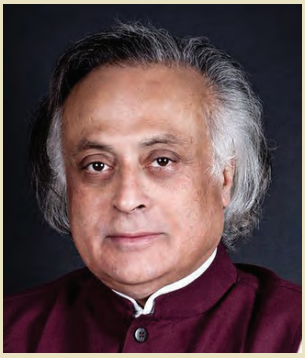
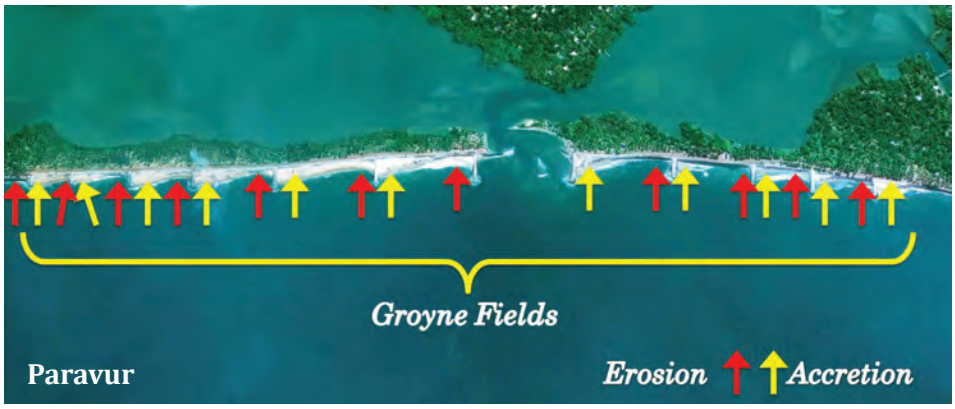
SHORELINE CHANGE ASSESSMENT FOR KERALA COAST



Shri. Jairam Ramesh
Hon'ble Union Minister of Environment and Forests

Complex and diverse types of natural processes that occur on the coastal zone bring in physical, chemical, and biological changes to the fragile coastlines. The coastline of India is undergoing changes due to several human interventions. Most of the shoreline changes are on account of the structures which have been constructed along the foreshore of the country's coast. Several of these developments are not compatible with the dynamic nature of the shoreline. Because of these factors, it has become imperative to identify areas subject to both long- and short-term erosion, since in most cases, rates of erosion have enhanced during the past decade. The Ministry of Environment and Forests is mapping the coastline to enhance the India's preparedness to face sea hazards like storm surge and Tsunami.

The National Assessment of Shoreline Change for Gujarat, Puducherry and Odisha has already been released by the Hon'ble Union Minister of Environment and Forests, Shri. Jairam Ramesh. The shoreline change maps for the coast of Kerala is being released and the major highlights are provided in this fact sheet.



Coastal erosion becomes a hazard where human activity is threatened by a temporary or permanent hold back of the shoreline. Coastal accretion is the opposite, where the shoreline builds over time. Shorelines and coastal processes are not restricted by administrative borders, and constantly change in response to wind, waves, tides, sea level fluctuation, seasonal and climatic variation, human alteration, and other factors that influence the movement of sand and material within a shoreline system. The loss (***erosion***) and gain (***accretion***) of coastal land is a visible result of the way shorelines are reshaped in the face of these dynamic conditions.

Shorelines change seasonally, tending to accrete slowly during the summer months when sediments are deposited by relatively low energy waves and erode dramatically during the winter when sediments are moved offshore by high energy storm waves. In addition, attempting to halt natural coastal process with seawalls and other hard structures

Kerala - Facts & Figures

Latitude	10° 00' N
Longitude	76° 25' E
Area	38863 km^2
Kerala State Population	33,387,677
Population Density	859/km^2
Length of Coastline (km)	580 km
Population in Coastal Districts	9,397,625
Area of Coastal Districts	22418 km^2
Average Population Density in Coastal Districts	2022/ km^2 (2001 Census)
Total number of rivers in Kerala	44
West Flowing	41
East Flowing	3
Longest River	Periyar
Longest Backwater Lake	Vembanad

only shifts the problem, subjecting downdrift coastal areas to similar losses. Also, without the sediment transport, some of the beaches, dunes, barrier beaches, salt marshes, and estuaries—are threatened and would disappear as the sand sources that feed and sustain them are eliminated.

As populations continue to grow and community infrastructures are threatened by coastal erosion, there is increased demand for accurate information regarding past and present trends and rates of shoreline movement. There is also a need for a comprehensive analysis of shoreline movement that is consistent from one coastal region to another. In order to correctly interpret shoreline change, all shoreline data were analyzed and evaluated in light of current shoreline conditions, recent changes in shoreline uses, and the affects of human-induced alterations to natural shoreline movements. In areas that show shoreline change reversals (i.e., where the shoreline fluctuates between erosion and accretion) or areas that have been extensively altered by human activities, knowledge of natural and human impacts are typically required for proper interpretation.

The coastline of the state of Kerala is ~590km long and consists of nine coastal districts. The southern tip of Kerala coast borders the state of Tamil Nadu and the northern end connects to the state of Karnataka.

SHORELINE CHANGE ASSESSMENT OF KERALA

The shoreline change assessment of Kerala Coast represents long-term shoreline change for a period of 38 years from 1972-2010. Shoreline change evaluations are based on comparing five historical shorelines extracted from satellite imageries for the above time period, with recent shoreline derived from Landsat - 5 for the years 1990, 2000 and 2006 and LISS III images (for 2010) including limited field surveys. For the coast of Kerala, base maps were prepared on 1:50,000 scale using the toposheet of the Survey of India. Onscreen digitization of coastline was made using various satellite imageries on 1:50,000 scale and stored as different layers in GIS environment for the years 1990, 2000, 2006 and 2010. Depending on location and data source, different proxies for shoreline position were used to document coastal change, including high water line, wet-dry line, vegetation line, dune toe or crest, toe or berm of the beach, cliff base or top, and the instantaneous water line as extracted from satellite imagery. These multi-date shorelines served as input into the USGS Digital Shoreline Analysis System ('DSAS') software to cast various transects along the coast of Kerala. A distance of 500m intervals from the baseline was assigned to calculate the erosion/ accretion statistics in ArcGIS 9.3 software. The results obtained were categorized into eight classes of **"Zones of erosion/ accretion"** as follows:

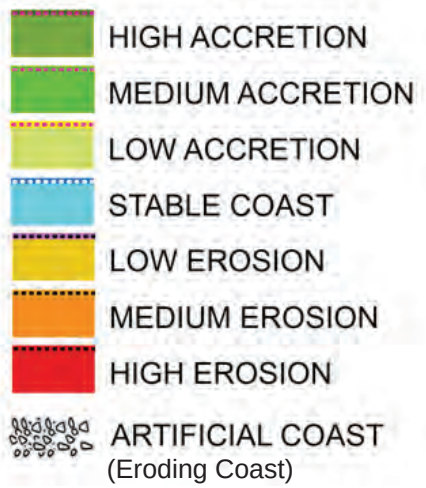
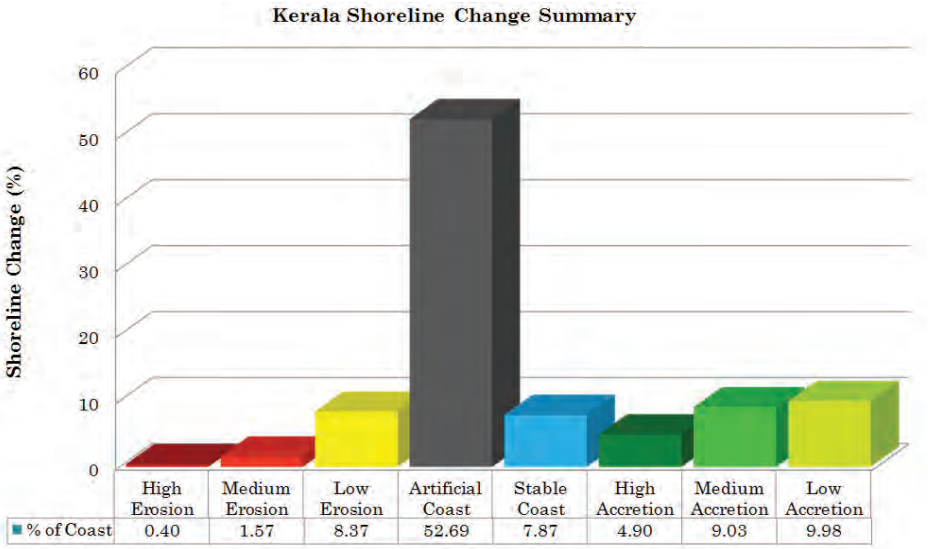


Table 1: Shoreline Characteristics and Statistics for Kerala Coast

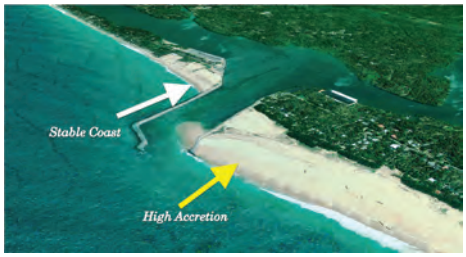
Classification of Coast	Extent (km)	Percent of Coast	Cumulative %
Length of Coastline	587.8		
High Erosion Zone	2.3	0.40	
Medium Erosion Zone	9.2	1.57	
Low Erosion Zone	49.2	8.37	
Artificial Coast: (Eroding Coast)	309.7	52.69	**63.02**[#]
Stable Coast	46.3	7.87	**7.87**[$]
High Accretion Zone	28.8	4.90	
Medium Accretion Zone	53.1	9.03	
Low Accretion Zone	58.69	9.98	**23.92**
Rocky Coast	30.5	5.18	5.18
Number of Ports	17		
Number of Harbours	11		
Number of Fish Landing Centres	90		
Number of Groynes	106		
Number of Breakwaters	25		

[#](Sum of High erosion + Medium erosion + Low erosion + Artificial Coast)
[$](Sum of High accretion + Medium accretion+ Low accretion)

Fig. 1: Overall Erosion/ Accretion Pattern along the Kerala coast



Vizhinjam Harbour



Peramatura Harbour

Kappil

Thalassery Fishing Harbour

Table 2: Erosion/ accretion characteristics near Ports

Coastal Districts of Kerala	Ports	South	North
Thiruvananthapuram	Vizhinjam	Low Erosion	Artificial Coast
	Valiathura	Artificial Coast	Artificial Coast
Kollam	Sakthikulanga	Artificial Coast	Artificial Coast
	Kollam Harbour	Artificial Coast	Artificial Coast
Alappuzha	Nil		
Ernakulam	Cochin	Artificial Coast	High Accretion
	Munambam - Kodungallor	Artificial Coast	Medium Accretion
Thrissur	Nil		
Malappuram	Nil		
Kozhikode	Beypore	High Accretion	Artificial Coast
	Vadakara	Low Accretion	Stable Coast
Kannur	Thalassery	Artificial Coast	Artificial Coast
	Mapilla Fishing Harbor	Artificial Coast	Artificial Coast
Kasaragod	Nil		

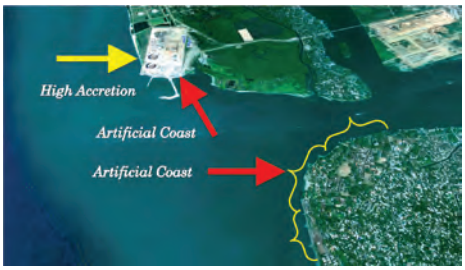
Major Port Intermediate Port Minor Port

Table 3: Erosion/ accretion characteristics near river mouths

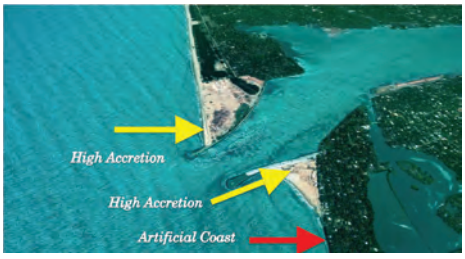
Coastal Districts of Kerala	Rivers draining into Arabian Sea	South	North
Thiruvananthapuram	Neyyar River	Low Erosion	Low Erosion
	Panathura River	Artificial Coast	High Erosion
Kollam	Nil		
Alappuzha	Nil		
Ernakulam	Nil		
Thrissur	Periyar River	Artificial Coast	Artificial Coast
Malappuram	Bharathapuzha River/Ponnani River	Low Erosion	Low Accretion
Kozhikode	Murat River	Low Erosion	Artificial Coast
	Korapuzha/ Anelapuzha	Low Erosion	Low Erosion
	Chaliyar River	High Accretion	Artificial Coast
	Kadalundi River	Artificial Coast	Artificial Coast
Kannur	Mahe River	Stable Coast	Artificial Coast
	Anjarakandi Puzha	Artificial Coast	Artificial Coast
	Dharmadam Puzha/Tellichery River	Artificial Coast	Artificial Coast
Kasaragod	Karingode River	Low Accretion	Low Erosion
	Chittari River	Low Erosion	Low Erosion
	Chandragiri River	Low Erosion	Low Accretion
	Mogral River	Low Accretion	Stable Coast
	Uppala River	Low Accretion	Stable Coast

Neendakara Harbour

Kollam Fishing Harbour

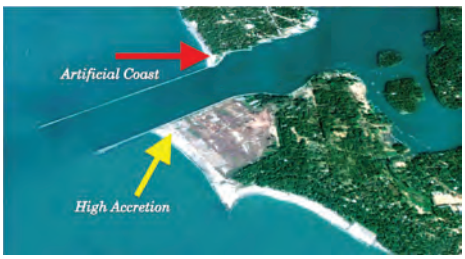


Cochin Harbour



Periyar River

Ponnani Port



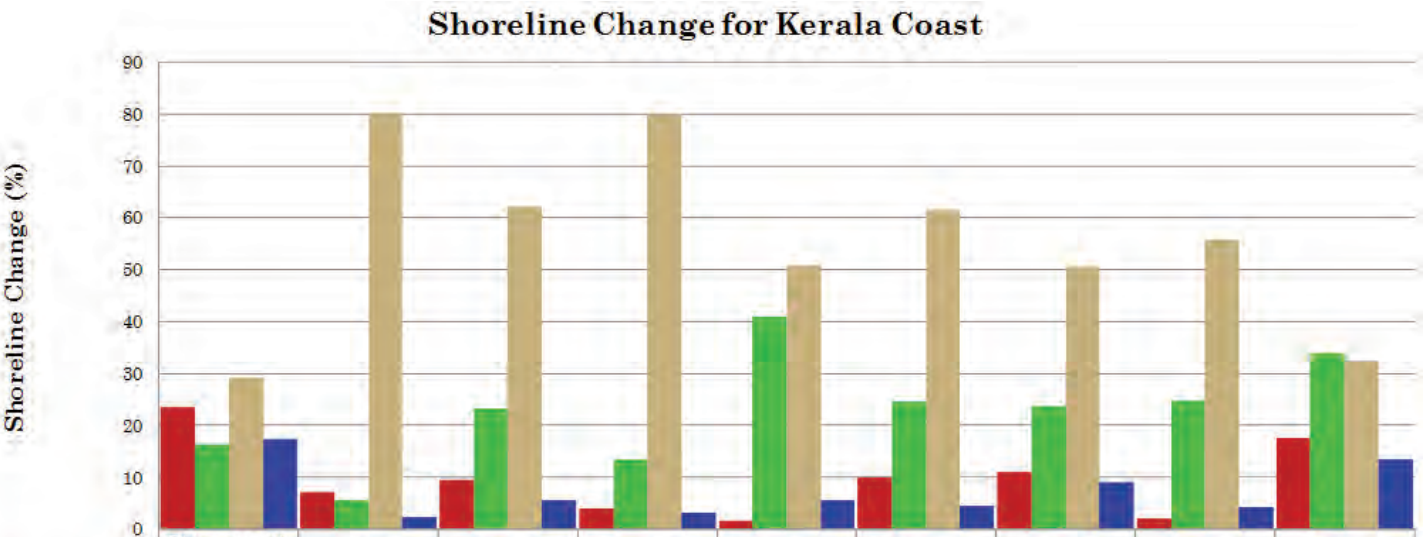
Baypore

Along the Kerala coast, eroding areas (sum of high+medium+low erosion) account for 10.3%. Seawalls and/or riprap revetments / groynes have been constructed in as much as 310 km of the coastal stretch of Kerala to protect coastal infrastructure from erosion and these areas have been classified as 'Artificial Coast'. It is evident that nearly 53% of the Kerala coast is classified under this category. These 'artificial coasts' are essentially eroding coasts and is managed by structures. It is therefore only appropriate to consider "artificial coasts" as eroding coasts. Thus, the overall erosion characteristics of the Kerala coast is 63.02% (sum of high+medium+low erosion+artificial coast). This indicates that only 37% of Kerala's coast is "natural" (no intervention). Of this, accretion is dominant along 24% of the coast, particularly in the Ernakulam District, which has an intricate network of backwaters (Vembanad Lake). Sum of high, medium and low erosion on the natural coastline of Kerala is 10% and 8% is stable coast.

District-wise erosion/ accretion characteristics

There are nine coastal districts in Kerala, which have key infrastructure facilities such as Ports and Harbours and the intricate network of backwaters and wetlands along the coast. District-wise statistics indicate that erosion is dominant in all the coastal districts of Kerala (Fig. 2), with minimum erosion at Thrissur District (1.5%) and the maximum at Thiruvananthapuram (23%). Artificial coasts are dominant at Kollam and Ernakulam (80%). Maximum accretion occurs at Thissur (41%) and the minimum at Kollam (5.5%). It is possible therefore to correlate high accretion to less artificially managed coasts and vice versa. Stable coasts are more prevalent along the coast of Thiruvananthapuram (17%). Tables 3 and 4 provide details of shoreline change dynamics observed near ports and harbours and at river mouths.

Fig. 2: District-wise erosion/ accretion characteristics of Kerala coast



	Thiruvananthapuram	Kollam	Alappuzha	Ernakulam	Thrissur	Malappuram	Kozhikode	Kannur	Kasargode
Erosion	23.33	6.89	9.30	3.83	1.46	9.78	10.96	1.95	17.49
Accretion	16.08	5.47	23.19	13.39	40.84	24.51	23.68	24.66	33.84
Artificial Coast	29.06	79.92	61.98	79.74	50.67	61.31	50.41	55.71	32.34
Stable Coast	17.17	2.12	5.53	3.04	5.41	4.40	8.90	4.09	13.26

In summary, this assessment indicates that the a major stretch of Kerala's coastline (~63%) is eroding (including artificial coast). Based on the above information and data it is advised that proper precautions be taken prior to erecting any further structures along the eroding and vulnerable coastal stretches of Kerala.

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COOPERATING ORGANIZATIONS

National Centre for Sustainable Coastal Management [NCSCM], Chennai
Society of Integrated Coastal Management [SICOM], New Delhi
Institute for Ocean Management, Anna University, Chennai & ENVIS - COAST

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This fact sheet is also available online at http://www.ncscm.org

Padinar Harbour
Kasaragod
Kannur
Azhikka Port
Mappila Bay Fishing Harbour
Darmadam Fishing Harbour
Vadakara Fishing Harbour
Kozhikode
Fishing Harbour at Puthiyappa
Beypore
Malappuram
Thrissur
Ernakulam
Cochin Port
Vembanad Lake
Alappuzha
Neendakara Harbour
Kollam
Thiruvananthapuram
Valiyathura Port
Vizhinjam Harbour
ARABIAN SEA

Legend

RATE OF EROSION & ACCRETION

- HIGH EROSION
- MEDIUM EROSION
- LOW EROSION
- NO CHANGE
- LOW ACCRETION
- MEDIUM ACCRETION
- HIGH ACCRETION
- ARTIFICIAL COAST(Eroding Coast)
- SEAWALL