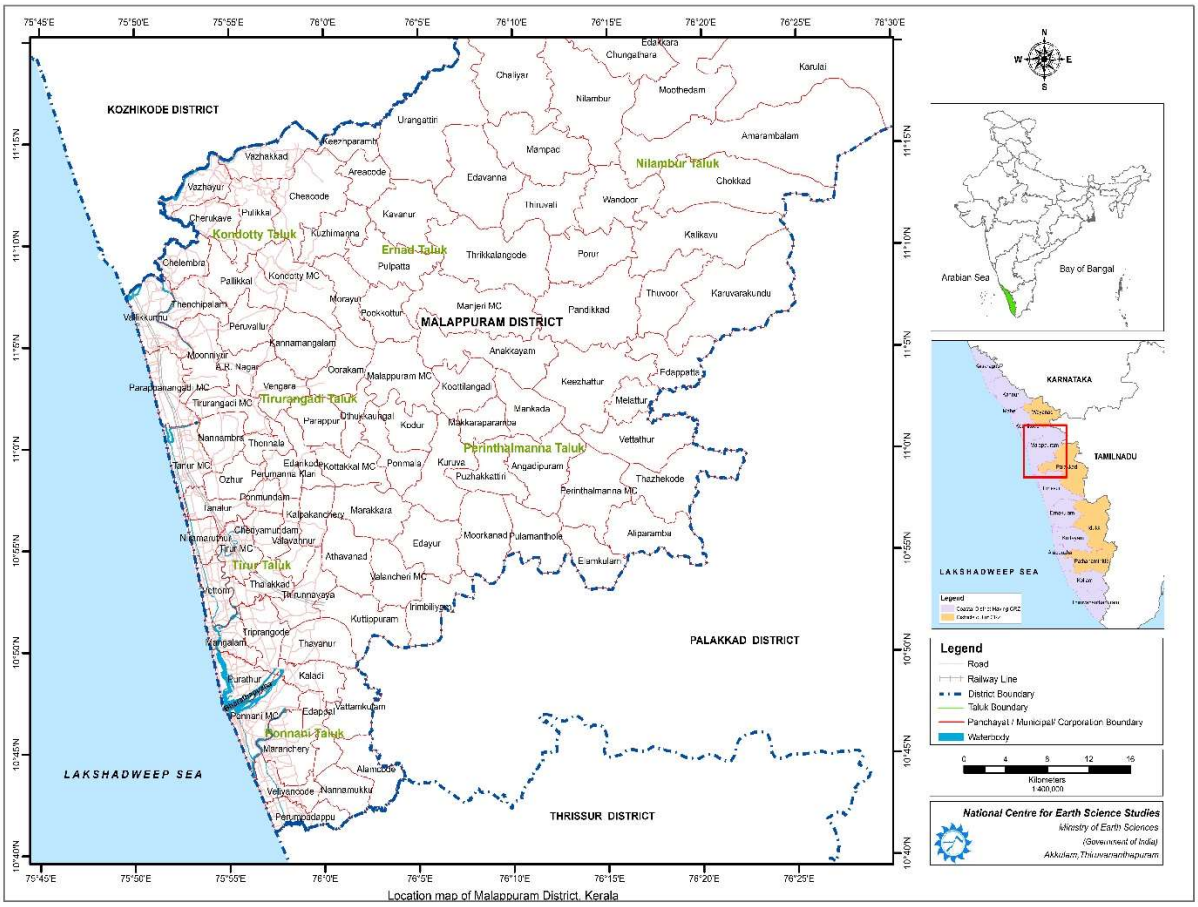
2.1 Malappuram District

Malappuram district forms part of Malabar region of Kerala, which is predominantly a land of hills and valleys transcending to coast. Malappuram literally means an elevated place on the top of hills. The district has a unique place among the geologists due to the fact that Laterite, first identified by Francis Buchanan is in the area near Angadippuram, which is the type area of Laterite. Malappuram district came into existence on June 16, 1969. Malappuram district is composed of portion of the erstwhile Palakkad and Kozhikode districts. It was carved out of Ernad taluk and portions of Tirur taluk of Kozhikode district and portions of Perinthalmannna and Ponnani taluks of Palakkad district. The Nilgiris of Tamil Nadu in the east and Lakshadweep Sea in the west provides natural boundaries. In the north, the district is bounded by Kozhikode and Wayanad districts and in the south by Palakkad and Thrissur districts. The district has a seacoast of about 70kms long and also has the presence of stretch of lakes and backwaters. District lies between North latitudes 10^{o} 47' 10" to 11^{o} 31' 38" and East longitudes 75^{o} 49' 38" to 76^{o} 33' 10". The Zamorins held sway over Malappuram and their chieftain Para Nambi, ruled the area in early days. The whole of erstwhile Malabar district including the present Malappuram district, which was ceded by the English East India Company, became part of Madras Presidency till the re-organization of States in 1956. Total area of Malappuram District is 3550km^2, which is about 9.13% of the total area of the State and ranked 3rdamong the districts in terms of area. The location map of Malappuram district is given in Figure 1.

2.1(a) Administration

There are two systems of administrative set up in the State – Revenue and local self-government. Under the revenue system the district is divided into Revenue Division, Taluks and Villages. However, for local administration, the district is divided into Urban local bodies (Municipal Corporation and Municipal Councils) and rural local bodies comes under the hierarchy of District Panchayat consisting of Block Panchayats defined with geographically contiguous cluster of a few Grama Panchayats. For the implementation of development activities, Panchayats are grouped under Community Development Blocks. Therefore, all these units viz., Taluks, Villages, urban and rural local bodies have their own relevance and importance.

The district comprises of two Revenue Divisions (Tirur and Perinthalmanna) consisting of 7 taluks (Tirur, Tirurangadi, Ponnani, Ernad, Nilambur, Perinthalmanna and Kondotty) and 138 revenue villages. Under the local self-government system, the district is divided into 12 Municipal Councils (Malappuram, Manjeri, Kottakkal, Nilambur, Perinthalmanna, Ponnani, Tirur, Parappanangadi, Valancherry, Thirurangadi, Thanoor and Kondotty) and 15 Development Blocks (Areacode, Kondotty, Kalikavu, Kuttippuram, Malappuram, Mankada, Nilambur, Perinthalmanna, Perumpadappu, Tanur, Tirur, Tirurangadi, Vengara, Wandoor and Ponnani) which consisting of 94 Panchayats.



Location map of Malappuram District, Kerala

Figure 1: Location map of Malappuram District

2.1(b) Physiography

As a continuum of the State, the district too can be divided into three distinct physiographical units such as the coastal plains, the midlands and the eastern highland regions. The coastal plains

form the low land areas adjacent to the Lakshadweep Sea. The entire Kerala falls into such three micro regions viz., (i) North Kerala Coast, (ii) Central Kerala Coast and (iii) South Kerala Coast. The Malappuram district falls in the Central Kerala Coast. Each micro region is further divided into sub-micro regions on the basis of topography, geology, soils, climate and natural vegetation. Thus, Malappuram consists of 5 such sub-micro regions viz. (i) Malappuram Coast (ii) Malappuram Undulating Plain (iii) Chaliyar River Basin (iv) Nilambur Forested Hills (v) Perinthalmanna Undulating Uplands, followed by the mountainous region.

Malappuram Coast: This region lies all along the coastal tract of Malappuram district. It makes its boundaries with Kozhikode coast in the north, Malappuram undulating plain in the east, Thrissur coast in the south and Lakshadweep Sea in the west. This region is drained by the major rivers like Chaliyar, Kadalundi, Ponnani etc. canals and backwaters. All of them are used for inland navigation. This coastal plain slopes towards west very gently. The maximum height (104 m) is located at Kalpakancheri village of Tirur taluk. The rivers show the meandering character which implies that flood plain attained matured condition. Coconut palms and paddy are the vegetations found in this region.

Malappuram Undulating Plain: This region makes its boundaries with Nadapuram-Mavur undulating plains in the north, Chaliyar river basin and Perinthalmanna undulating upland in the east, Pattambi undulating plain in the south and Malappuram cost in the west. This undulating terrain lies parallel to the Malappuram coastal region. It has number of isolated residual hills and generally slopes towards west and in some places towards east. The Nenmini hill (478 m) at the central part of the region, which located at Kannmangalam village of Tirurangadi taluk is the highest spot in the region. The minimum height (95 m) is found in the northern tip of this region, i.e., at Vazhayur village of Ernad taluk. This region has cashew, coconut and tapioca as the important vegetation cover.

Chaliyar River Basin: This region lies entirely in Ernad taluk. It makes its boundaries by Nilambur forested hills in its north and east, Perinthalmanna undulating upland in the south and Malappuram undulating plain in its east. This region falls under the middle course of the Chaliyar River. Before entering to this region, this river takes its origin from the northern and eastern hilly forest area and flows westwards. This region has ups and downs in the form of isolated hills. It has undulated terrains

and the region slopes towards west. Rubber, cashew, pepper and coconut are the important vegetation found here.

Nilambur Forested Hills: This region makes its boundaries with Kozhikode forested hills and Wayanad forested hills in the north, Tamil Nadu in the east, Mannarkad - Palakkad forested hills in the south and Chaliyar River basin in the west. This region is a part of the Western Ghats. It is a scarp slope area and there is a drop of 700 m. in height within a short distance of one kilometre. There are many peaks with over 1000 m in this region. The minimum height (115 m) is located at Mambad village. There is a valley in between the north-western and eastern portions of this hilly tract and thereby the slope of this region is the catchment area of the Chaliyar River and its tributaries.

Perinthalmanna Undulating Uplands: This region makes its boundaries with Chaliyar River basin in the north, Mannarkad-Palakkad forested hills in the east, Palakkad gap in the south and Malappuram undulating plain in the west. This region is having a number of isolated hills, mostly in the southern area of the region from where streams originate and join with the Kadalundi River and Thoothapuzha. Kadalundi River drains this region. The maximum height of the region is 610 m at the Vadakkangara village of Perinthalmanna taluk. The 100 m. contour which shows the minimum height, runs throughout this region. There are some forested patches found in the isolated and thick shrubs and bushes found mostly in the southern portion of this region. Coconut, palms, rubber, pepper and cashew are the vegetation cover of this region.

Mountainous region: The eastern region of this district is a mountainous plateau with lofty hills covered by thick forests. Nattavaram hill with a height of 1388 m is situated in this region. The highest point in the ghat sector within the district of Malappuram is 2594 m, which is at the border with Nilgiri District (TN) part of Mukkuruthi Peak.

2.1(c) *Rivers and drainage characteristics*

The Malappuram district is blessed with five perennial rivers. They are (i) Chaliyar or Beypore River (ii) Kadalundi River (iii) Puraparamba River (iv) Tirur River and (v) Bharathapuzha.

Chaliyar River, known in the lower reaches as the Beypore River. It is one of the major rivers

of the state. The lower reaches form part of the west coast inland navigation system. Chaliyar River takes its origin from Elembileri hills of Vythiri taluk of Wayanad district. Its important tributaries are Cherupuzha, Iringapuzha, Kurumbranpuzha, Kanhirapuzha, Karimpuzha, Punnapuzha, Vadaprampuzha and Chaliyar. The main river traverses through the Cholamala estate, Kanthapara, Kurumbanmala, Edakkara, Chungathara, Amarambalam, Nilambur, Mampad, Urungattiri and Kizhuparamba of Malappuram district, before it empties itself into the sea at Beypore. This river has a total length of about 168 km with a drainage area of 2,818 sq.km. The annual run off has been estimated as 1330 cubic metres. The river is navigable and motor boats can ply from the mouth of the river upto Kuttiadi. Timber from the forests is extensively floated down to Kallayi through this river.

Kadalundi River, also known as Karimpuzha or Oravanpurampuzha, originates from the silent valley reserve forests at an elevation of 1219 m. above the mean sea level. Olippuzha and Velliar are its main tributaries and the river drains Karuvarakundu of Nilambur taluk, Pandikkadu, Vettikkattiri, Pandalur, Anakkayam, Malappuram, Urakam villages of Ernad taluk, Edapatta, Melattur, Keezhattur, Koottilangadi and Kodur villages of Perinthalmanna taluk and Othukkungal, Parappur, Vengara, Thennala, Tirurangadi,Koduvayur, Moonniyur, Parappanangadi, Ariyallur and Thenhippalam villages of Tirurangadi taluk before it falls into Lakshadweep sea at Kadalundi. This river flows through the coastal tract for a distance of about 30 km, which causes high floods and damages to the low-lying areas during monsoon. This river forms part of the west coast navigation system from Palathingal in the south to Mannur in the north. Through this river also timber logs and bamboo rafts are floated down to Kallayi. It has a length of 130 km, with a catchment area of 1114 sq.km and a total runoff of 2189 million cubic feet.

Purapparamba, a small river of 8 km originates from the tail end Purapparamba cut. It flows in the western direction and crosses the Madras-Mangalore railway line between Tannur and Parappanangadi stations. The Canoli canal connects the river with other rivers in the district.

Tirur river originating from the Athavanad village of Tirur taluk, flows south-west up to Tirunavaya and flows upto Elamkulam in the north-western direction. Then it turns south-west and finally joins Bharathapuzha to reach the sea near Ponnani. It traverses through Ananthavoor, Thirunavaya, Talakkad, Valavannur, Cheriyamundam, Tirur and Purathur villages of Malappuram

district. It has a total length of 48 km, with a catchment area of about 142 sq.km and a total runoff of 269 million cubic feet. The river is navigable and motorboat can ply between Tirur and Ponnani. It also forms part of west coast water transport system. Tirur river is connected with Purapparam bariver by Tanur-Kuttiadi canal.

Bharathapuzha River, the second largest rover in the state takes its origin from the Anamalai hills in the Western Ghats at about 982 metres above the sea level. After flowing through Pollachi taluk of Tamil Nadu state it enters the Palakkad district of Kerala state. During its course, it forms the boundary between Palakkad and Thrissur districts. It then enters Malappuram district. The important tributaries of Bharathapuzha are Gayathripuzha, Kannadipuzha, Korayar and Thoothapuzha. The villages which touch the river in the district are Aliparamba, Anamangad, Elamkulam, Pulmanthole, Moorkkanad of Perinthalmanna taluk, Edayoor and Irimbiliam villages of Tirur taluk before it joins the Bharathapuzha at the tri junction of Irimbiliam, Parudur and Anakkara villages. Thereafter the combined river flows westward. At the lower reaches it is known as Ponnani River. It has a total length of about 209 kms and joins the Arabian sea near Ponnani town.

2.1(d) Coastal Wetlands

Apart from the estuarine part of the rivers joining the Lakshadweep Sea, other small backwaters in the district are in the Ponnani taluk. As a part of west coast canal system there is a continuous water route connecting Vadakara with Ponnani. The Veliyankode lake is situated 5 km south-east of Ponnani and it opens to the sea at Veliyankode. A regulator is installed there to prevent the inflow of saltwater into the lake. Maniyar kayal, Valancherry kayal and Maranchery kayal, all in Ponnani taluk, are the other minor backwaters in the district.

Kadalundi in Kozhikode and Malappuram districts have been identified by the Ministry of Environment and Forests, Government of India, under National Wetland Conservation Programme. Kerala Kadalundi wetland is sustained by its native species that thrive in the unique environment. A land rich in biodiversity, the location is breathtakingly picturesque; a rarity that can be claimed only by a few other places in the world. It was the wetlands that nourished the availability of underground water that has made Kerala the green state of the country. Wetlands located near and adjacent to seashores play an important role in sustaining the natural conditions of the sea and the neighbouring

land. The wetlands at Kadalundi, Chaliyam and Vallikkunnu, the areas where the Kadalundi River merges into the Arabian Sea, have an ecosystem that balances the climate and is rich in biodiversity. However, the wetlands are being destroyed by the irrational interference of human beings, who have a skewered perspective for developing a modern society. This has a big impact on the ecosystem and climate of the region. As a result, there is a crisis in the living and survival of a variety of species. The reality is such that people who depend on the wetlands for survival are also in a crisis situation. They keep talking about the destruction of the wetlands, the resultant decline in marine wealth, change in the structure of wetlands, and the ensuing change in climate.

2.2. Demography and Socio-Economic Activities

Kerala has 33.38 million population as per the Census 2011. It is the 13th most populous State in India with an overall population density of 860 per square kilometer. The State of Kerala accounts for 2.8% of India's population but it contributes nearly 4% of the Indian economy. Kerala is occupied with three times more dense settlement than the rest of the country. The coastal regions are more populated than the mountains and eastern hills of the State with 2.5 times the overall population density. Kerala has a Human Development Index of 0.79, which is "very high" and the highest in India. Kerala also has the highest literacy rates among all Indian states at 98.9% and a life expectancy of 74 years which is among the highest in the country. Kerala has experienced a rapidly dropping rural poverty rate, which fell from 59% in the mid-1970s to 12% by 2010, while the overall poverty rate fell 47% between the 1970s and 2000s, compared to a drop of just 29% in total poverty in the country. As per 2011 census, Kerala is the most literate state in India having literacy rate of 93.91%.

While Kerala has what appears to be rapid growth by the standards of most areas, its 4.9% decadal population growth rate in 2011 was the lowest in India and less than one-third of the India average of 17.64%. Between 1951 and 1991, Kerala's population more than doubled from 15.6 million to 29.1 million, reaching 33.3 million by 2011. Kerala is currently heading for zero growth in its population, as the state has a meager fertility rate and a stabilizing death rate. In 2021, census figures predict Kerala might record negligible population growth, which will be a first in India. The population is advanced with literacy and educational attainment. The various sectors such as agriculture cash crop production, animal husbandry, aquaculture, fisheries, micro enterprises and large-scale industries, tourism etc. plays important role in the economy of Kerala. This state is unique

in many respects among the states of India, one of which is its settlement pattern, characterized by a rural-urban continuum. Applying the "continuous method" to study spatial change in the occupational structure across rural, small towns and large urban units (comprising of cities/big/medium towns and agglomerations), it is interesting to note that economic diversification in general and manufacturing in particular has been fairly rapid in rural areas.

Malappuram district ranks the 3rd in terms of geographical area (3554 sq.km) of the districts in Kerala. Malappuram is the most populous district in the State with a population of 4,112,920. In terms of density of population, Malappuram is the 4thdense (1157persons per sq km) district and the 2ndurban dense district in the State. The district has recorded the lowest (14th) rank in total, male, female work participation rates (25.8%, 45.8 % and 7.6 %) and in urban and rural work participation rate (24.7 % and 26.7 %) in the State. The district has the highest percentage of non-workers (74.14) in the State. Malappuram district is reported to have the highest decadal growth rate of population (13.45 %) in the state during 2001-11. The district occupies the 9thposition in literacy rate (93.57per cent). The district holds the top position in average household size (5.2 persons per household).

2.3. Coastal Geomorphology and Ecosystem

The shoreline of Kerala is generally straight, trending NNW-SSE, with minor variations. The various coastal geomorphological units are beaches, beach cliffs, stacks, islands, shore platforms, spits, bars, beach ridges, estuaries, lagoons and tidal flats. The beaches are mostly sandy and dynamic in nature. Throughout the coast exists narrow stretch of beach except in cliff areas. In areas like Kovalam, Vizhinjam, Varkala, Ezhimala, Bekal etc. the headland is directly abetting the sea where the wave break occurs along the foot of lateritic cliff. The height of the cliff may be of 20 m or more. In some coast having cliffs, there are numerous stacks protruding into the sea in nearshore as well as in offshore regions. These stacks are the vestiges left behind after an island or head land portion which has been eroded out or still receding. Around Mahe and Thalassery, these stacks are found aligned nearly parallel to the coast. In lateritic coast offshore islands are observed in certain locations. The Green Island located in the offshore of Thalassery coast is a similar type of island and have continuity with the mainland with a string of stacks. The constant wave attack on the neck portion resulted discontinuity of the stacks and becomes an island. The coastal wetlands, backwaters and estuaries along the coast of Kerala are rich, biologically and ecologically diverse as well as

economically significant ecosystems which plays important role in livelihood of people. The major backwaters in Kerala are Vembanad, Ashtamudi, Kayamkulam, Akkulam, Kadinamkulam, Anchuthengu, Edava, Nadayara, Paravur, Vattakayal, Chettuva, and Valiyaparamba.

Physiographically, the district is divisible into three regions from West to East viz., i) the coastal plain, ii) the midland region and iii) the hilly terrain. The coastal plain is 5-10 km wide with a maximum elevation of about 10m towards the east. It extends as a narrow stretch of land lying along the coast from Kadalundi Nagaram in the north to Ponnani in the south. It exhibits depositional landforms of marine, fluvial and fluvio-marine origin. Paleo-beach ridges suggestive of marine regression in the Quaternary period are well developed in the coastal tract. It becomes very narrow towards north of Tirur and the maximum width is seen along Chauravalam – Tirurangadi area. The area lying between the coastal plain in the west and the high range in the east is occupied by midlands. This is the most prominent physiographic unit of the district. The midland region is relatively wide with elevations ranging between 200 and 300m. It is a denudational terrain characterised by flat-topped laterite capped flats, mesas, interfluves, hills, mounds and spurs interspersed by narrow valleys as well as wide alluvial valleys and flood plain. Geomorphological studies in this region have brought out remnants of four paleo-planation surfaces around 550 m, 350-400 m, 150-230 m and 45-130 m above msl. Of these, the first two surfaces only have accordance of summits with relicts of laterite, whereas the latter two have extensive and plateau-type remnants with thick laterite profile. The hilly region in the east is more than 600 m high. The terrain is characterized by hills and narrow incised valleys representing structural cum denudational landforms. Some of the highest peaks along the eastern border are ·2554 Makarti peak, ·2476 Nilgiri peak and ·2383 Anginda hill Chaliyar puzha is the major river draining the northern part; Kadalundi puzha drains the central part, while the lower reaches of Ponnani river drain the coastal tract in the south.

2.4. Marine Fishery Resources

Fisheries sector is recognized as one of the important sectors contributing significantly to the nation's economy. It is not only recognized as a powerful income and employment generator as it stimulates growth of a number of subsidiary industries, but also is a source of cheap and nutritious food earning foreign exchange too. It provides livelihood to approximately 14.49 million people in

our country. Kerala is one of the prominent maritime States in India and is blessed with most productive portion of Arabian Sea with a continental shelf area of 39,139 Sq km. Many commercially important finfishes and crustaceans form the high value fish species. The projected value of total fish production from Kerala comes to 706.882 MT by 2019-20. Over exploitation is one of the major threats in marine fishery resources. If the rich underexploited demersal and pelagic resources are utilized effectively, Kerala can brag the top position in total fish production and contribute fruitfully towards the economic development of the State. According to the available estimates of potential fishery resources of the West Coast, particularly in the south-west coasts, Kerala possesses the richest fishing grounds in the region. Marine fish landings for 2014-15 in Kerala was estimated at 524468 MT and that for 2013-14 was 522308 MT. Contribution of various fish resources include, pelagic fin fishes 361956 69 MT, demersal fin fishes 49416 9 MT, crustaceans 65955 12 MT, molluscs 34057 6 MT and miscellaneous 13084 MT.

Kerala holds the second position in terms of fisherfolk population, among the nine maritime states in our country. A great deal of Kerala's economy depends on fishing for subsistence, livelihood and employment. Fish consumption in Kerala is four times the national average and the production share of Kerala is the second largest in the country with 16.6% of India's total marine exports. The total populace of fisherfolk residing in the state of Kerala is estimated to be 11.11 lakh, which includes 8.55 lakh in the marine sector and 2.55 lakh in the inland sector (GOK, 2015). Out of this, the number of active fishermen is 2.28 lakh (1.90 lakh in marine sector and 0.42 in the inland sector). Currently, there are 222 fishing villages in the marine sector and 113 in the inland sector, where fishing and its allied sectors provide livelihood to a vast majority of population (GOK, 2015). Primarily the fishers depend on fishing as the prime source of income. However, 12% of the fisherfolk generates additional income from allied fishing activities like marketing/repairing nets, fish vending/processing and other fishery related activities. The socio-economic condition of the fisherfolk in the state is sad, when compared to the general section of the population. Most of them are in the grip of subsistence economy and indebtedness due to socio-economic constraints, education and depletion of fishery resources. The density of population in the coastal area is 2168 persons per km^2.

According to the Kerala Fisheries Handbook, Malappuram district is having a population of 191,676 fisherfolk in the marine sector including the male, female and children, whereas in the

inland fishing sector, the total fisherfolk population is 4,313 taking the total population to 95,989 (2019-20). Under the fisheries department, fish seed farm is located at Ullanam in Parappanangadi Municipality. Matsyafed is having a Prawn Hatchery located at Veliyamcode in Ponnani Municipality. Fishing harbour at Ponnani has been the main hub of fishing activities in the district. Construction of Tanur fishing harbour has been taken up, whereas a fishing harbour at Parappanangadi has been proposed. Marine fishing villages numbering 23 are located along the district coast. Similarly, there are 6 inland fishing villages in Malappuram district. Fish landing centres numbering 15 are available in the district. Wandoor Grama Panchayat and Nilambur Municipality are maintaining hygienic fish markets in the respective areas within the district. Statistics from the Kerala Government- fisheries department show that Malappuram district total fish production based on 2018-19 data is 19539 MT including the marine (11133 MT) and inland (8406 MT) production. It is estimated that there are 1806 households within 50 meters from HTL in the district with a total of 12600 members living in them.

2.5. Biodiversity of Malappuram district

Malappuram district has a 70 km long coastal belt, a few several river mouths and lowlands which is the abode of natural aquatic and wetland species of flora and fauna. As per a KFRI report, in the lowlands of the district, the major formations of biodiversity are seen in the backwaters and associated marshes, ponds, streams, etc. Species of *Nymphaea, Nymphoides, Limnophylla, Hydrolea*, etc, characterize the formation. There are much disturbed patches of mangroves also in the district with characteristic species of *Avicennia, Excoecaria, Kandlia and Carallia*. Terrestrial formations in the midland region are more characteristic of agrobiodiversity, apart from few elements of natural flora and fauna occurring in barren areas and gaps of cultivated lands. Sacred groves are comparatively few in Malappuram district with species of *Hopea, Vateria, Vatica, Diospyros, Terminalia*, etc., present there. The natural forests in the district are represented by moist deciduous, semievergreen, evergreen, savannahs and the southern wet temperate forests. As per the studies carried out by KFRI in the district, a documentation of 4984 taxa flora and fauna is included of which 2545 taxa are plants and 2439 taxa are faunal elements. Among the floral elements, angiosperms dominate by the representation of 2024 species followed by fungi (363 species), algae (61 species), pteridophytes (51 species), gymnosperms (4 species), lichens (40 species) and bryophytes (2 species). Endemism in the angiosperm flora is represented by 10.09 percent compared

to certain other districts in Kerala. Among animals, the group Insecta is maximum represented with 1749 species, followed by Aves (398 species), Pisces (99 species), Mammalia (82 species), Reptilia (74 species) and Amphibia (37 species).

2.6. Pollution and Waste Management issues

Kerala Solid Waste Management Project carried the waste quantification and characterization to represent the bulk waste generators of the State namely Household, Commercial and Institutional. The waste generation rate per capita in municipalities varies from 364 grams/capita to 456 grams/capita. Low waste generation is noticed in urban local bodies of highland areas. Highly urbanized Municipalities generate above 450 grams/capita and the City Corporation generates around 545 grams/capita. Domestic waste contributes 55-65percent of total waste, while commercial establishment and markets are the second-highest generators of waste. The average waste generation rate in Municipalities is 419 gm/capita/day whereas, the Municipal Corporation areas is 545 gm/capita/day. Based on the 3 broad categories of geographical regions (lowland, midland & highland), the waste generation rates are higher in the coastal belts, which is around 545 gm/capita/day in Municipal Corporation areas whereas, the waste generation rate in the midland belt is about 454 gm/capita/day and it is about 383 gm/capita/day in highland areas.

Mainly, the waste management includes the management of biodegradable waste, management of recyclable wastes, management of non-biodegradable and non - recyclable wastes and the management of biomedical wastes. As per the Solid Waste Management Rules, 2016, Centralized Windrow composting systems exists at Brahmapuram, Kochi and at Njaliyan parambu, Kozhikode. However, household level decentralized solid waste management facilities do exist at Kochi and Kozhikode Corportaion. More than 70% door to door collection of dry waste is achieved for households in 84 urban local bodies and for establishments in 70 urban local bodies as in May 2022. Haritha Karma Sena is working in 92 urban local bodies and 923 Grama panchayaths for collection of dry waste. For wet wastes disposal decentralized treatment methods such as aero bins, pipe compost, compost pits, kitchen bins, biogas plants etc. are followed. Dry wastes are collected, segregated and disposed through recyclers. In Kerala there are 147 plastic recycling units, 21 Steel mills, and 7 kraft paper units. Non-recyclable plastic waste is shredded in the Resource Recovery Facility and is used for the tarring of Public Works Department and Local Self Government

Department roads. During the period 2016-2021, Clean Kerala Company Limited (CKCL) has produced 2399.13 T of shredded plastics and given to various agencies.

3. PURPOSE AND SCOPE OF CZMPS

The Coastal Zone Management Plans proposes a spatial planning framework for development by providing setbacks around sensitive eco-zones restricting development and other activities close to it. Setbacks require specific reference lines and boundaries for its meaningful implementation. The High Tide Line (HTL) forms the cardinal reference line for determining the setbacks for CRZ. The 50, 100, 200 and 500m CRZ lines landward from the HTL are the landward setback lines. In the case of inland Backwater islands and islands along the mainland coast, 20m from the HTL is uniformly demarcated. The Low Tide Line (LTL) and the Territorial water boundary (12 NM) form the setback lines towards the sea. The 50m line or width of the creek from the HTL has been demarcated along the tidal influenced water bodies that are connected to the sea and the distance up to which tidal effects are experienced, determined based on the salinity concentration of 5ppt. The CZMP has to be prepared in two scales (1:25,000 and 1:3960 or the nearest scale) in accordance with the guidelines given in Annexure-IV of CRZ notification 2019. The CZMP in 1:25000 scale with Survey of India Toposheets as base maps is required for formulating policy decisions. These are to be submitted to MoEFCC, Govt of India for approval after stakeholder/public consultations. The local level CZMP are to be prepared in 1:4000 with cadastral base maps and based on the approved CZMP. These local level CZM maps are for the use of local bodies and other agencies to facilitate the implementation of Coastal Zone Management Plans. The CZMP also has to incorporate the Hazard Line as demarcated by Survey of India (SoI) with a view to reduce the vulnerability of the coast. Critically Vulnerable Coastal Areas (CVCAs) demarcated by NCSCM is also incorporated into the CZMP prepared. Shoreline of high, medium and low erosion stretches for such erosion prone areas will be added after receiving the data from NCSCM.

4. COASTAL ZONE MANAGEMENT PLANS

The para 6 of the CRZ Notification 2019, numerates the following instructions for carrying out the CZMP of a State:

(i) All coastal States and Union territory administrations shall revise or update their respective coastal zone management plan (CZMP) framed under CRZ Notification, 2011 number S.O. 19(E), dated 6th January, 2011, as per provisions of this notification and submit to the Ministry of Environment, Forest and Climate Change for approval at the earliest and all the project activities attracting the provisions of this notification shall be required to be appraised as per the updated CZMP under this notification and until and unless the CZMPs is so revised or updated, provisions of this notification shall not apply and the CZMP as per provisions of CRZ Notification, 2011 shall continue to be followed for appraisal and CRZ clearance to such projects.

(ii) The CZMP may be prepared or updated by the coastal State Government or Union territory by engaging reputed and experienced scientific institution(s) or the agencies including the National Centre for Sustainable Coastal Management (hereinafter referred to as the NCSCM) of Ministry of Environment, Forest and Climate Change and in consultation with the concerned stakeholders.

(iii) The coastal States and Union territories shall prepare draft CZMP in 1:25,000 scale map identifying and classifying the CRZ areas within the respective territories in accordance with the guidelines given in **Annexure-IV** to this notification, which involve public consultation. All developmental activities listed in this notification shall be regulated by the State Government, Union territory administration, local authorities or the concerned Coastal Zone Management Authority within the framework of such approved CZMP, as the case maybe, in accordance with provisions of this notification.

(iv) The draft CZMP shall be submitted by the State Government or Union territory to the concerned Coastal Zone Management Authority for appraisal, including appropriate consultations and recommendations in accordance with the procedure(s) laid down in the Environment (Protection) Act, 1986 (29 of 1986).

(v) The Ministry of Environment, Forest and Climate Change shall thereafter consider and approve the respective CZMP of concerned State Governments or Union territory administrations.

(vi) The CZMP shall not normally be revised before a period of five years after which, the concerned State Government or the Union territory may consider undertaking a revision.

4.1. Demarcation of High Tide Line (HTL) and Low Tide Line (LTL)

The highest level horizontal positional and spatial accuracy in mapping and presenting the HTL becomes necessary for field uses by CRZ implementing agencies. The agencies are looking for a planimetric accuracy approaching zero error. The different approaches now practiced in the country to demarcate the HTL are Tide level projection, using morphological signatures observed in the field as well as from the high-resolution satellite imageries. NCESS follows the approach as per the guidelines mentioned in the Annexure IV of CRZ Notification 2019. As per the Amendment to the CRZ Notification 2019: gazette notification no. S.O. 1422(e) dated 1st may, 2020 & no. S.O. 4886(e) dated 26th November 2021, In case there exists a bund or a sluice gate constructed in the past, prior to the date of notification issued vide S.O. 114(E) dated 19th February 1991, the HTL shall be restricted up to the line long along the bund or the sluice gate and in such a case, area under mangroves arising due to saline water ingress beyond the bund or sluice gate shall be classified as CRZ-IA irrespective of the extent of the area beyond the bund or sluice gate. Such areas under mangroves shall be protected and shall not be diverted for any developmental activities. The coastal morphological signatures are collected by field work as well as from the satellite imageries for the purpose of demarcation of HTL.

Morphological signatures are good indicators of shoreline oscillation and inundation of coastal waters, which could be used for identifying the HTL. The inundation of coastal waters on to the land and seasonal shoreline oscillations are dependent on coastal morphology. Shoreline remains stable and would not retreat significantly along cliffy coasts. The shoreline retreats up to the cliff base along pocket beaches. Artificial morphologies like seawalls confine the oscillation of shoreline along the line of the structure itself. Sandy beaches are prone to seasonal and long-term shoreline oscillation. Long term stability of the beach and the position of the stable part of the beach would be evident from morphological signatures such as berm and berm crest. This could be done by field methods and using combination of spatial data sources including satellite data. The HTL must be fixed with respect to certain reference points on the land. These reference points at sufficiently close intervals (preferably at least 1km along shore) have to be marked with respect to latitude-longitude and known points in the base map. Geomorphologic features like berm crest, cliff, headland, line of permanent vegetation, etc. are indicators of the reach of sea water into the land. Stable coastal protective structures like seawall also limit the intrusion of seawater. Hence High Tide Line (line of

maximum reach of seawater into the land during spring tide) can be fixed in the field, with respect to these features and tied to the reference points, as detailed below:

a) ***Landward (monsoonal) berm crest for beaches***

In all the well-formed wide beaches, one or more berms (which are nearly horizontal part of the beach developed through the deposition of sand by wave action) are usually observed. The seaward end of the berm at which a sudden downward slope is observed is termed a berm crest. When there is only one berm, it normally gets eroded during the monsoon with a berm crest on the landward side. But when there are two berms the landward berm is the monsoonal berm, which normally do not get eroded. Or else we can say that the erosion reaches only to the second berm crest. Since the tidal waters do not reach the coast beyond this landward berm crest, it is taken as the HTL. The distance to this point from the reference point is measured using the beach profile to fix the position of the HTL.

b) ***Seawall/revetments/embankments***

In highly erosion-prone areas, no second berm is observed landward. Such locations will be protected mostly by seawalls. During monsoon season majority of these places are devoid of beaches. The waves impinge upon the seawall during the monsoon season, especially during the high tide. Thus, they are the artificial barriers stopping the waves/tides at the coast. Since the seaward part of the seawall in most cases is defaced due to erosion, the landward toe is taken as the HTL boundary in such locations. There are some locations with two or three lines of seawall, particularly in the accreting areas. The seaward seawall is considered here for the purpose. On the other extreme, in the case of continuously eroding sites there are lines of sea wall which are now in the sea. In such cases the landward seawall is taken. In order to facilitate the demarcation of HTL at seawall locations, the latter has to be clearly marked in the beach profile during coastal surveys.

c) ***Permanent Vegetation Line***

Permanent vegetation develops on the stable part of the beach. There are several locations along Kerala coast, which has only one berm and the beaches undergo severe erosion during the

monsoon, and yet not protected by seawalls. In such cases, permanent vegetation, particularly well grown coconut trees, which are the main vegetation species prevalent all along the coast, is used as an indicator. The part of the beach landward of monsoon berm crest, which is mostly stable, and the line of permanent vegetation normally follows the line of monsoon berm crest which is the HTL.

d) ***Coastal sand dune / paleo-aeolian dune***

Sand dunes are mounts, hills or ridges of sand that lies behind the part of the beach affected by tides. They are formed over many years when windblown sand is trapped by beach vegetation or other stationary objects. Sand dunes are habitat for coastal plants and animals. The size and morphology of coastal dunes is dependent on the complex interaction between controlling winds, sediment supply, and the geomorphology of the nearshore and beach environment. Mostly, dunes can be divided into those that form from the direct supply of sediment from the beach face (primary dunes), and those that form from the subsequent modification of primary dunes (secondary dunes). Sand dunes provides and storage and supply for adjacent beaches. They also protect inland areas from storm surges, hurricanes, floodwater, and wind and wave action that can damage property. Sand dunes support an array of organisms by providing nesting habitat for coastal bird species including migratory birds. The main secondary dunes include blowouts, parabolic dunes, and transgressive dune fields.

In Kerala, coastal inland areas have remnants of coast-parallel sand ridges manifesting the Holocene transgressive still stands of sea. North and Central Kerala coasts had such dispositions of strandlines of alternating ridges with swales. However, due to the demand of dense population in the coastal region and development activities, we could rarely see such raised dunes/ridges currently in Kerala except along the Pallikkara-Kanhangad coastal belt in the Kasaragod District. Another interesting feature witnessed is the foredunes bordering the beaches along most part of Kerala coast. They are seen in the backshore of the beaches as shadow dunes continuously being formed due to the sand blown out and trapped around any obstruction such as shrubs or grasses in the backshore.

e) ***Mangroves***

Mangroves are unique plant communities comprising of evergreen trees and shrubs

belonging to several unrelated families observed in tropical to subtropical intertidal regions, where constant tidal water exchange takes place. Mangrove ecosystem ecologically functions as a complex ecotone or interface zone between the terrestrial and marine ecosystems, exemplifying diverse habitats, including microhabitats, characteristic of terrestrial, intertidal and aquatic environs. As an invaluable ecological system and for reasons of its rich biodiversity, economic and social standing for sustenance and survival of community people, sustainability of sea food, and shore-line stability, conservation of mangroves is of paramount importance. They exhibit remarkable adaptation for salt tolerance with a spread of around 1 lakh sq.km world over distributed in about 30 countries. Mangroves in India account for about 5 percent of the world's mangrove vegetation and are spread over an area of about 4,800 sq.km along the coastal States/UTs of the country. The best development of mangroves in India is along the east coast with nearly 57% (~2750 sq.km) of the mangrove ecosystem of the country. Along the west coast of the country occur 23% (~1100sq.km) of the Indian mangroves and the remaining 20% is around the Andaman and Nicobar Islands (India). The east coast, unlike the west coast, is endowed with the largest mangrove wetlands developed on larger river deltas created by the major east flowing rivers of the country.

Kerala once in the 1950's was blessed with a large spread of about 700 sq.km mangroves but has been declined considerably to around 20 sq.km. All along the Kerala coast there are a good number of small mangroves stands, though mostly in isolated patches, fringing the estuaries and backwaters (kayals); and around islets or along river margins in the coastline stretches. Kerala with its very limited extent of mangroves is in no way free from the current trends of degradation of mangrove systems in the country. Mangrove systems in Kerala exhibited a higher grade of heterogeneity in their environmental settings and ecosystem features. Mangrove systems are one of the most threatened habitats in Kerala, as anywhere else in the country, or in the world. There is confusion about the actual/exact extent of mangrove distribution in Kerala in the absence of a precise estimate of it.

There are 15 true mangrove species and 49 mangrove associates observed in the coastal brackish water areas of Kerala. The 15 true mangrove species belonged to 9 genera spread over 7 families. The family, Rhizophoraceae is the most represented one with 6 species belonging to 3 genera. Mangrove associates are generally observed in the fringe areas where the wetland nature is devoid of any salinity. Species like *Acanthus ilicifolicus*, *Excoecariaagallocha*,

Aegicerascorniculatum, *Rhizophora mucronata*, *Sonneratiaapetalae*and *Acrostichumaureum*are were found in all the districts of Kerala, whereas *Rhizophora apiculata*is widely distributed in Kannur and Kollam districts but not found in Malappuram. *Avicennia officinalis* is one of the common species noticed in all the districts, however, this is not the case with *A. marina* which was not seen in Trivandrum and is one of the threatened mangrove species in Kerala. Out of four species belonging to the genus Bruguiera, B. cylindrica has relatively wide distribution, however, it is not recorded from in Kottayam district. *B. parviflora* has wide distribution in the northern parts of Kerala which is not present in Trivandrum, Kollam, Alappuzha and Kottayam. *Kandeliakandal*is also a rare species which is distributed in all districts except Trivandrum, so also *Sonneratiacaseolaris* which is found in five districts namely Trivandrum, Kollam, Alappuzha, Kannur and Kasargode, whereas *S. alba* is becoming endangered due to its small populations in the districts of Ernakulam, Kozhikode, Kannur and Kasargode. *Lumnitzeraracemosa*is one of the rarest mangrove species in Kerala found in four districts namely, Trivandrum, Kollam, Alappuzha and Kannur.

Sometimes, small creeks or pockets or far inland areas in the upriver vicinities or close to coastal waterways or canal works, harbour mangrove systems, which may apparently remain dry for considerable time, but remain intact-unless it is wantonly degraded by man-since the water table of area or site is generally just below surface. Both the fringe and the riverine mangroves have significant productivity status as they turn out high amount of organic matter. The wetland bays or pockets, of small or large areas, associated with them are affected by freshwater runoff from adjacent upland areas and rivers, as well as sediments and nutrients transported by the river inflows.

The mangroves and the mangrove wetland system, offer congenial habitats or home grounds for many and varied faunal communities, which remain well integrated in a natural web of food chains, right from the detritus feeders and primary consumers (herbivores) to secondary, or tertiary consumers (carnivores). The mangroves and the wetland system being located in, somewhat like, an isolated setting, comparatively much away from the human settlement areas, the ecosystem premises are amply used as the homing environs by a wide variety of animals, both invertebrates and vertebrates. Mangroves are seen along the mouths of the rivers joining the sea and also along the banks of the backwaters, especially at Bharathapuzha, Kadalundi, etc. Most of the mangrove areas are on private holdings which add to the unrestricted manipulation of this very characteristic formation with several ecological and biological functions. Characteristic mangrove species in the

formation are *Avicinea officinalis*, *A. marina, Excoercaria agallocha, Kandelina candel and Caralia brachiate*. Certain mangrove associates and several species of grasses and sedges constitute the vegetation type.

Malappuram district has mangrove systems of certain extent, predominantly of sporadic and sparse stands. The existing mangrove stands, about 2.4% of the total extent of mangroves in the state, are in varying stages of degradation, except at a few sites associated with the Kadalundi River in its coastal stretch. The mangrove stands in the coastal areas of Malappuram district, based on their order of geographical placement, mainly include Sparse mangroves in and around Bharatapuzha (Ponnani) estuary, including small mangrove patches of Tirurpuzha and the mangrove stands fringing Kadalundy River and its estuary. As per the ZSI report, the mudflats and the sand banks in the estuarine environs of the Bharathapuzh River-one of the largest west flowing rivers in Kerala, particularly in northern Kerala-have patchy remnants of mangroves. Such sparse vegetations are mostly found restricted to the sea mouth near Ponnani Port vicinities and Purathur area. The locales in and around the Vadickal Kadavu where the Tirurpuzha, a rivulet-tributary, joins Bharathapuzha also harbour moderate growth of mangrove patches. Mangroves associated with the Bharathapuzha estuary in and around the Ponnani, in general, portray a dismal picture of devastation exhibited at many sites with only sparse regenerating clumps of mangroves. Fair growth of this otherwise disrupted and degraded mangrove stands of this major river, are found along the river margins of the Tirurpuzha at Vadickal Kadavu and located in the premises of the very same rivulet near to the town area of Tirur. The important mangrove plants are *Avicennia officinalis, Excoecaria agallocha, Dolichandrone spathaceae, Derris trifoliata,* etc. A small patch of very old *Rhizophora mucronata* thrives well in the Vadickal Kadavu area.

The mangroves and the mangrove wetland system in and around Kadalundy, offer congenial habitats or home grounds for many and varied faunal communities, which remain well integrated in a natural web of food chains, right from the detritus feeders and primary consumers (herbivores) to secondary, or tertiary consumers (carnivores). The mangroves and the wetland system being located in, somewhat like, an isolated setting, comparatively much away from the human settlement areas, the ecosystem premises are amply used as the homing environs by a wide variety of animals, both invertebrates and vertebrates. Being at the boundary of Malappuram-Kozhikode districts, the area has a better distribution of mangrove stocks, and is third in position with considerable areal extent.

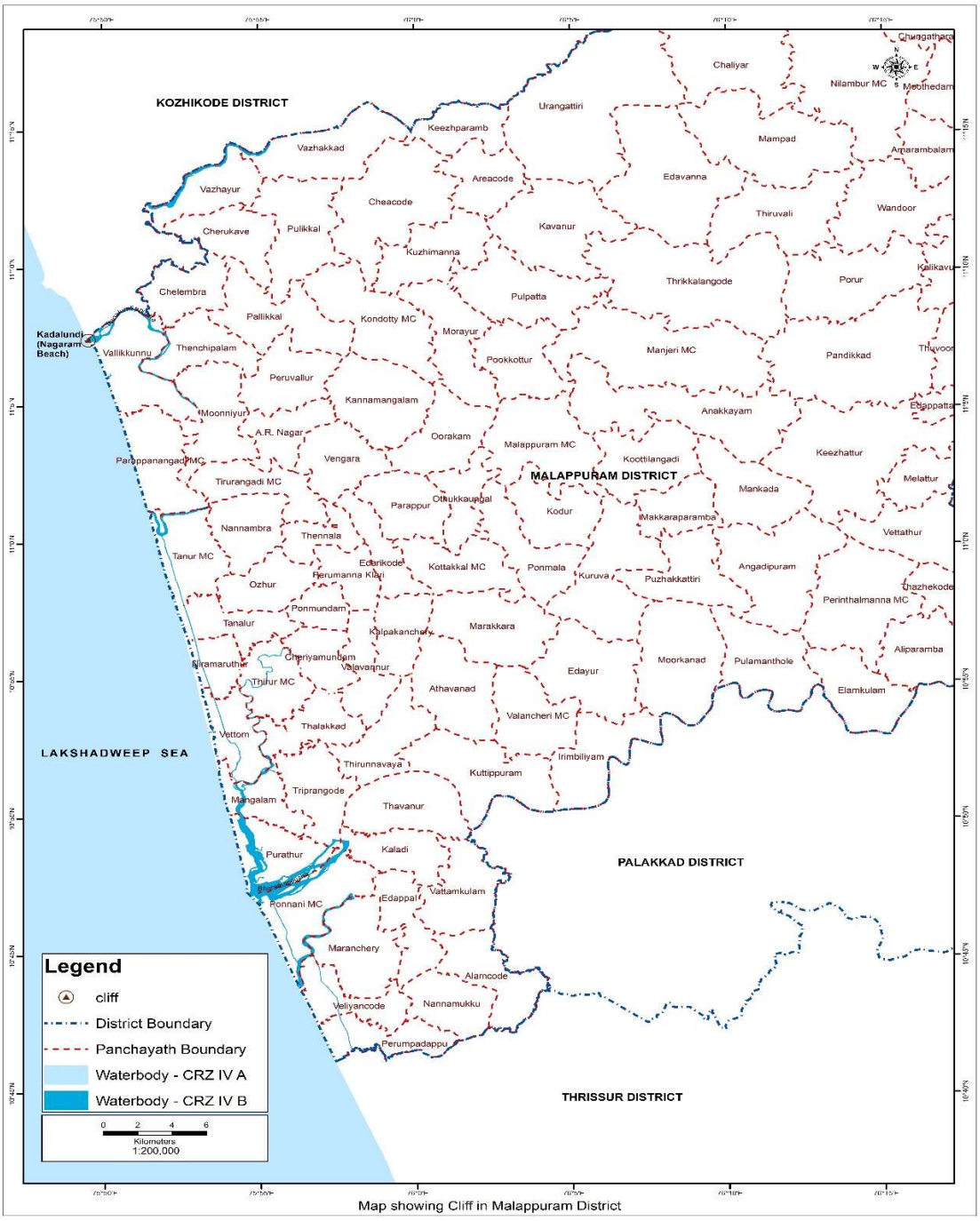
The stands are in varied configuration owing to the impacts of degradation. The wanton degradation of mangrove systems in this district portrays a picture that evokes the careless attitude and disregard for mangrove wealth. The mangrove depletion at many sites in the district has gone to the extent that the functional ecosystem role of those stands has been narrowing down, over the years, with its tell-tale implications on hydrological and biotic features. A good part of the mangrove systems is thriving very much in the developmental limits of the urban settings of the district; the existing mangrove patches within these areas are steadily and systematically being removed in the guise of developmental activities of the district. Mangrove vegetation of better growth is found along the upriver margins contiguous to the estuary, and also fringing around a few small islets, namely Balathuruth, Mannanmad, Neelattuthuruth, etc. The mangrove vegetation, however, does not exemplify the features of the healthy stand of mangroves, but mostly with wood shrubby thickets rendering an appearance indicative of the kind of degradation these mangrove patches have been undergoing due to the anthropogenic interferences. Although the mangrove plants comprise, primarily, of the species *Avicennia officinalis, A. marina, Bruguieracylindrica, Kandelia candel,* etc., assorted assemblages of other halophytic species, like *Rhizophora mucronata,* and non-halophytic species are also found along the river margins and around the islets. Small blocks of regenerating mangroves can also be seen on some of the prominent tidal flats formed in the estuary.

f) *Rocks, Headlands, Cliffs*

The 590km long Kerala coast is dotted in between by rocky promontories, headlands and steeply sloping cliffs. Except the coastal districts of Ernakulam and Alappuzha, all the other 7 districts have distribution of such rocks/headlands/cliffs to varied extent. At the rock outcrops, headlands and cliffs the water is quite deep that there is virtually no spatial displacement in the waterline. Hence, the High-Water Line available in the topographical maps (transferred to the base map) can be taken as such. However, at the eroding laterite cliffs (e.g., Varkala, Paravoor, Thalassery in Kerala), the latest position of the toe is taken from the cross section measured at the respective sites. This is to be verified against the satellite imagery and transferred to the base map.

The cliffs and rocky promontories are rare along the Malappuram coast except for the north end of the Vallikkunnu Panchayat, at the confluence of the Kadalundi River with the Lakshadweep Sea. The location is mostly exposed as low elevation laterite formation exposed by the beach with

nominal presence of sandy frontal beach during the fair-weather period. Wave cut notches in the laterite outcrops are visible at a few locations along the Vallikkunnu beach stretches. The following map (Figure 2) shows the location of the Vallikkunnu beach with outcrops of laterite.



Map showing Cliff in Malappuram District

Figure 2: Map showing the locations of coastal cliffs in Malappuram District

g) ***Influence of Tidal action***

CRZ shall apply to the land area between HTL to 50 meters or width of the creek, whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea. The tidal influenced water bodies as per the CRZ Notification 2019 means the water bodies influenced by tidal effects from sea in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds that are connected to the sea. The distance up to which CRZ is applicable shall be governed by the distance up to which the tidal effects are experienced which shall be determined based on salinity concentration of five parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced. As per the Office Memorandum dated 26th June, 2019 of the MoEFCC, guidelines were issued facilitating updation of CZMPs, according to which, the CZMP database prepared as per the CRZ Notification 2011 shall be used as the base for revision or updation of the CZMP, as per the provisions contained in the CRZ Notification, 2019. Therefore, the tidal effects as marked in the CZMP prepared as per the CRZ Notification 2011 forms the basis for the updation of the CZMP currently being prepared. The tidal limit of various tide influenced waterbodies of the Malappuram District is given in the table below in terms of location with latitude and longitude.

Table: Salinity/CRZ limit along the inland water bodies in Malappuram District

Sl. no	Name of Waterbody	Latitude	Longitude
1	Beypore River (Chaliyar)	11°14'34.79"N	75°55'20.91"E
2	Kadalundi River	11° 4'57.22"N	75°53'2.32"E
3	Purapparamba River	11° 1'17.35"N	75°53'2.05"E
4	Thirurpuzha	10°55'58.51"N	75°56'3.47"E
5	Bharathapuzha	10°49'12.24"N	75°57'33.35"E
6	Kanjiramukku River	10°47'7.27"N	75°57'58.94"E

4.2. Demarcation of Ecologically Sensitive Areas

Guidelines for preparation of the CZMP specifies that the CZM maps shall clearly demarcate the land use plan of the area and map out the Ecologically Sensitive Areas (ESAs) or the CRZ-IA areas as per mapping made available by NCSCM to coastal State and Union territories. Coastal ecosystems provide a variety of ecosystem services for humans; however, these systems are susceptible to both terrestrial and marine factors because they are situated in the coastal ecotone. Consequently, coastal marine ecosystems are very sensitive to environmental change and human activities. Constructions for coastal development are still often located in sensitive biological and ecological areas without much consideration of their impact. In this context, the CRZ Notification 2019 provides provisions to achieve coordinated development of the population, economy, and environment in the coastal area. Ecological sensitivity refers to the degree of reflection of ecosystem interference in human activities and changes to the natural environment; that is, the degree to which the ecosystem responds to environmental changes caused by the combination of internal and external factors. Through identifying such sensitive areas, conservation and management strategies could be developed that facilitate the sustainable use of coastal resources.

The different ecologically sensitive areas as listed in the CRZ Notification 2019 have been assimilated from the previously approved CZMP maps as directed through the guidelines and further the changes occurred till recently has been captured using high resolution satellite data. The same has been field verified for accuracy assessment wherever required.

5. ECOLOGICALLY SENSITIVE AREAS/COASTAL LANDUSE

5.1. Mangroves

In Malappuram district, considerable extent of mangroves in the coastal belt has been degraded or depleted by the resultant causes of environmental impacts from the consequences of extensive drainage programmes like irrigation/hydro projects at the upstream areas of the Bharathapuzha River system, affecting the runoff potential and periodicity of the inflow waters reaching the coastal zone in a highly insufficient and erratic rate. The coastal-zone degradation process like excessive extraction of sand deposits from the riverbed and sandy-beach areas all along

the coasts of these districts have further posed threats to the prevalence and perpetuity of this unique ecosystem.

Malappuram district occupies very less extent of mangroves compared to its counterparts in the northern districts of Kerala. Kadalundi, Kerala's first community reserve is endowed with relatively good patches of mangroves, however, Pulluni of Thirur, Murukummadu, Kootaikadavu are few places where relatively good patches of mangroves are found. However, Pulluni mangroves face acute threat from developmental activities. Pulluni of Thirur, Malappuram district is facing destruction as good patches of mangroves along with an endangered species, *Bruguiera sexangula.*

Distribution of mangroves in Malappuram district is depicted in the map given in the Map - 4 of Annexure-I. The total extent of mangroves in Malappuram district is 0.640991 Km^2, which is relatively less while comparing with some of the coastal districts in Kerala. Among the local bodies, Vallikkunnu Panchayat tops the list with the presence of 0.177433 Km^2 of mangrove, mainly due to the mangroves in the Kadalundi River as the district share part of the Mangrove Community Reserve. The Mangalam Panchayat has got considerable extent of mangroves (0.115124 Km^2). Among the Municipalities, Tirur tops the list with 0.056122 Km^2 followed by Tanur Municipality (0.031225 Km^2). Except for the nominal presence of mangroves in Ponnani Municipality (0.016701 Km^2), Tirurangadi and Parappanangadi Municipalities do not have any traces of mangroves. Among the 18 Panchayaths within the CRZ limit, half of them (8 nos.) do not have any traces of mangroves. (Detailed table is annexed in Annexure 2).

5.2. Coral Reefs

Coral Reefs locations have not been reported from the Malappuram coast.

5.3. Reserve Forests

Reserve Forests have not been reported from the Malappuram coast.

5.4. Sand Dunes

Sand dune locations have not been reported from the Malappuram coast.

5.5. Salt marsh

Salt marsh locations have not been reported from the Malappuram coast.

5.6. Nesting Ground of Birds

Nesting ground of bird's have not been reported from the Malappuram coast.

5.7. Archaeologically important and Heritage Sites

An archaeological site is a place (or group of physical sites) in which evidence of past activity is preserved (either prehistoric or historic or contemporary). Archaeological sites are open museums for living history. Heritage is a broad concept that includes the natural as well as the cultural environment. It encompasses landscapes, historic places, sites and built environments, as well as biodiversity, collections, past and continuing cultural practices, knowledge and living experiences. The prime concern of Conservation, Preservation and Maintenance of ancient monuments and archaeological sites along the coastal region remains one of the objectives of the CRZ Notification.

In Malappuram district, there are no such archaeological/heritage sites within the purview of CRZ area.

5.8. Seagrass

Seagrass locations have not been reported from the Malappuram coast.

5.9. Mud flats

Mud flats locations have not been reported from the Malappuram coast.

5.10. Turtle Nesting Grounds

The coastal stretches along the Alungal beach are identified as turtle nesting locations, though the local information confirms that turtles do not appear regularly during nesting period of November and December every year. Total area of turtle nesting is around 0.092491 Km^2. Parappanangadi Municipality tops the list with 0.077033 Km^2 spread of turtle nesting ground,

followed by Vallikkunnu Grama panchayat with 0.015458 Km^2.

5.11. Inter-Tidal Zone

Tides play very important role in determining the biodiversity of and fertility of coastal and estuarine ecosystems. Intertidal zone is the area between the high tide (HTL) and low tide lines (LTL) as per the CRZ Notification. Intertidal zone exists wherever the tidal effects are experienced. The intertidal zone is an ecosystem where a multitude of organisms living on the shore/banks survive changes between high and low tides. The tidal ranges are low in the southern side of the west coast of India and as we move northward, its amplitude increases. At Kochi, the ranges are of the order of 1m. The tidal range increases northward and reaches to more than 2m at Marmagao. At Mumbai, maximum ranges in tidal elevations are of about 5 m. Kerala coast being microtidal in nature with tidal amplitude around 1m with slight increase from south to north, the extent of intertidal area by the sea and inland water bodies are limited.

In the case of Malappuram district, intertidal area within the CRZ-IB category is 5.223642 Km^2 (provided in the Table in the Annexure-2). This includes intertidal zones by the coast as well as by the tidal influenced water bodies. Among Panchayats, Purathur tops the list with 1.424771 Km^2 spread of intertidal area, whereas among the urban local bodies, Ponnani Municipality tops the list with 1.316674 Km^2. Except Vazhakkad Panchayat, all other local bodies have varying spread intertidal areas. (Detailed table is annexed in Annexure 2).

5.12. Salt pan / Aquaculture ponds

There is no specific category of aquaculture ponds in Malappuram district, even if present are mostly classified under the intertidal areas (CRZ IB) or as CRZ IVB due to their seasonal or inconsistent use. The same sort of categorization adopted in the approved CZMP of 2011 is being followed in the updation process.

6. METHODOLOGY FOR PREPARATION OF CZMP

As outlined in the Annexure-IV, preparation of the CZMP has been undertaken in 1:25000 scale using the base grids of the Survey of India (SOI) topographic sheets. Wherever 1:25000 scaled

toposheets are not available, the 1:50000 SOI toposheets were enlarged accordingly to compose the base maps. The base maps were georeferenced as per the datum and projections specified in the guidelines. The cadastral maps of the villages (1:3960 or nearest scales as per availability) likely to be within the purview of CRZ have been appropriately georeferenced to maintain the horizontal accuracy required. To minimize the RMS error during the georeferencing, maximum number of control points were obtained from the field using GPS (combination of methods using long static DGPS, short static DGPS and RTK obtaining acceptable precision resolving ambiguities in the post-processing techniques) to define the location in terms of latitude and longitude geodetic points in DMS format with second decimal accuracy in seconds (X & Y as cartesian coordinates with submeter accuracy). Wherever, disparity has been noticed in the hardcopy scanned cadastral image, georeferencing has been done by seeding maximum control points adjusting with the physical signatures discernible on the high-resolution satellite image which has been used as a reference image.

6.1. Field mapping and map preparation

The field mapping has been performed with hard copy of the georeferenced cadastral sheets to match the mapping scale with the ground space distance. Hard copy of the satellite images to a matchable scale has also been printed out to refer simultaneously during the field survey which comes handy in matching with the co-locatable ground features. The field surveying becomes confident with the combination of both cadastral and satellite images as well as with tying up the coordinates obtained from the GPS. All the essential features and lines are captured using the GPS by tagging attributes while carrying out the field work so that it becomes easy collate the information into maps without any confusion or missing. The guidelines issued subsequent to the notification specifically clarifies that HTL, LTL, ESAs and Critically Vulnerable Coastal Areas (CVCAs) demarcated by the NCSCM, Chennai, and the Hazard Line as demarcated by the SOI, shall be used in preparation/updation of the CZMPs as required under the provisions of the CRZ Notification, 2019.

Timeline satellite images were verified for any considerable change in the HTL/LTL/ESAs. Significant changes in the terms of the reduction or increase of mangroves have been noticed at several places in the State, which has been verified in the field intensively. Based on the ground

condition, the variations in the extent of mangroves as well as the changes in HTL/LTL has been marked using the GPS tracking *in situ*. Apart from digesting the changes in the CZMP, separate table has been created to mark the changes at each location for scrutinizing the same at the vetting stage.

7. CRZ CLASSIFICATION

The CRZ Notification 2019 has classified the CRZ area in the following manner for the purpose of conserving and protecting the coastal areas and marine waters.

7.1. CRZ-1

CRZ-1 areas are environmentally most critical and are further classified as under:

7.1.1. CRZ-1 A

CRZ-1 A shall constitute the following ecologically sensitive areas (ESAs) and the geomorphological features which play a role in maintaining the integrity of the coast viz.:

(i) Mangroves (in case mangrove area is more than 1000 square meters, a buffer of 50 meters along the mangroves shall be provided and such area shall also constitute CRZ–IA).
(ii) Corals and coral reefs.
(iii) Sand dunes.
(iv) Biologically active mudflats.
(v) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wildlife (Protection) Act, 1972 (53 of 1972), Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 0f 1986), including Biosphere Reserves.
(vi) Salt marshes.
(vii) Turtle nesting grounds.
(viii) Horseshoe crabs' habitats.
(ix) Sea grass beds.
(x) Nesting grounds of birds.

(xi) Areas or structures of archaeological importance and heritage sites.

7.1.2. CRZ-I B

The intertidal zone i.e., the area between the Low Tide Line and High Tide Line constitutes the CRZ-I B.

7.2. CRZ-II

CRZ-II constitutes the developed land areas up to or close to the shoreline, within the existing municipal limits or in other existing legally designated urban areas, which are substantially built-up with a ratio of built-up plots to that of total plots being more than 50 per cent and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply, sewerage mains, etc.

7.3. CRZ-III

Land areas that are relatively undisturbed (viz. rural areas, etc.) and those which do not fall under CRZ-II, shall constitute CRZ–III and CRZ-III shall be further classified into following categories:

7.3.1. CRZ-III A

Such densely populated CRZ-III areas, where the population density is more than 2161 per square kilometer as per 2011 census base, shall be designated as CRZ–III A and in CRZ-III A, area up to 50 meters from the HTL on the landward side shall be earmarked as the 'No Development Zone (NDZ)', provided the CZMP as per this notification, framed with due consultative process, have been approved, failing which, a NDZ of 200 meters shall continue to apply.

7.3.2. CRZ-III B

All other CRZ-III areas with population density of less than 2161 per square kilometer, as per 2011census base, shall be designated as CRZ-III B and in CRZ-III B, the area up to 200 meters from the HTL on the landward side shall be earmarked as the 'No Development Zone (NDZ)'.

7.4. CRZ-IV

The CRZ- IV constitutes the water area and shall be further classified as under: -

7.4.1. CRZ- IVA

The water area and the seabed area between the Low Tide Line up to twelve nautical miles on the seaward side shall constitute CRZ-IV A.

7.4.2. CRZ- IVB

CRZ-IV B areas shall include the water area and the bed area between LTL at the bank of the tidal influenced water body to the LTL on the opposite side of the bank, extending from the mouth of the water body at the sea up to the influence of tide, i.e., salinity of five parts per thousand (ppt) during the driest season of the year.

7.5. Regulation limits/lines

The CRZ limits has been revised or updated as per the provisions contained in the CRZ Notification 2019. The 50 meters No Development Zone (NDZ) in the case of CRZ-III areas/ a 50 meters buffer line (CRZ limit) in the case of CRZ-II areas or the width of the creeks that are influenced by tidal from sea in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds. have been drawn. The landward extent of NDZ/Buffer by the creek is up to the location where the salinity limit of 5 part per thousand is encountered.

By the seacoast, a 500-meter line from HTL is drawn as CRZ limit irrespective of whether the area is under CRZ-III or CRZ-II. As per the CRZ Notification 2019, a new sub-category of CRZ-IIIA by the coast is introduced, where the NDZ is limited to 50 meters and the same has been updated. Similarly, as in the previous CZMP, the 200-meter line of NDZ by the seacoast has been drawn for the CRZ-IIIB areas.

The NDZ of the islands in the coastal backwaters as well as islands along the mainland coast has been limited to 20 meters, the same has been updated in the CZMP being prepared according to the CRZ Notification 2019, but it will be implemented only after the approval of IIMP of the

particular Island.

Subject to the information to be provided by the State Government on the details of village-wise survey numbers pertaining to government land for deciding/enabling ease in demarcation of buffers around mangrove areas, a uniform buffer of 50 meters have been demarcated in case of mangrove area being more than 1000 square meters. The ownership details of Mangroves more than 1000sq.m spread area provided by Govt. of Kerala is provided in the **Annexure 4**.

7.6. CVCA and IIMP

Critically Vulnerable Coastal Areas (CVCA)

Sundarban region of West Bengal and other ecologically sensitive areas identified as under Environment (Protection) Act, 1986 such as Gulf of Khambat and Gulf of Kutchh in Gujarat, Malvan, Achra-Ratnagiri in Maharashtra, Karwar and Coondapur in Karnataka, Vembanad in Kerala, Gulf of Mannar in Tamil Nadu, Bhaitarkanika in Odisha, Coringa, East Godavari and Krishna in Andhra Pradesh shall be treated as Critical Vulnerable Coastal Areas (CVCA) and managed with the involvement of coastal communities including fisher folk who depend on coastal resources for their sustainable livelihood.

No CVCA is marked in the Malappuram district and in Kerala, except certain parts around Vembanad Lake, no other areas have been marked as CVCA by the NCSCM.

Integrated Island Management Plan (IIMP)

The islands demarcated in Malappuram district as mainland coast islands and inland islands in the coastal backwaters need to have Integrated Island Management Plans (IIMPs), as applicable to smaller islands in Lakshadweep and Andaman & Nicobar, as per Island Protection Zone Notification, 2011 number S.O. 20(E), dated the 6th January, 2011 to be formulated by the Kerala State. This would be carried out with the help of NCSCM, once all such islands marked in this CZMP are approved by the Ministry of Environment, Forest and Climate Change. There are forty-four number of backwater islands are present in Malappuram district. The islands are buffered with 50 m or width of the creek whichever is less and 20m CRZ line landward of HTL is also depicted in the

map which will be considered only after IIMP is implemented. The dimensions of backwater islands show wide variation in the district, ranging area from <0.000195 Km^2 (An Island in Veliyancode) to 0.161261 Km^2 (An Island in Kadalundi in Vallikkunnu Panchayath). All together the area of islands in the district accounts for 0.903973 km^2 (Detailed table is annexed in Annexure 2).

8. HAZARD LINE

A 'Hazard line' has been demarcated by the Survey of India (SOI) taking into account the extent of the flooding on the land area due to water level fluctuations, sea level rise and shoreline changes (erosion or accretion) occurring over a period of time. The hazard line mapped by SOI has been shared by NCSCM as part of the previous CZMP prepared. The hazard line is to be used as a tool for disaster management plan for the coastal environment, including planning of adaptive and mitigation measures. With a view to reduce the vulnerability of the coastal communities and ensuring sustainable livelihood, while drawing the CZMP, the land use planning for the area between the Hazard line and HTL need to be take into account as such impacts of climate change and shoreline changes.

9. CRZ CATEGORIES OF MALAPPURAM DISTRICT

The CRZ of the Malappuram district consists of CRZ-IA, CRZ-IB, CRZ-II, CRZ-IIIA, CRZ-IIIB, CRZ-IVA and CRZ-IVB. Altogether 23 local bodies are covered under the CRZ area of which 18 are Grama Panchayaths out of which 4 are classified as 'other legally designated Urban areas' and 5 are Municipalities. Altogether 28 villages are under the purview of CRZ in Malappuram District. The details are provided in the table annexed (Annexure-2).

The new village and panchayat boundaries provided by KCZMA, obtained from Survey and Land Records does not match with the survey plots and district boundaries in the approved CZMP, 2011. Hence old boundaries (approved CZMP, 2011) are used for this exercise, as per the instruction from DoECC, Govt. of Kerala.

CRZ categories and ESAs (Panchayat/Village-wise) in Malappuram District

A detailed table is annexed (Annexure-2) along with this report separately on the

Panchayath/Village-wise statistics of HTL, ESAs, intertidal area, mangrove buffer, area covered under each CRZ category.

10. CONCLUSION

Statistics of the CRZ status of Malappuram District is summarized below:	
Total length of HTL along the Seacoast	50.40 Km
Total length of HTL along the inland water bodies	270.73 Km
Total Area under the Archeological/Historical sites	NIL
Total Area under the Turtle Nesting Sites	0.092491 Km^2
Total area under mangrove extent	0.640991 Km^2
Total area under mangrove buffer	0.81135 Km^2
Total area under intertidal zone (CRZ-IB)	5.223642 Km^2
Total area under CRZ-II along the Seacoast	10.1432 Km^2
Total area under CRZ-II along the inland water bodies	3.570172 Km^2
Total area in No Development Zone in CRZ-III along Seacoast	3.50 Km^2
Total area in No Development Zone in CRZ-III along water bodes	5.211692 Km^2
Total area in CRZ-IIIA along the coast between 50-500 meters	5.192387 Km^2
Total area in CRZ-IIIB along the coast between 200-500 meters	3.992965 Km^2
Total area under the CRZ-IVB category	15.067392 Km^2