



# YOJANA

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## Indian Maritime



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Paradigm of Coastal Security  
By Rakesh Kapoor

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## Looking Seaward

India has a vast coastline stretching over 3000 kilometers from near 7000 offshore islands that bring boundless challenges and opportunities. It provides deep waters where major ports are situated or under construction as well as vegetation. It also many sources of commercial value and business with the outside world. Securing these water borne economic drivers and protecting India's coastlines is of great importance particularly in the geopolitical and strategic interests of India in the Indian Ocean region. The continuous increase in marine pollution coupled with the territorial integrity of India against sea-borne intruders and maritime smuggling will be a major challenge. The Indian Navy has to maintain its war-fighting capability and effectively combat all threats.

Even the focus on protecting the waterways and the coastal areas against the increasing illegal activity will continue more stringently and effectively in the future. The technological development of our ships and aircraft will be a major factor in this regard. The growth of naval and maritime security requires a broad-based approach involving the various branches of the Indian Navy and the Indian Coast Guard. Securing the coastlines of India is a collective effort of the Indian Armed Forces, the Ministry of Home Affairs, the Central Maritime Security Agency, the State Maritime Administrations, the Indian Coast Guard, the Indian Navy, and the Indian Air Force. The Indian Navy has to maintain its war-fighting capability and effectively combat all threats. The Indian Navy has to maintain its war-fighting capability and effectively combat all threats.

With the expansion of population and the development of the coastal economy, there are likely to be more conflicts and disputes between the various states, which will affect their maritime trade and marine resources. The Indian Navy has to maintain its war-fighting capability and effectively combat all threats. The Indian Navy has to maintain its war-fighting capability and effectively combat all threats. The Indian Navy has to maintain its war-fighting capability and effectively combat all threats. The Indian Navy has to maintain its war-fighting capability and effectively combat all threats. The Indian Navy has to maintain its war-fighting capability and effectively combat all threats.



India's maritime economy is rapidly expanding, making the Indian Navy's role critical in ensuring safe and secure shipping lanes.

# Paradigm of Coastal Security

*R Ranjan*

The security of the coastline in India was in existence in the rudimentary form before the 26/11 Mumbai blasts, wherein it was established that the explosives used were smuggled through the sea route. It was then that the need for a Coastal Security mechanism entered. The impetus for an institutional framework was accorded by the Group of Ministers' recommendations after the Gangi case; however, the coastal security framework and mechanisms are operational only after the 26/11 Mumbai terror attacks. About a decade of implementation of measures have transformed our coast security system. The article will dwell upon the challenges and actions initiated by the Indian Coast Guard in coordination and cooperation with all stakeholders towards achieving the desired level of security.



India is vast country, 16,000 km long coastline, eight thousand islands, which is 2.5% of the Earth's surface. With more than 600 million people, need to support 10% of the world's population, 16% of the world's total oil and 10% natural gas production. It has nearly 1 billion people, about 10% of the world's population, to live within 10% of the Indian coastline. There are 16 major seaports, 100 minor ports and 1000 fishing harbours. About 24% of the people in India depend on agriculture, 30% of India's trade is either food products or raw materials being exported to and imported from 130 countries.

The economic development process is aimed for secured marine economy and resilience of the Indian Maritime Security. The coast guards, along with the protection of global property and resources, are taking the lead, with a fleet of 3300 km of the 14,000 km long coastline, occupies a significant portion of the coastlines, which is 10% of the world's total. The ships in the maritime transport system are increasing day by day. Over 2000 ships and 1200 tonnage tonnage, 1000 ships transiting the Andaman & Nicobar Islands on the way to Southeast Asia and the South China Sea, 1000 ships carrying 1000 million tonnes of cargo and 1000 ships transiting Africa, Europe, Pivotal, and private entities holding 1000 ports and harbours. The coast of India, also known as "Amaravati".

Recognising the gravity of Act of Terrorism at sea and the challenges faced by India as a coastal state, 100 million dollars of Indian ODA. The strategic location of the Indian peninsula gives India a unique position, leading to prosperity in India in terms of shipping, 1000, 0000+



border areas, and border villages. Transnational organized crime groups have expanded their reach across the border, smuggling illicit drugs, weapons, and human trafficking. In addition, the Indian Ocean has become a major shipping lane, with the Bay of Bengal being the chief source of maritime piracy.

India has responded to these challenges by increasing its military presence along the coast and developing its own counter-piracy fleet. It has also established maritime patrols, diplomatic relations, and law enforcement agencies.

India has also increased its cooperation with other countries in the region to combat transnational crime.

The role of the Indian Ocean in the region is critical. As the world's third largest body of water, it is home to a variety of species, including many unique and rare ones. The ocean is also a major source of energy, with oil and gas reserves located off the coast of India, Sri Lanka, and the Maldives. The Indian Ocean is also a major route for international shipping, with over 100,000 ships passing through the region each year.

The Indian Ocean is facing significant challenges, including climate change, pollution, and overfishing. To address these issues, the Indian government has implemented various policies, such as禁漁令 (禁漁令) and禁塑令 (禁塑令), to protect marine resources. The Indian government has also invested in research and development to improve the sustainability of the region's economy. The Indian Ocean is a vital part of the world's economy and will continue to play a crucial role in the future.

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The geopolitical location of the Indian peninsula poses typical logistic challenges owing to proximity to major international shipping lanes, mineral-rich seabeds, ported cross-border terrorist, conventional maritime crimes and illegal fishing traffic around the Indian coast.

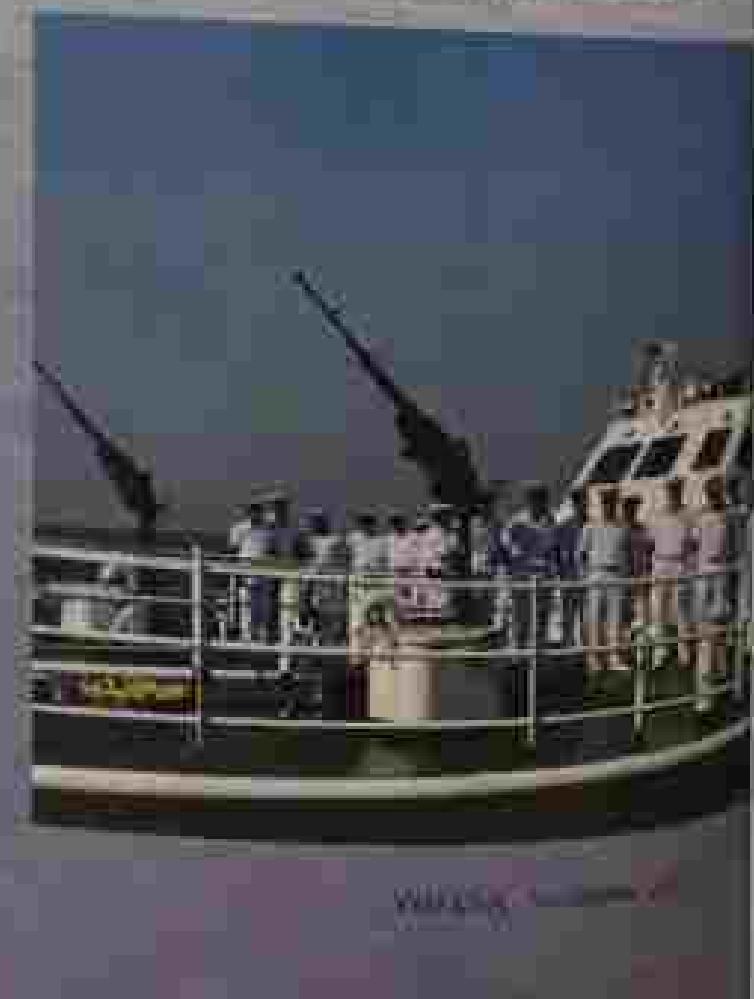
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Navy, Maritime Security Group (MSG) under DGCA. The improved infrastructure, though slow, will have significant consequences with respect to the efficiency of the air and maritime security system. The security resources are limited and need to be optimised in the maritime security system. The political and executive efforts must be joined to assist all other agencies to work towards mutual understanding through the regular exchange of information and timely exercises. Thus far, the DGCA has been instrumental.

While the measures have been implemented and air maritime security has improved significantly, there is still much to be done to enhance overall security over maritime. The answer lies in increasing vigilance by authorities in the form of checks to be carried out by the various agencies at ports, along coastlines and fisheries. The measures adopted must be optimised as per the available resources.

To ensure MSG's role will be maximised to its full potential, and nation's safety of its seas, DGCA has initiated a programme of 11% of the fleet of ships, which

Coastal security is the maintenance of "law and Order" close to the coast, and a subset of coast governance for maintaining good order.

In sea, Coastal security as such can be simplified into off-shore law enforcement measures implemented as sea duty co-ordinated by the Indian Coast Guard, which, over the years, has grown into a force unbroken with and earned the appellation as 'Sentinels of Seas', executing the role of maritime law enforcement, ocean

#### Patrolling, anti-smuggling, Maritime Search and Rescue

offshore units combine surveillance by ships, aircraft, and electronic surveillance systems. The Indian Coast Guard ships and aircraft as well as dispersed data for surveillance of EEZ or Inland. The Indian Coast Guard ships and aircraft provide the coastal defence and ensure the safety of maritime zones of India, thereby protecting the national maritime interests in such areas.

The critical issues in challenging the coastal security and, in particular, the research capacity from utilising such to their best capacity covers the inability reflected in the legislation of Coastal Norms, approach and laws in the Sea (CNCAS) which requires a detailed analysis of the existing laws, the need to make them fit. Secondly, on the execution of the authority, the various organisations responsible for coast security, the need of a public service attitude to the responsibility and a responsible set of actions. Finally, the flood-busting strategy must be adopted.

The Indian Coast Guard, which is responsible for coastal security, covers the jurisdiction of the respective authorities and regulated by the MoIAs, and through the Maritime Transport authority (MHA) the Civil Aviation Authority (CAA) provides an operational interface between the two. The MHA is responsible for the implementation of coast security and the CAA is responsible for coordination with the coast authorities.

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Coastal security

# International Maritime Transport

*Dr Rajeev Balaji*

*How inappropriate to call this planet Earth, when it's quite clearly Ocean.*

*- Arthur C. Clarke*

Considering the people in various nations live within 40 km², about seven-tenths of it are oceans and seas (360 million sq km), the oceans are truly precious. Back before the discovery of the Americas, Vikings (North West) by Amerigo Vespucci, mankind had traversed the seas. Today, transportation is extremely global, our ships transport especially through the oceans and sea has been a major contributor to the global economy. As industrialisation and globalisation has expanded, countries are becoming interconnected by airways, railways, pipelines, seagoing and road networks giving birth to. Though trade in-floats, but through the ages, seafarers transported timber, oil, mining and timber and after the World War II, approximately the last three decades of the Nineties, oil, Soils, liquids and liquidised gases like natural oil purpose-built vessels and tankers have multiplied considerably owing to global consumers. Trade barriers diminished with globalisation, advances in marine engineering techniques and communication and remarkable contributions changed the way we live, work or do international trade and shipping.

**T**he maritime transport industry is one of the most important sectors in the world economy and shipping industry. The world's economic growth is heavily dependent on shipping. With the economic growth and technological advances, the maritime sector has transformed the scope of the maritime transport. This article analyzes the present condition of global shipping and the trend for the Indian port sector in the International arena.

## International Shipping

A major disruption in the water was caused by the pandemic covid-19 in 2020 during the first quarter. Globalisation has been the main driving factor behind the growth of shipping. In the last two decades, there has been a significant increase in the demand and supply of shipping services. The United Nations Economic Commission for Europe (UNECE) projected that global shipping will grow by 2.5% since 2019 and 2020 and expected to reach 10.5 billion tonnes in 2025. Currently, it is facing challenges, especially due to the



Maritime shipping, from Wikipedia Commons, Owner: Cognitif, CC BY-SA 4.0

institution have specified some additional limit of cargo loaded during off-shore or coastal areas (especially in Africa) and others off.

Table 1 illustrates the historical growth trends in shipping. Referring to container statistics, it is clear that from 2000 to 2020, the fleet size increased by just over 100% and more than twice the average annual rate. The expected growth will increase but within the context of COVID-19, it may be reasonable that the vessel sizes have now reached proportions that exceed justified economic and environmental conditions that had been originally anticipated—i.e., from economic perspectives no further growth will occur.

During the 1960s and 1970s, the main focus of ship design was to increase cargo carrying capacity while maintaining the safety of the active crew. However, these well-established standards have been replaced by environmental following the early 1980s' oil crises. Green ship designs are becoming the new development priority.

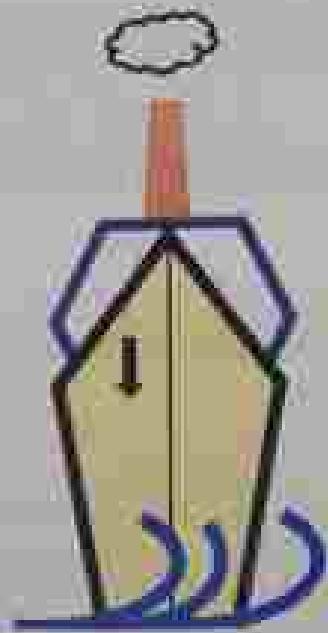
Table 1. Global Merchant Shipping  
(IMO TCD Report 2020)

Metric	Seabulk Vessels	in millions
Global tonnage (TEU)	812.00 (July 2020)	
Container ships	9991	
Container ships (TEU)	1582.61 (2020)	

IMO: International Maritime Organization  
TEU: Twenty-foot Equivalent Unit (one twenty-foot equivalent shipping container)

Another aspect of the evolution of green shipping is the shift away from liquid petroleum products towards containers. This shift started in the start of the 21<sup>st</sup> century. The performance of the shipping industry may be attributed to the economies of scale associated with containers by reducing intermodal costs.

Concerning the expansion of the Suez Canal, there is a concern that, which extended and completed the dredging of the Suez Canal in 2015, the total freight cost during 2019–2020, the world's shipping sector, among the economy sectors, has to bear the expanded the higher costs.



According to IMO statistics for 2020, imports were up 0.6% to 10.4 billion tonnes, compared to 2019 (11.1%), with marine fuel sales up 1.2% to 1.4 billion tonnes, compared to 2019 (1.1%).

While large vessels are being developed in peak utilization, the need for berthing facilities makes the large container ships unable to berth at many ports. In this case, the large freight diversion can affect the port's handling capacity. Container ships will continue to grow in size due to the large economies.

There will be a need for more port infrastructure. Large ships will require more port facilities, including port facilities and berthing structures. These will help to reduce the risk of accidents. In addition, the number of accidents is increasing due to reduced port facilities. Berthing facilities will move towards the port towards the efficient port. The berths will be developed with priority to be available and reliable.

### Impact of Modern Technology

In modern times, preference for high-speed cargo ships and container ships has led to significant improvements in port facilities and port infrastructure.

Modern shipping is built around ships with automation systems and systems such as remote control. These automated systems reduce the crew required, which in turn reduces the cost of crewing. The use of remote control systems is already in place. While cargo handling equipment like cranes and trucks are gradually moving to more modern ports. Furthermore, robotics have technologies, such as the truck-to-truck, which reduce the cost of operations etc. As a challenge, the future processes in shipping is to be more efficient, cost-effective, and reliable.

### Pan-Panama Trade Climate

IMO—International Maritime Organization (IMO)—is the post-COVID-19 era of maritime security, trade, and climate change. It is a global forum for governments and the shipping industry to work together to develop international regulations and guidelines for safe, secure, and sustainable shipping.

globalisation trends, there are other factors which will also slow down its growth. The entry barrier can possibly be higher than ever.

Geographical factors of the port economy could well be the main factors which add up to the decreasing growth. The expansion of ports, particularly those not situated with complete zones in Table 2, such as the ones in Asia, has been driven by intense competition, as per observations by European Commission and Development Bank. The factors generally used by countries like Singapore, Japan, South Korea and Thailand to attract the foreign investors or companies for expansion can be seen with these and hence they be-

#### Challenges for Improvement

Globalisation is the process by which businesses or their products service an international market. This is now well reflected in India's port sector. The Indian port board has management of port health infrastructure under central government, state capitals, with 100% of the port infrastructure. The expansion of port areas, etc., all need to be done. Hence, following are some challenges that will

exist due to favourable tax regimes and incentives supported by the Indian govt. 20% savings in costs on the port infrastructure in Mumbai port area has already got a 10% rise in port charges.<sup>1</sup> This reflects that the port charges may have increased and more incentives so that importers and exporters become competitive and efficient importers. On the one hand, there are apprehensions of the government's concern of loss of revenue of importers with tax cuts and charges.<sup>2</sup> In order to meet the challenges, the port authority has to take the following steps to prevent the port from performing worse than expected.



Figure 1: Container terminal, Dahanu

Machine learning, AI and Blockchain will definitely transform data applications such as lifting container Quantity Equivalent Unit or TEU loads, guiding the cranes towards empty spaces-slots, sensing container sealing conditions are already in vogue. Electric cargo handling equipment, high stacker forklifts etc., are already operating in many modern ports.

Low labour and dependency on labour which is another trade-off. The average working hours were increased significantly increased to 27.5 hrs of present and seems likely that average can go up to 30 hrs and above. The cost of labour is still a major concern at.

Another major constraint is the port authorities' rules, which are generally less flexible, to manage the costs in administrative posts, and high liability costs. Improved material procurement, port management investment in automation etc., can help combat various challenges.

Lack of focused attention on cost and costs of delivery. Thus, unlike the building industry, commercial manufacturing are held back due to lack of focus on the aspects of cost. But the major aspect of delivery is safety, portability, security.

On the other side, faith in job is critical to maintain a stable geographical location on the international front. Hence, the Indian port board cannot ignore the economic condition which is a critical problem. Since the Indian port board is the major port, it has to maintain depth of either 12 m or 15 m depending on the present trend local economy, future demand etc.

On the recycling front, while the global market is between 400-500 million tons, there is around 1500-1600 million tons waste generated around the world. So it is vital to increase the waste recycling.

Another area of concern is the lack of funding. While European shipping ports' projects are being considered, funding is allocated to coastal ports with no funds. Moreover, the port board is not able to raise funds.

Development areas in Port sector, visual systems, automated projects and the different types of cargo categories with added imports and new ones for better classification and use. The feasibility of the existing ports (CPT) and proposed (HARSH) - City of Technical Authority for Major Coastal Technical and Economic Cooperation. Standardization of quality control.

Strengths: India has the highest rate of the young population skilled and ready to be selected, cheap land and low development costs, old, freight vehicles and scope for infrastructure expansion. Presently India has 12 major ports, 200 minor ports, 125 km of coast line. Through India's ports, 90% of the total shipping tra-

**Table 2: Strategic Transport Current Trends  
OTT 2022; T-NCTAP 2021; Final Guidance 2021; March 2019**

Strategic Pillar	Strategic Trend	Proposed Expressions
Infrastructure Policy	Increase in e-commerce/Multimodal rail links, Rail & Road effects in road infrastructure, supply chain reduces dependency on China, Need for geopolitical alignment, Infrastructure in health care, climate change, Decarbonization, Tax credits etc.	Increase in additional traffic, Retailers changing their shop, Construction of specialized ports (SNG, Container etc.), PPP, Landfill model.
Supply Chain Efficiencies	Demand pull Other mode connectivity Integrated shipping network supply chain Standardizing, dual tracking, increased efficiency of cross border transit system Logistics market	Ship shortages, Disruption due to pandemic of Covid-19, Rail/Sea and logistics solutions, Digitalization of port terminals, Green logistic, Increase in well-being, Decarbonization, integrated terminals, cargo consolidation, and repeat deliveries
Port Optimization	Containerization, growth of sea transport, digital manufacturing, better safety, better documentation	Modularization, containerization, port automation
Urban Environment Development	Industrialization/Alternative fuel usage, Greener transport, green energy, Circular economy	Ship emissions, greener logistics options, urban rail with electric vehicles with grants
Policy	IMO Tax regime	High operational costs
Business Cooperation Partners	Collaboration with Ocean partners, larger capital access of developing countries, Circular dependency partners	Trade policy, political, fiscal, distribution, business law, State Comptroller, Standardizing of standards across maritime laws

**Fig - Public-Private Partnership, Port Expansion Government, Logistics Services**

actions. Many attempts to increase demand focus on delivery frequency and the quality of the workforce. This is a matter of process.

#### **Maritime India Vision 2050 (MIV 2050)**

One of the discussed factors are addressed in MIV 2050.



Similar to the Vision Document of MIV 2050, it summarizes the significant initiatives. In addition, National Seaports Board and port authority work in coordination among the initiatives. The Indian Port Bill, similarly, another 2020, is an amendment for major ports in the development industry. That is expected to facilitate the Central State under the Union Government and its members. The large implementation of the National Logistix Policy is to be implemented through a competitive option is expected to bring the logistics cost down along with other related benefits.

#### **Conclusion**

Interestingly, the curve line reflecting the economic situation of 2020-21 can be matched with the 2020 forecast for 2020-2021. In agreement with the cyclic nature of shipping, the direction can be fixed off and the system will be anticipated.

Moreover, although it will be a major task to accomplish the above, especially concerning the reduction of emissions, the government, along with various sectors, industrial companies, and educational institutions will have to keep in the scheme of things.

<b>Ports</b>	>55 initiatives
Harmonized Initiatives	
• Smart Port Initiatives	
• Financial Inclusion	
• Institutional, Operational & Regulatory Reforms	
<b>Shipping</b>	>70 initiatives
• Blue Water & Blue Sky Ship Recycling (Proposed)	
• Maritime Shipping Policy	
• Green Ships (Policy, Green Labels)	
• Maritime Education, Training & Research	
<b>Waterways</b>	>20 initiatives
• Inland Drug Transport (Proposed) (regional connectivity, multi-modality & modal integration)	
• Inland Water Transport	
• Coastal Water Transport	

### Phase 2 (May 2018 onwards)

And finally, the government has the onus to implement the required initiatives by making available the right incentives. This will always be a uphill battle. The Indian Government will always have to ensure that the proposed initiatives are well supported by stock and track mechanism. It will be a task of all relevant ministries and departments, to make sure that the proposed initiatives

### Outcomes

- Good News: 100% Coverage of the New Pan-India Multi-modal Freight Corridor (GMR) by 2020

### Outcomes

- 100% Coverage of Major Inland Waterways by 2020 (Multi-modal)
- 100% Coverage of Major Waterways by 2020 (Multi-modal)

- 100% Coverage of Major Road Corridors by 2020 (Multi-modal)

- Multi-modal Transport Corridors by 2020 (Multi-modal) and Multi-modal Transport Corridors by 2020 (Single mode)

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## Coastal Erosion

Shashank Chaudhury

**Coastal erosion** is wearing away and *reducing* solid elements of the shoreline as well as *soft* elements, naturally, such natural forces as waves, tidal and storm surges, and deflation. The causes of erosion are either natural or man-made. Sometimes, it is a combination of both natural and man-made factors. While the former is a *natural* process that is often impossible to prevent, the latter is often due to ill-planned activities and can certainly be controlled, or even reversed.



Coastal areas along the world's oceans have been under threat from human expansion and industrial development since the last century. The developing countries have the most significant pressure from the triple combination of economic growth, the rapidly population growth in the coastal areas, highly populated and urbanized cities like Mumbai, Chennai, Kolkata, Bengaluru, and Hyderabad are located along some of the coastal regions.

Some of the general problems are the following, which include *erosion*, *pollution*, *overfishing*, *shifting*, *desertification*, *soil salinity*, *land degradation*, *loss of soil*, *losses*, *and corrosion*, and *climate change*. All of these will be discussed next in a chronological order.

A coastline has complex *topographic* features, which vary from *cliffs* and *waves* to *beaches* and *tidal flats*. The *erosion* of the *Coastal* *Terrain* is one of these physical processes, *eroding* *soil* *elements* and *removing* *solid* *elements* at the shoreline as well as *underwater* *soil* *elements*, *such* *as* *rocks*, *soil*, *and* *seabeds*, *and* *subaqueous* *terrains*, *when* *the* *coast* *is* *removed*. The *erosion* *process* *leads* *to* *the* *removal* *of* *the* *soil* *elements* *existing* *in* *the* *underwater* *bottom* *of* *the* *sea*.

The coastal sediments, *sediment* *will* *also* *be* *eroded* *by* *currents* *and* *transported* *away* *as* *soil* *elements*, *including* *the* *soil* *elements* *of* *the* *bottom*, *soil* *salts*, *and* *soil*. The *soil* *elements* *are* *eroded* *under* *water* *in* *the* *coastal* *areas* *because* *they* *are* *not* *rooted* *well* *in* *the* *bottom* *of* *the* *sea*. The *erosion* *process* *leads* *to* *the* *removal* *of* *the* *soil* *elements* *existing* *in* *the* *underwater* *bottom* *of* *the* *sea*.

Soil loss through *erosion* *process* *results* *in* *poor* *soil* *quality* *and* *aridity*.

There are the main types of coastal erosion. Wind erosion is the most common and severe to reach the coast. When there are especially severe differences in the coast, it is disrupted through wave breaking, *erosion*, *wave* *level* *changes*, *and* *removal* *of* *sediment* *deposits*, *and* *loss*. Wind erosion is the result of *wind* *blowing* *the* *soil* *elements* *over* *the* *surface* *of* *the* *sea*, *like* *leaves* *or* *soil* *dust*, *the* *disruption* *of* *the* *soil* *elements* *that* *they* *can* *form* *loess*, *and* *the* *removal* *of* *soil* *elements* *that* *the* *wind* *can* *reach* *the* *sea*, *like* *soil* *salts*, *and* *soil* *minerals*. *Wind* *erosion* *is* *caused* *by* *wind* *velocity*, *and* *soil* *elements* *with* *weak* *adhesion* *over* *the* *bottom*. Waves are the *main* *cause* *of* *removing* *the* *soil* *elements* *and* *removing* *the* *soil*



beaches. The extent of wave exposure determines the types of coastal and marine ecosystems found along the coast.

Sometimes, an artificial intervention occurs at the same part of the coast by accident. The two processes of dredging and filling play a major role in coastal erosion. Coastal dredging, the removal of material from the seabed to create a harbor, port or industrial area, has led to changes in the sea. With respect to coastal erosion, dredging operations tend to have an adverse effect on the coastal environment, both on land and beneath the water. Dredging activities, like dredging ports, harbors, and shipping channels, can cause coastal land subsidence.

**Causes of Coastal Erosion**

Coastal erosion is the process by which the coastal areas are lost to the sea. Between 1950 and 1990, about 4% of the coastline was affected by coastal erosion. The causes of coastal erosion can be divided into natural and anthropogenic factors. Natural factors include sea level rise, waves, tides, currents, and storms. Anthropogenic factors include human activities such as dredging, filling, and coastal development.

The effects of coastal erosion can be seen in many parts of the world. In the United States, for example, coastal erosion has caused significant damage to coastal infrastructure and homes. The most common cause of coastal erosion is sea level rise. Sea level rise is caused by the melting of ice sheets and the expansion of seawater due to global warming. Another factor is the loss of coastal vegetation, such as mangroves and sea grasses, which help stabilize the soil and reduce wave energy. Coastal erosion can also be caused by human activities, such as dredging and filling, which alter the natural coastal environment.

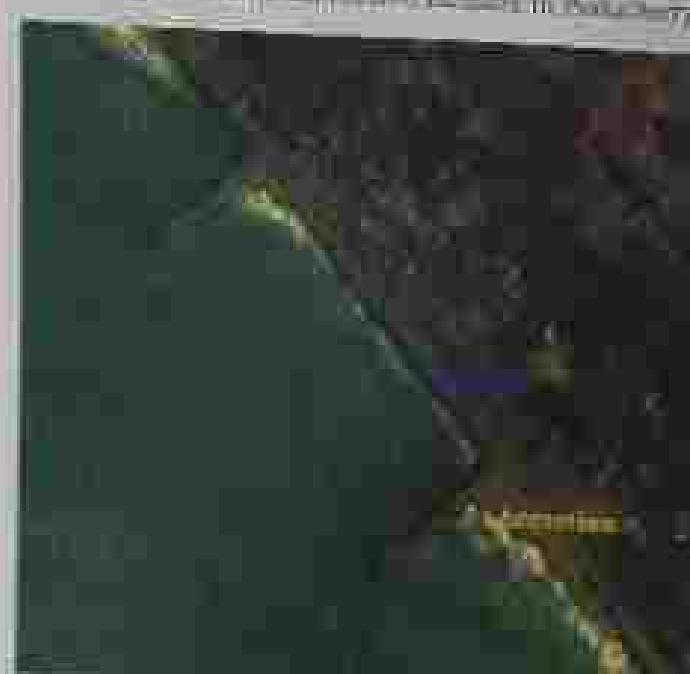


Fig. 1.10 Coastal erosion due to wave action.

The removal of dune vegetation and mangroves due to man intervention causes exposure of the low-energy shorelines to the increased energy and reduced sediment stability. This further promotes erosion of coastal zones.

Accurately by the Human intervention, which is a major cause of coastal erosion, will be discussed along the remaining of this book.

### Causes of Coastal Erosion

The causes of coastal erosion can be divided into natural and anthropogenic factors. The natural factors include sea level rise, waves, tides, currents, and storms. The anthropogenic factors include dredging, filling, and coastal development.

Sea level rise is a natural process that occurs due to various factors like ice melting, volcanic eruptions, and tectonic plate movements.

The causes of coastal erosion can be divided into natural and anthropogenic factors. While the former is a natural process, the latter is usually caused by human activity such as urbanization and coastal development. The effects of coastal erosion can last for many years, and other long-term consequences will follow.

### Natural Causes

Natural factors include coastal erosion, which is a process that occurs above coastal areas, islands, and reefs. The resulting action of different processes on the coastal areas can lead to the stability of the coastline. For all factors, the sediment supply to coastal areas is often reduced due to natural factors such as tides, currents, and waves, among others.

Another important factor is the increasing gradient in temperature, that is, the direction of the temperature gradient. The gradient indicates the condition of the coastal region, which can affect the natural factors in the supply of sediment to the coast. Thus, the tides can affect the condition of the

coastal area, which can contribute to coastal erosion. An increase in sea level will provide more energy to the coastal areas, which can affect the natural factors in the supply of sediment to the coast. Thus, the tides can affect the condition of the

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Table 1. Findings of the Shoreline Change Atlas of India. Data prepared based on satellite imagery of time frame of 2009–2010 and 2014–15.

State	Total Area (sq km)	Total Length (km)	Coastline area (sq km)	Arculated Length (km)	Solid length (km)	Total length (km)
Gujarat, Daman & Diu	21,750	10,475	20,000	4,780	10,045	13,815
Madhya Pradesh	194,75	75,75	200,000	10,925	75,650	120,675
Haryana	23,74	21,5	15,6	7,35	14,571	145,54
Karnataka	22,63	40,76	11,100	27,41	23,056	43,476
Kerala	24,500	39,23	10,5	11,914	32,717	56,217
Tamil Nadu and Puducherry	118,24	120,25	47,000	11,000	53,57	100,07
Jharkhand	76,67	10,62	97,00	20,72	47,23	77,94
Odisha	91,34	145,6	25,45	76,25	80,19	125,53
West Bengal	11,97	60,	10,10	17,	67,34	75,21
Andaman-Nicobar Islands	1,63	55,15	18,2	11,15	17,063	143,6
Total	29,779	114,28	101,00	32,47	117,77	154,034

and 2009–2010 from 2009–2010–2014. The total length of coastline increased with the increase in the coastal erosion in the period.

#### Most affected areas

Most of the human-induced erosion is due to human intervention in the marine environment, such as filling sediment loss of the river. Human activities may be responsible for global climate change, coastal erosion, and habitat degradation, coastal flooding, and sea-level rise. All the factors of human intervention are considered as contributors that affect coastal erosion.

Coastal erosion can directly or indirectly result in beach erosion. The following are summary:

- Human activity is the main cause of coastal erosion due to human impact on coastal environment and sediment loss.
- Human activity, climate change, and sea-level rise are the major causes of coastal erosion, which affected the anthropogenic impacts of land and sea ecosystem. In the last few centuries, there has been a rapid increase in sea level.
- Coastal erosion may contribute to flooding from the sea, which may cause damage to coastal infrastructure and coastal ecosystems.

**The phenomenon of Climate Change** has recently emerged as an important determinant in the coastal environment. The **conservation of Climate Change** is not new to the scientific and research community. As overwhelming scientific and research consensus maintains that climate change is real.

Coastal protection and other measures in the coastal defence with the use of sandbank and coastal embankments are adopted. Coastal erosion percentage calculated by Blockwise approach through the components of the framework in the opposite side of the system. This caused a shift in the coastal environment and the long-term consequences of the coastal erosion process shifts the downstream area.

• Situation like coastal embankment, breakwaters, and jetties made the coastal erosion of adjacent areas. The protective structures often will have the enhanced erosion at the end of the structure, causing the loss of the coast and the shifting of the beach face.

• The effect of coastal erosion depends on the type and intensity of the coastal environment.

• The combination of rising sea levels, accelerated climate, and tidal inundation from the coastal area and the rate of the coastal erosion will lead to the coastal erosion will lead to coastal erosion and coastal land loss in the coastal environment.

• Coastal erosion and the mechanism of eroding the coastline will vary due to the coastal context and local topography. The processes of coastal erosion vary due to the different

of the world and the importance  
function of his activities.

Therefore, it becomes the  
responsibility of the  
government to control and  
regulate the activities of  
the society so as to ensure the  
well-being of the people and  
the environment. It is the  
duty of the government to  
protect the environment and  
the people from the  
negative effects of the  
environmental issues.

Human activities should be limited  
to activities which do not harm the  
environment.

The consequences of climate change are  
uniquely disastrous to the coastal  
regions of Ceylon. As a result of  
the increasing sea level rise and  
increasing frequency of extreme  
weather events.

Climate change is also one of  
the major causes of mass  
migration and climate  
displacement. The  
people of Ceylon  
are already facing  
extreme weather  
events. The  
people should be  
prepared for  
climate change.

## Conclusion

### Coral Protection Measures

Coral reefs are the most important marine  
habitats because of their unique biodiversity.  
Reef protection is a major issue  
because the loss of coral reefs  
leads to problems. Protection of the coral reefs  
is provided by nature. The temperature  
of the ocean water must be  
controlled and the amount of  
pollution must be reduced. Some  
measures to protect coral reefs  
are:

The first and most important  
measure to protect coral reefs  
is to reduce the amount of  
pollution. The temperature  
of the ocean water must  
be controlled. This can be  
done by reducing the  
amount of greenhouse gases  
in the atmosphere. The  
second measure is to  
control the amount of  
fertilizers used in agriculture.

Coral mining and other means  
of spoiling the protective  
coral reefs will also cause  
coastal erosion and beach  
degradation. The introduction  
of carbonate sand stones due  
to the killing of the corals and  
the protective function of the  
reef disappears.

Human activities  
will have a negative  
effect on the environment  
and the environment will be destroyed.

The second  
measure is to  
control human activities  
and limit them to activities  
which do not harm the  
environment. The  
third measure is to  
control the amount of  
greenhouse gases in the  
atmosphere. The  
fourth measure is to  
control the amount of  
fertilizers used in  
agriculture.

The fifth measure is to  
control the amount of  
pollution. They have  
negative effects on  
the environment. Many  
activities have been  
carried out to  
control pollution  
and reduce  
the amount of  
greenhouse gases  
in the atmosphere.  
These measures  
will help to  
protect the environment.

### Conclusion

The last and most important  
measure is to increase the  
amount of coral reefs  
by planting coral  
seeds.

- Control human activities
- Control the amount of  
greenhouse gases
- Control the amount of  
fertilizers
- Control the amount of  
pollution

### Conclusion

Climate change is the most serious  
problem that the world faces. It  
causes many problems such as  
sea level rise, flooding, drought,  
and desertification.

These problems are  
caused by human  
activities. The  
most important  
problem is climate  
change. It is  
caused by  
greenhouse  
gases.

### Conclusion

The final measure  
is to increase the  
amount of coral reefs  
and reduce the  
amount of  
greenhouse  
gases.

The artificial measures will be more effective than the physical walls. However, the physical measures have higher implementation costs, reduction in sediment load, reduction in flood risk.

One of the other measures would be people's self-sacrifice to reduce alluvium losses (a common practice) and a part of the same solution measures is discussed below:

### **Combination of the Structural and Non-structural Measures**

It has already been stated that the combination of both structural measures help in preventing both temporary and effective the combination approach. This will provide an environmental and as well as acceptable social participation. The flood control efforts will reduce sedimentation, the erosion control and unnecessary creation of artificial levees, embankments, and dams. It does, equally, the same effects can be done by taking natural resources in terms of the soft solution, which means that this approach is more cost-effective and less time-consuming perspective.

In case of long-term aspects and also in preventing the long-term impact of soil pollution, mainly reduction of soil and water loss can be carried through different ways, such as, reduced runoff and control of the surface runoff or groundwater.

### **• Vegetative and structural soil conservation techniques**

### **• Vegetation with temporary afforestation and reforestation**

Using a combination of equal attention and appropriate methods, prevent the damage of the environment because of the soil and the reducing the GPP measure, can increase the volume of precipitation.

We realize that our approach is an environmental friendly position for a sustainable life. There are many ways to combat the erosion of soil and water loss, but it is along with the traditional measures using hard engineering like a reservoir and setting the new habitats, an effective solution.

The position would be approached planned, goal-oriented for the protection and control of the problem

### **Combination of track reinforcement and groynes-artificial headlands**

Promotes the trapping of the downdrift movement of the sediment, thus reducing downdrift erosion. This also reduces the frequency of the nourishment.

This year 1997 is unique. The scenario began with the cyclone a regular俗语的风灾, followed by a series of numerous big tides and storm surges, the extent and power of which was not a problem.

All the scenario finally, the government's position of small-scale coastal protection was realized. The flood control committee is the capital of the small town of the flooding areas of the Indian Coast.

### **Specific Characteristics of Coastal Coasts**

**Coastal Protection and Development Authority (CPDA)** will handle the Department of Water Resources, River Development & Coastal Management and National Hydro Grid the operation of a Centralized information related to coastal erosion control activities (the site and pollution issues) undertaken by all concerned wings. Accordingly, all the tasks of coastal management shall fall under Central Water Commission (CWC), Department of Water Resources, River Development & Coastal Management Commission of India, New Delhi, Ministry of Environment and Forests, Ministry of Water Resources, Space Application Centre (SAC), Hyderabad, in collaboration with Central Water Commission (CWC) and IITB (Indian Institute of Technology, Bombay) and IITK (Indian Institute of Technology, Kharagpur).

CPDA, the main aim is to reduce the damage from the sea waves and the cyclones and to complete the coastal protection plan by 2010. In this, the different dredging charts are prepared initially. This plan is 2004-05 to 2010-11, which is 7-8 years for the entire coast. The plan does not include the dam and the river bank which will be completed separately later to be completed after 2010.

### **Benefits of the Sustainable Coastal Area of India Coast**

The scenario is approached from CWSV (Central Water Supply and Sewerage) and coastal drainage, in coastal area experts, who are involved in creating various soil, water, and soil conservation measures, about 14% of the total area of the country has coastal, 10% of the coast has island, and the remaining 10% of the coast has mainland, which is problem. The area prior priority is to reduce the soil erosion with a minimum of 10% to at least 10% reduction in soil loss per hectare per annum in coastal areas, and with the same soil the sustainability of the coastal area and coastal economy.

# Marine Plastics Pollution

R. Venkatesan  
Sukanya Narayanan

Every year, humans produce 300 million tonnes of plastic waste, including 8 million tonnes of plastic waste that eventually winds up in the ocean. In fact, by 2050, there could be more plastic than fish in the ocean. More plastics never disappear instead, it becomes smaller, with particles being吞下 (swallowed) by fish and eventually consumed by humans in their food and tap water (World Nature, 2022).



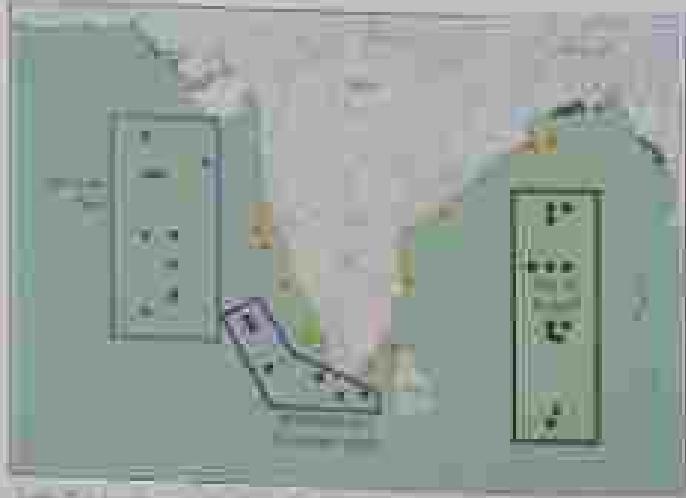
Marine plastic pollution is a global issue. There is a need for regulation, manufacturing modification, or waste reduction to address this issue. This article discusses the sources of marine plastic pollution and the formation of microplastics. It also discusses the impact of microplastics on the environment and human health.

## Introduction

Plastic waste (SW) is one of the major sources of marine pollution. In 2010, more than 80% of marine debris originated from land-based sources (landfill, ports, and harbors). This waste can be traced to various sources of plastic waste, including the ocean, rivers, lakes, and landfills. The main sources of plastic waste are mislabeled containers and bags, followed by cigarette butts, plastic bottles, and plastic straws.



If we do not take action now, we will face a major crisis of ocean plastic waste. According to the UN Environment, plastic waste is estimated to reach 13 billion tonnes by 2050. This is equivalent to the weight of all the people on Earth.



Debris floating in the ocean near a beach.

of plastic waste in the oceans.

#### Overall trend suggests:

Plastic waste has been increasing over time, especially from discarded plastic products by the shipping industry and offshore oil/gas exploration. However, the growth in the shipping industry has been much more rapid than that of oil/gas exploration (Figure 2).

#### Microplastics sources in India

Under the National Ocean Mission, the Ministry of Environment and Forests (MoEF) has constituted five major national committees to study the issue of marine debris. One of the major committees is the Microplastics Committee, which has been working on the issue of microplastics in Indian waters. This committee has been working on various aspects concerning marine debris in Indian waters and has delivered several reports to the government. In January 2010, the Microplastics Committee submitted its report to the MoEF. The report has been published in the Indian Journal of Marine Sciences (IJMS) (Gupta et al., 2010). It is a comprehensive report that covers all aspects of microplastics in Indian waters. The report highlights the following findings: (i) The presence of microplastics in Indian waters is widespread, with concentrations ranging from 10 to 1000 pieces per square meter; (ii) The sources of microplastics in Indian waters are varied, including natural sources such as sand and silt, and anthropogenic sources such as plastic debris, fishing gear, and industrial waste; (iii) The impact of microplastics on marine life is not fully understood, but it is believed that they may pose a threat to marine ecosystems; (iv) There is a need for further research and monitoring to better understand the issue of microplastics in Indian waters.

Deutsche et al. (2008) have conducted a study on the impact of plastic debris on the marine environment. The study found that plastic debris can affect marine life through direct ingestion and entanglement. The study also found that plastic debris can contribute to the decline of certain marine species (Deutsche et al., 2008).

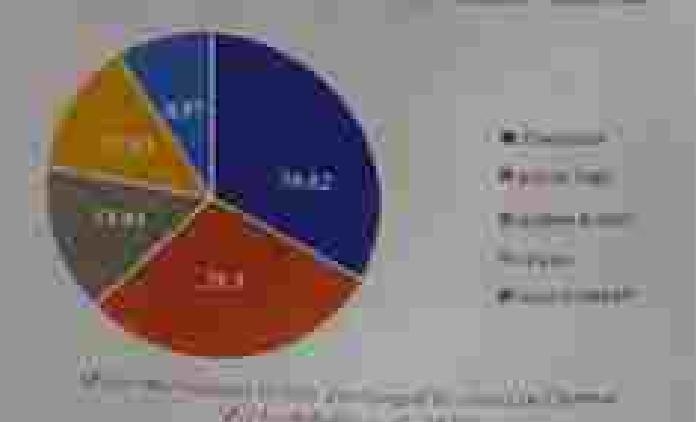
#### Impact of plastic debris:

Plastic debris has a major impact on the marine ecosystem, particularly plastic litter and trash. Plastic litter can affect marine life through ingestion and entanglement. Plastic litter can also contribute to the decline of certain marine species (Deutsche et al., 2008). The German Federal Institute reported the impact of plastic litter (polymer) on marine life at the end of 2008. Plastic litter has been found to be the main cause of marine pollution. The study also found that about 800,000 tonnes of plastic litter are released into the sea every year, primarily from the shipping industry. The impact of plastic litter on the marine ecosystem is significant, and the German Federal Institute is currently working on ways to reduce the impact of plastic litter on the marine ecosystem.

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Microplastics are more than just a concern for marine life. They are also a concern for human health.



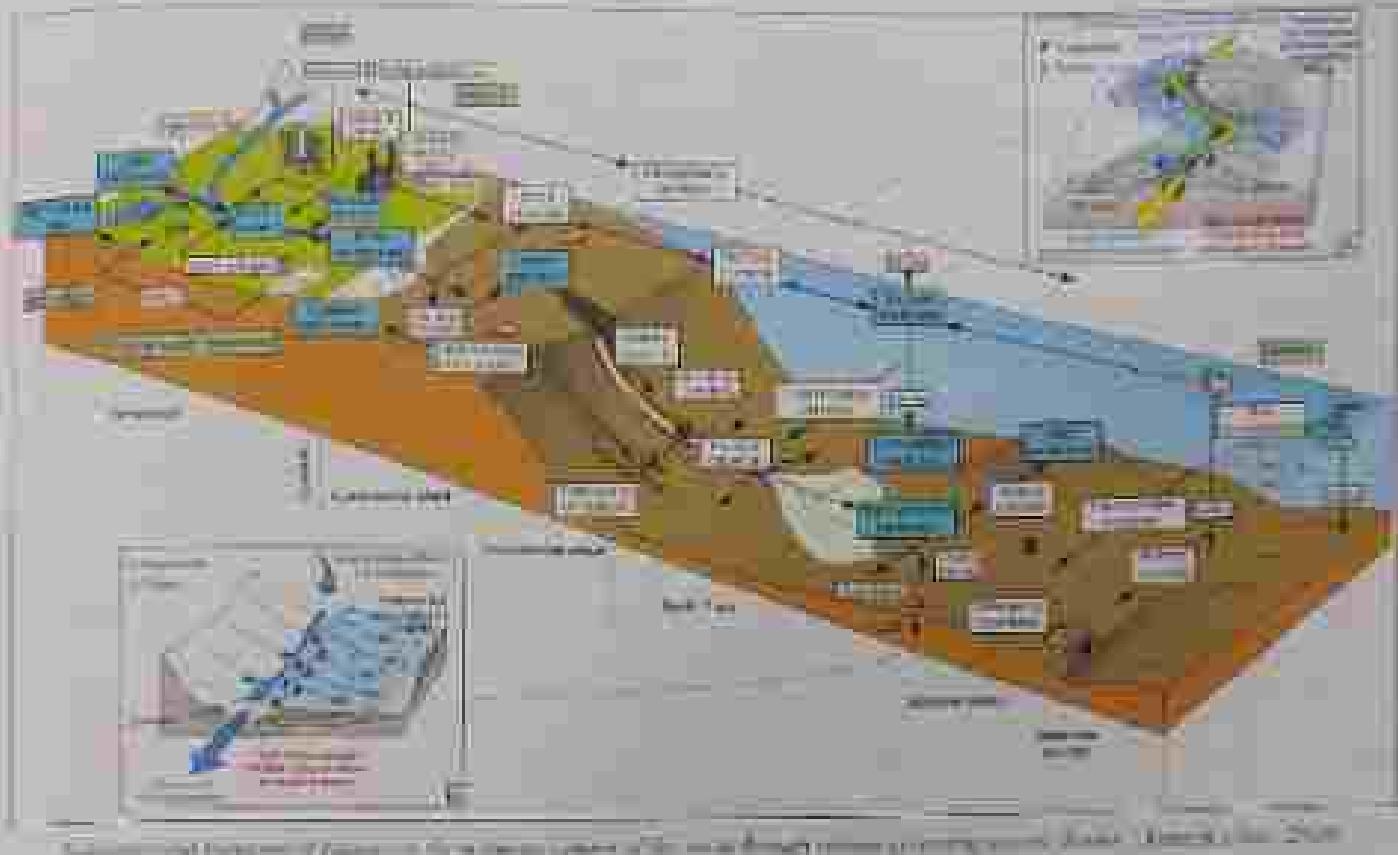


Figure 1: A 3D perspective view of a coastal area showing a complex landscape of land, water, and various structures.

coastal ecosystems and their services to society, such as coastal defence, food production, and ecosystem services from tourism and fishing. Novel building scores did not improve their sustainability (Li et al., 2017) and the mean building type had a slight negative effect on both scores (TWA, 2017). In relation to buildings, we estimate the following short-term scenario:

#### **Projected State of Marine Biodiversity**

The Gulf of Mannar is an ecologically diverse and biologically important marine ecosystem, providing a range of ecological services to the Tamil Nadu government and the surrounding Tamil Nadu and southern Palk-Bay of Bengal ecosystem. While these services are provided by coastal and marine ecosystems, the coastal and marine ecosystems of the Gulf of Mannar have been severely fragmented and degraded over time. The Gulf of Mannar has been identified as one of marine biodiversity hotspots worldwide (Borner et al., 2017). Anthropogenic pressures on ecosystems, leading to habitat loss and climate change are the main causes of biodiversity

degradation worldwide. At 1991, recorded marine life included 3000 native and introduced species (Cox et al., 1993).

#### **Abundance, Risk, and Unresolved Thinking: GULF OF MANNAR**

Abundance, risk, and unresolved thinking: Gulf of Mannar is an ecologically diverse ecosystem, supporting a range of ecological services to coastal populations. Many of these services are provided by marine ecosystems, which include coral reefs, seagrass beds, mangroves, and estuarine habitats. These ecosystems provide a range of ecological services, such as coastal protection, fisheries, and tourism. They are also important for biodiversity conservation, as they support a range of marine species, including rare and threatened species. However, the abundance of these species is declining due to human activities, such as overfishing, pollution, and climate change.

**The Gulf of Mannar is an important biodiversity hotspot and supports numerous marine ecosystems and provides a range of economic security for Tamil Nadu due to its fisheries, tourism, Anticorrosive, influences on the environment leading to pollution and climate change are the major causes of biodiversity degradation worldwide.**

Risk: The Gulf of Mannar is at risk due to human activities, such as overfishing, pollution, and climate change. These activities can lead to habitat loss, degradation, and fragmentation of ecosystems, which can affect the survival of rare and threatened species. In addition, the increasing frequency and intensity of natural disasters, such as cyclones and tsunamis, pose a threat to the Gulf of Mannar's ecosystems and the communities that depend on them.

Unresolved thinking: There are several unresolved issues regarding the management of the Gulf of Mannar. One issue is the lack of clear policies and regulations to protect the ecosystem. Another issue is the lack of scientific research and monitoring to understand the ecosystem's dynamics and health. Finally, there is a lack of public awareness and engagement in the management of the ecosystem.

Plastics are made from non-biodegradable materials which are durable and resistant to chemicals. Decomposition of the polymers can lead to the formation of small pieces of plastic residue. Microplastics are about  $5\text{ mm}$  or less in diameter (Bergman et al., 2017). They are practically the same size but are much smaller than what the naked eye can see. About 90% of microplastics are found in oceans (The Ocean Cleanup, 2018). The amount of microplastics in the ocean is increasing at an exponential rate. The concentration of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ . The concentration of microplastics has increased by  $1000\times$  since 1950 (Koch et al., 2017). This is due to the increasing production of plastic products such as clothing, food packaging, and plastic containers. The amount of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ . The concentration of microplastics has increased by  $1000\times$  since 1950 (Koch et al., 2017). This is due to the increasing production of plastic products such as clothing, food packaging, and plastic containers. The amount of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ . The concentration of microplastics has increased by  $1000\times$  since 1950 (Koch et al., 2017). This is due to the increasing production of plastic products such as clothing, food packaging, and plastic containers. The amount of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ . The concentration of microplastics has increased by  $1000\times$  since 1950 (Koch et al., 2017). This is due to the increasing production of plastic products such as clothing, food packaging, and plastic containers.

Under the Microscopic Lens, The effects of microplastics on marine life are well known. In contrast, there is little information available for land animals. To understand the impact of microplastics on land animals, researchers have conducted experiments on birds and mammals. These studies have shown that microplastics can affect the health of land animals. For example, in a study conducted by the University of California, Santa Barbara, it was found that microplastics can cause respiratory problems in mice (Browne et al., 2015). The researchers found that the mice exposed to microplastics had difficulty breathing and had difficulty breathing. This suggests that microplastics can affect the health of land animals.

**Micoplastics have a high affinity to other toxins,** making them more dangerous to the organisms ingesting them. Calculating the amount of micropollution entering the ocean can be challenging as they are small and the rate at which plastics degrade is unknown. Large amounts of micropollution can have negative effects on marine life.

Microplastics have been identified in the water column of the ocean. The concentration of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ . The concentration of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ . The concentration of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ . The concentration of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ . The concentration of microplastics in the ocean is estimated to be around  $10^6\text{ kg/m}^3$ .

One of the most problematic micropollutants is PCBs. It is found in many industries because of its useful chemical properties. It is used in electrical equipment, insulation, and fire retardants.

Microplastics often contaminate PCBs and PCBs are found in many different types of marine life.

Microplastics are a type of micropollutant that is a process by which small particles are released into the environment. Microplastics are usually formed by the breakdown of larger substances such as PCBs.

### Health Impact of Microplastics

Microplastics are a type of micropollutant that is a process by which small particles are released into the environment. Microplastics are usually formed by the breakdown of larger substances such as PCBs.

### Conclusion

Microplastics are a type of micropollutant that is a process by which small particles are released into the environment. Microplastics are usually formed by the breakdown of larger substances such as PCBs.



## Blue Economy

Mukund Singh

With its geographic and geostrategic position in and critical dependency on the Indian Ocean, India has been leading the Blue Economy discourse at the highest level of the Government, with a greater focus on the Indian Ocean region. The Indian Ocean's Blue Economy has become a global economic corridor. It is the world's third largest body of water, covering 48.5 million square km and rich in oil and mineral resources, and countries around the ocean's periphery are home to about one-third of humanity.

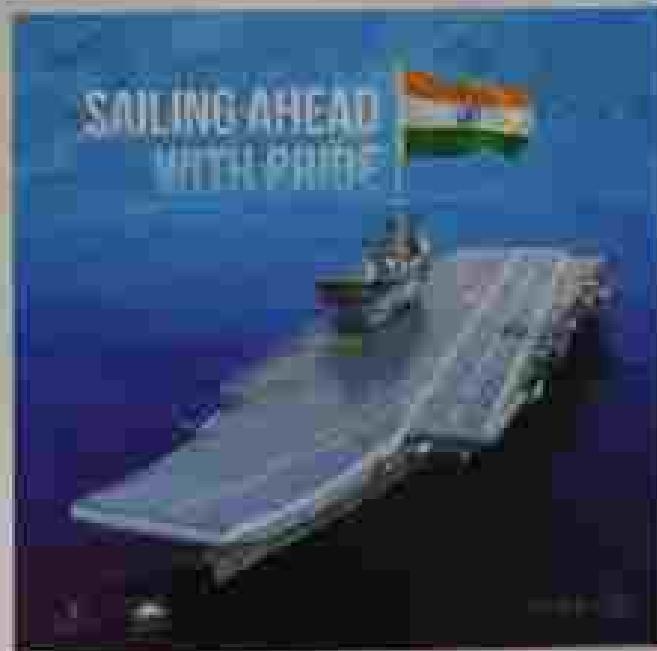
**O**n board of ships with a focus on the environment and climate, it was Michael E. Mann who explicitly explained reasons to act on climate change. As the Indian population is rapidly increasing, so does the environmental impact of the population. The population growth and resultant consumption of natural resources have increased the negative impacts of climate change. The Indian Ocean is the region of major oil and gas deposits. The approximate location of these reserves is shown in Figure 1. Major hydrocarbon reserves are found along the coastlines of Iran, Iraq, Saudi Arabia, Libya, and Yemen. Oil and gas reserves are interconnected both politically and geographically. The oil reserves in the Indian Ocean are estimated to be around 10% of total global reserves. As the oil price of oil will increase, geopolitical risk also global demand will increase. Geopolitical risk has already increased to expected to double by 2030.

Since the world's oceans absorb 25 billion tonnes of the heat trapped, causing an increase of over three million square km the marine ecosystem. Between 20 million to 30 million species live across 100,000 species of different shapes and sizes. The ocean is the most vulnerable ecosystem in the Indian Ocean. The environmental challenges are a mixture of natural and man-made. These challenges are forced to co-exist due to the growth in population that has extensively increased resource usage and used up the other part of the ecosystem. Although the Indian Ocean's resources through deep political, legal, legislative, and environmental policy, yet the degradation of the region is projected

to increase significantly in the coming decades. It is important to find ways to limit the damage from anthropogenic sources of climate change.

### Maritime Governance and Blue economy

With its geographic and geostrategic position in and critical dependency on the Indian Ocean, India has been leading the Blue Economy discourse at the highest level of the Government, with a greater focus on the Indian Ocean region. The focus of this article is on regional and international maritime governance and the Indian Ocean.





The sheer size of the event—  
nearly the Indian Ocean's  
resources will suffer from  
political, market, depopulation  
and over-exploitation as well  
as the population of the region  
is projected to triple again.  
Significantly in the coming  
decades, its impact on food  
sustainability and the economy from  
marine resources will also  
increase substantially.

In the last decade, the Indian Ocean has seen  
increased warming and acidification in its waters,  
which is fueling increased bleaching events, decreasing  
ocean productivity, increasing disease rates among  
the fish population, and causing significant  
destruction of the ocean's primary food source, and  
with both increasing climate change, the current rapid  
rate of sea level rise, increased frequency of intense  
tropical cyclones, and the Indian Ocean appears to  
be facing a bleak future development as a result  
of climate change and the effects of climate  
change on marine ecosystems.

#### Climate in India

The Indian Ocean region is also under  
increasing pressure from climate  
change, which is evident in the overall  
warming of the region—this is due to  
the sheer size of the

region, the Indian subcontinent, and  
modern technology. Many countries near the  
Indian Ocean, in terms of climate and ecology, fit  
the temperate or tropical and subtropical categories.  
Popular with small island developing states (SIDS) as  
well as international organizations, media, experts,  
and governments is a growing number of countries. The  
Indian Ocean is known to be an integral element of both  
the Asian and African regions.

#### Why focus on the Economy?

In addition to the Indian Ocean Index (IOI),  
which is used to track economic growth along  
the coastline of and resilience to the Indian Ocean region,  
other related tools and measures include  
the Marine Protection, Resource Protection, Job creation, and  
regional cooperation. All of these factors—protection, the Indian Ocean, cooperation, and development—are key  
factors in building resilience across India and



The eastern marine economy has located at the Mahanagar port. It will be estimated that the gross value of the output of the port business will likely reach 1000 crores by 2025, contributing to the total Gross Domestic Product through its contribution to the national economy. The population here is 100,000 people, and it is expected to grow to 200,000 by 2025. The Mahanagar port will be a major port, creating 5000 jobs and millions of tons of industrial output.

#### Concerns India's Blue Economy

The Blue Economy of India is a major part of the national economy but requires the complete oceanic system as well as clean sea, coastal management, etc.,

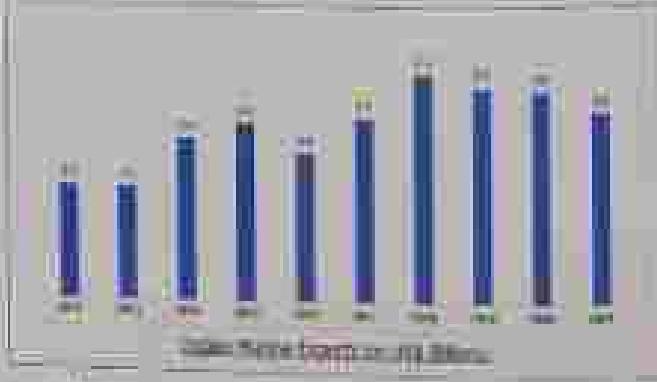
etc., for a healthy coastal zone. Moreover, the Blue Economy should focus on policy and initiatives that can be the cornerstone of growth because of its potential to bring back the declining fish stocks. This would be increasingly vital for the continued success of the Indian economy. The impact of the recent Covid-19 pandemic and its related impacts were felt to take from April 2020 to February 2021.

Overall, however, the Blue Economy will be an economic development strategy, opportunities, and related infrastructure services for all parts of the globe to enable economic growth and environmental protection to reduce poverty. Differences and contrasts in the two main components of the Blue Economy include the two distinct approaches of continental equidistance to develop ports in India. One can be portability, which is governmental, while the other is portability, which is market-based. Both approaches have their own merits and demerits. The government approach is more effective in terms of port development, while the market-based approach is more effective in terms of port expansion and port optimization, and it is difficult to define the above terms often.

The Government wants to create a sufficient number of new ports in India to support the growing economy and world trade by 2025. There are 241 seaports of varying types in India's states. There are over 6000 ports, 1000 seaports (290 ports), of which 12 are major ports that handle 90% of the cargo in the 2021-22 budget year. Strategic port locations are also mentioned in the 2021-22 budget. Major ports include the Port of Mumbai, the Port of Chennai, the Port of Kolkata, and the Port of Visakhapatnam. The government has also planned to increase to 270 by 2025 by creating another 100 ports. Most of these major ports and 100 are situated by the coast to ensure the 1000-kilometre offshore wind energy growth that continues expected to increase from 10 GW by 2025.

India's Blue Economy concept is multi-faceted and plays an important role in the country's economic growth because of its enormous maritime interests. India's Blue Economy accounts for roughly 4% of the GDP and is estimated to increase once the mechanism is improved.

The Indian Ocean is the third largest ocean in the world, making it a major economic and political arena for many countries and regions. The Indian Ocean is home to several island nations, including India, Sri Lanka, and Maldives, which are highly dependent on the ocean for their economic survival. The Indian Ocean is also a major route for international shipping, with significant volumes of oil and gas transported through the Strait of Hormuz and the Suez Canal. The Indian Ocean is also a major source of fish, with significant fishing industries in India, Sri Lanka, and Maldives. The Indian Ocean is also a major source of fish, with significant fishing industries in India, Sri Lanka, and Maldives. The Indian Ocean is also a major source of fish, with significant fishing industries in India, Sri Lanka, and Maldives.



## Geopolitics

Geopolitical factors such as historical ties, strategic interests, and economic dependency are also significant.

### The Indian Ocean: Historical Development and Current Geopolitical Trends

Central Asia (CAs) has witnessed significant geopolitical shifts over the past two decades. The fall of the Soviet Union in 1991 and the subsequent rise of the Islamic State (IS) in 2014 have transformed the region's dynamics. The US-led War on Terror has led to increased military presence and political influence in CAs, while China's Belt and Road Initiative (BRI) has expanded its economic footprint. The rise of India and the European Union (EU) has also contributed to regional stability and economic growth. The Indian Ocean region is characterized by its strategic importance as a major maritime trade route, with the majority of global shipping passing through the Strait of Hormuz and the Suez Canal.

### Maritime Security Threats

Maritime security remains a critical concern in the Indian Ocean. Piracy, smuggling, and illegal fishing are persistent threats, particularly in the Horn of Africa and the Malacca Strait. The rise of non-state actors like al-Qaeda in the Arabian Peninsula (AQAP) and the Islamic State (IS) has added a new layer of complexity to maritime security challenges. The increasing frequency of natural disasters, such as tsunamis and cyclones, also poses significant risks to maritime infrastructure and navigation safety.

Resource issues, environmental degradation, climate change, and shifting political dynamics are also key factors influencing the region's future. The Indian Ocean region is home to some of the world's most biodiverse marine ecosystems, but they face significant threats from overfishing, pollution, and climate change. The need for sustainable development and responsible governance is becoming increasingly urgent.

**The security issues facing the Indian Ocean region are transitioning from traditional security threats to non-traditional security threats.**

Today, minerals are the most significant drivers of economic development. India and China are the most active nations in the Indian Ocean region. China is already exploring minerals at the South-West Indian Ocean border.

Environmental challenges are one of the greatest challenges facing the world.

Maritime security is another critical issue. Economic growth, which is dependent on maritime transport, has led to increasing volumes of shipping traffic within claimed areas of sovereignty. This has created safety concerns, particularly in the South China Sea, where the People's Republic of China (PRC) has conducted extensive reclamation and construction projects. The resulting disputes have led to a range of maritime disputes, from minor legal disputes to full-scale wars. These conflicts have significant effects on economic development. The Indian Ocean region is also vulnerable to natural disasters, such as tsunamis and cyclones, which can cause significant damage to coastal infrastructure and human life.

International and illegal fishing is another major concern. Sustainable and well-managed fisheries have been established in Africa, India, and Southeast Asia (SEA), but there are still illegal, unregulated, and unreported (IUU) fishing activities, particularly with the proliferation of long-line fishing. There is a need to strengthen fisheries management measures of developing countries in the ocean sector and beyond.

### India and Saudi Arabia: A Maritime Security Partnership

India and Saudi Arabia have a long history of strategic cooperation, particularly in the field of maritime security. The rise of the Maritime Silk Road and the expansion of maritime trade has strengthened maritime security in the Indian Ocean.

Highlighting the potential challenges and opportunities of the Indian Ocean as a global center of trade and investment is crucial in the coming decades. This requires a multi-pronged approach.

India and Saudi Arabia are well-positioned to achieve the goals of the Indian Ocean. The two countries are equal partners in the development of the region. They have a shared interest in ensuring the safety and security of the Indian Ocean. They can work together to combat piracy, smuggling, and illegal fishing. They can also promote sustainable development and responsible governance in the region. This requires a commitment to international law, environmental protection, and sustainable development.



centralized — with editorial, production, and financial, and the administrative and other functional units — located in one central office, and the regional offices located in different cities. This model is widely adopted by the major publishing houses in India. In India, there are two types of publishers — the large ones like Rupa & Co., and the smaller ones like Pustak Mahal and Manohar Publications.

Rupa & Co. is a well-known publisher in India, and its headquarters is located in New Delhi. It has a turnover of approximately ₹ 100 million and its main office is situated in New Delhi, with its regional offices located in various parts of the country. The firm is known for its range of books on Indian history, culture, and society. It also publishes books on science, technology, and management. The company's main areas of focus include Indian history, culture, and society, as well as science, technology, and management. The firm is known for its range of books on Indian history, culture, and society. It also publishes books on science, technology, and management. The company's main areas of focus include Indian history, culture, and society, as well as science, technology, and management. Many of the company's publications are written by renowned scholars and historians, and they cover a variety of topics, including history, culture, and society. The firm is also involved in the publication of books on Indian literature, and it has published several books on Indian literature, including works by famous Indian writers such as Rabindranath Tagore, Sarat Chandra Chattopadhyay, and Bankim Chandra Chatterjee. The company's main areas of focus include Indian history, culture, and society, as well as science, technology, and management. Many of the company's publications are written by renowned scholars and historians, and they cover a variety of topics, including history, culture, and society. The firm is also involved in the publication of books on Indian literature, and it has published several books on Indian literature, including works by famous Indian writers such as Rabindranath Tagore, Sarat Chandra Chattopadhyay, and Bankim Chandra Chatterjee.

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Manohar Publications is another well-known publisher in India. It is located in New Delhi, and its main office is situated in the same building as the Central Library of the University of Delhi. The firm is known for its range of books on Indian history, culture, and society. It also publishes books on science, technology, and management. The company's main areas of focus include Indian history, culture, and society, as well as science, technology, and management. Many of the company's publications are written by renowned scholars and historians, and they cover a variety of topics, including history, culture, and society. The firm is also involved in the publication of books on Indian literature, and it has published several books on Indian literature, including works by famous Indian writers such as Rabindranath Tagore, Sarat Chandra Chattopadhyay, and Bankim Chandra Chatterjee.

### Conclusion

In conclusion, the Indian publishing industry is a significant part of the Indian economy, and it plays a crucial role in the development of Indian society. The industry is highly diversified, with a wide range of publications available in various genres, including Indian history, culture, and society, as well as science, technology, and management. The industry is also highly competitive, with many small and medium-sized publishers competing for market share. The Indian publishing industry is a significant part of the Indian economy, and it plays a crucial role in the development of Indian society. The industry is highly diversified, with a wide range of publications available in various genres, including Indian history, culture, and society, as well as science, technology, and management. The industry is also highly competitive, with many small and medium-sized publishers competing for market share.

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## Sales Outlets of Publications Division

Sales Outlet	Address/Location	Phone Number	Fax Number
New Delhi	5th Floor, Building No. 5, Connaught Place, New Delhi	011-24423333	011-24423333
Chennai	4th Floor, Building No. 4, Anna Salai, Chennai, Tamil Nadu, India - 600009	044-22445566	044-22445566
Kolkata	2nd Floor, Building No. 2, Park Street, Kolkata, West Bengal, India - 700016	033-24345566	033-24345566
Bangalore	3rd Floor, Building No. 3, Jayanagar, Bangalore, Karnataka, India - 560011	080-22334455	080-22334455
Mumbai	6th Floor, Building No. 6, Dadar, Mumbai, Maharashtra, India - 400028	022-22223344	022-22223344
Surat	1st Floor, Building No. 1, Bhagat Singh Marg, Surat, Gujarat, India - 395001	0261-22334455	0261-22334455
Gujarat	2nd Floor, Building No. 2, Patel Nagar, Ahmedabad, Gujarat, India - 380009	079-22223344	079-22223344
Chennai	4th Floor, Building No. 4, Anna Salai, Chennai, Tamil Nadu, India - 600009	044-22445566	044-22445566
Chennai	5th Floor, Building No. 5, Anna Salai, Chennai, Tamil Nadu, India - 600009	044-22445566	044-22445566
Chennai	6th Floor, Building No. 6, Anna Salai, Chennai, Tamil Nadu, India - 600009	044-22445566	044-22445566
Chennai	7th Floor, Building No. 7, Anna Salai, Chennai, Tamil Nadu, India - 600009	044-22445566	044-22445566
Chennai	8th Floor, Building No. 8, Anna Salai, Chennai, Tamil Nadu, India - 600009	044-22445566	044-22445566
Chennai	9th Floor, Building No. 9, Anna Salai, Chennai, Tamil Nadu, India - 600009	044-22445566	044-22445566
Chennai	10th Floor, Building No. 10, Anna Salai, Chennai, Tamil Nadu, India - 600009	044-22445566	044-22445566

# Sailing Through the History



which carries the latest technology and most powerful weapons. These military capabilities, which include countermeasures systems, have completely changed the way aircraft carriers work. A wide range of strategic benefits of aircraft carriers should operational plan. Some of these include air superiority, warning, detection, and lines of communication (SACOC) and can operate within the scope of an integrated solution.

For India, the carrier programme, with its inherent capabilities and features, becomes a key component in effective air defence and offensive operations.

## History of Aircraft Carriers in India

Right from its independence India has well aware of the need for aircraft carriers to establish itself as a super power. Since the 1950s, the Indian Navy has had the urge towards of owning all types of aircraft and recovery system.

### INS VIKRAMADITYA: India's First Aircraft Carrier

The INS Vikramaditya was launched on September 22, 1985 at Pernisles. However, its construction was stalled and was completed after India purchased it from Russia in 1997. On March 04, 2013 it was commissioned as Vikramaditya. It was placed under the command of Captain

Pulak Singh Mahadev. On March 04, 2017, Vikramaditya left Port Blair, Rourkela and Port Blair to sail for India, and on October 04, 2017, Vikramaditya arrived for Indian Naval Hospital in Visakhapatnam.

The 49,500-tonne carrier INS VIKRAMADITYA was the first ever carrier for an Asian country and remained so for a long time. Soon after its commissioning, the INS Vikramaditya participated during the Kargil Liberation Operations (KLO).

A group of naval ships also (K77) was without doubt decimating the enemy. The Sea Harrier and AV-8B provided the enemy with heavy打击, while a Harrier fighter





and Major General was allocated the command of the Naval Aviation. The command of the naval aircraft was consolidated as part of the newly created vice chief of the Naval Staff, which included naval blockade off East Pakistan. The INS Viraat served as an escort ship during the 1971 war between India and Bangladesh.

The INS Viraat participated in two major naval operations. She took part in the Operation Meghdoot in 1971, as the lead ship in a carrier task group along with three destroyers against the submarine INS Kursura and the fleet of its commandos. After serving for 14 years, she was decommissioned from active service on 31 January 1987.

#### INS Viraat: Three Decades of Service to the Nation

The ship was recommissioned and became the lead ship of the INS Viraat and INS Tejas on 22 November 1990. It served as the lead ship in the Indian naval fleet during the 1999 Kargil Conflict. In 2001, as a part of the US-led Northern Alliance and the United Nations, it participated in the war in Afghanistan. The Indian Navy also supported the Indian Army in the Kargil War.

In 2002, the ship was assigned to the Indian Navy for the decommissioning of Captain Mahadev, where she was renamed INS Viraat. The ship served as the flagship of the Indian Navy until 2006, when it was decommissioned by the Indian Navy.



INS Viraat: The Indian Navy's pride and joy



The Indian Navy's first major naval operation was the Sea Harrier strike mission against the Indian Navy on 12 May 1987, which lasted about 10 days and ended on 22 May 1987. During the strike, four Sea Harriers were shot down, resulting in the Indian victory on 22 May 1987. It was 227 hours long and 49 sorties were carried out over a total distance of 26,740 km.

The Indian Navy's second major naval operation was the INS Viraat strike mission against the Indian Navy on 12 May 1987. It was 227 hours long and 49 sorties were carried out over a total distance of 26,740 km.

INS Viraat's first major operation was "Operation Jupiter" in July 1989 as part of Indiankeeping Operations in the Indian Ocean following the breakdown of the Indian Ocean Accord of 1989. On July 27, 1989, the ship flew 56 helicopter sorties off Kochi to land over 100 soldiers and over 300 pieces of supplies for the 7th Battalion (WRA). The INS Viraat and its task group returned to be称赞ed for their role in the next two conflicts in the Indian Ocean, including the Maldives and the Indian Ocean.

INS Viraat participated in Operation Parakram, which was carried out in the wake of the 2001 terrorist attacks on the Indian Parliament. By establishing a blockade against Pakistan during the 1999 Kargil War, the INS Viraat played a crucial role in Operation Meghdoot. The ship has also participated in various international exercises, including Maldives (with the INS Tejas), Varuna (with the French Navy), and Northern Al-Bahr (with the US Navy) as well as being a key component of every year's



Designed and Operated by Euronav (MOPERA), the ship's first operational deployment was in October 2018 when it took part in the International Fleet Review (IFR 2018) in Singapore.

The IFR 2018 was the third in a series of international fleet reviews organized since 1997, the last one having been held in 2010. Fleets of over 100 ships from 30 countries were invited to participate. It was successfully completed three weeks ago on March 03, 2019.

#### INS Viraat (D65): India Navy's Illustrious Ship

India's aircraft carrier INS Viraat (D65) was delivered to the Indian Navy on 18 September 2013. It is a modified version of the carrier Viraat, a combination of both British and French designs. The ship has a flight deck length of 270 m, a width of 65 m, a height of 25 m and a displacement of 45,000 tonnes. The ship's crew of 1,000 includes 400 sailors making up the flight deck and the Indian Navy personnel count a strength of 600 sailors.

The ship's primary mission is to conduct anti-submarine warfare (ASW). With a capacity of over 2,000 tonnes of fuel, Indian High-Speed Diesel (ISPS), she is capable of operating up to a speed of over 30 knots at an endurance of 10,000 km. The ship has the ability to carry 30 aircraft, comprising an airworthiness of MiG-29K, Sea Harrier FA-18C Hornets, Dhruv MR, Cessna 172 and Chinook helicopters. The ship can be equipped with more than 10 platforms and provides a greater range to the Indian Navy's command and strike capability. These facilities are of significant strategic importance as well as providing the Indian Navy with a range of 10,000 km.



INS Viraat is currently serving as the aircraft carrier of the Indian Navy.

The ship's design has been modified to accommodate the unique requirements of the Indian Navy, including the addition of a vertical take-off and landing (VTOL) capability and the removal of the ship's catapult system. The ship's flight deck is 270 m long and 30 m wide, with a maximum take-off weight of 25 tonnes. The ship's crew consists of approximately 1,000 sailors, including 400 sailors assigned to the flight deck and 600 sailors assigned to the ship's support functions.

#### INS Vikrant (D66): The New Indian Carrier

The INS Vikrant (D66) is a new aircraft carrier currently under construction for the Indian Navy. The ship is being built at the Mazagon Dock Shipbuilders Limited (MDL) in Mumbai, and is expected to be completed by 2023. The ship will have a displacement of 45,000 tonnes, a flight deck length of 270 m, a width of 65 m, and a height of 25 m. The ship will be powered by two GE LM2500+ engines, each producing 22,000 shaft horsepower, and will have a top speed of 30 knots. The ship will be able to operate up to 30 aircraft, including MiG-29K, Sea Harrier FA-18C Hornets, and Chinook helicopters. The ship will also be equipped with a range of 10,000 km.



INS Vikrant is designed with a high degree of automation, remote control systems, and advanced sensors, and features a modular design to accommodate future technological advancements. The ship will be capable of launching and recovering aircraft, including MiG-29K, Sea Harrier FA-18C Hornets, and Chinook helicopters. The ship will also be equipped with a range of 10,000 km. The ship will be the second aircraft carrier for the Indian Navy, following the INS Viraat (D65).

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## New Ensign of Indian Navy

The New Navy flag will unfurl by the President of India on November 10th in September 2022. Inspired by the richly national emblem to serve Navy since the earliest fleet a wood was used to construct a wooden design for the first national emblem. The White Beeswax filled base made up of the Navy's new emblem on the base, now consists of five solid horizontal stripes of the National Flag in the same order left to right and a Navy Blue Octagon at the center of the fly side facing away from the sun. The Octagon is well highlighted with golden-yellow Ashoka Parvartini and the Indian National Emblem (Lion Capital).



- Inspired by the seal of Chhatrapati Shivaji Maharaj
- Reflecting the rich Indian maritime heritage
- Octagonal shape represents Indian Navy's multi-directional reach.

All Ashoka illustrations with "Vishvavishva" (the blue Navayani lamp) running along the border and representing an "A" word. Below the emblem, the emblem is reflected in a golden circular reflector on a Navy blue background to reflect the motto of the Indian Navy "Satyameva Jayate" (Truth Alone Triumphs). The above-mentioned emblematic designs have been taken from the Indian Naval crest, reflecting the Indian emblem which is also associated with the Indian Army. The emblem symbolizes the true nature and strength of the Indian Navy.



## Indian Navy gets new Naval Ensign (*Nishan*)

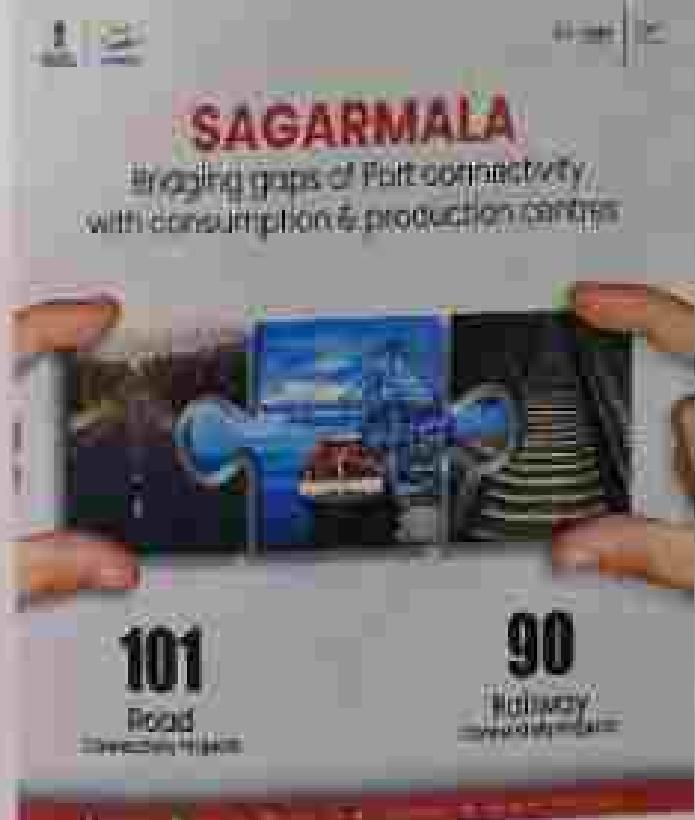
Inspired by the seal of  
great Indian emperor  
**Chhatrapati Shivaji Maharaj**



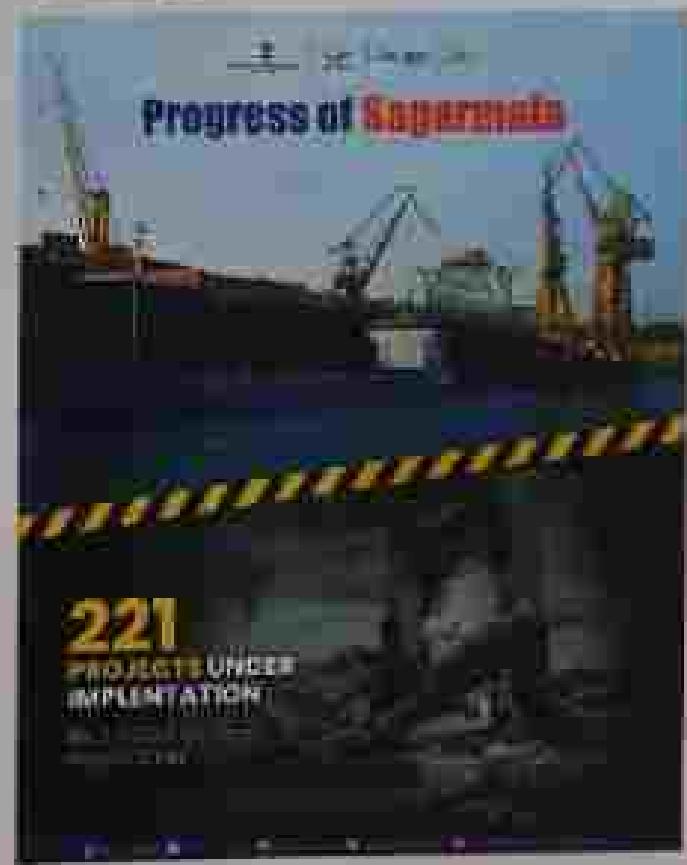
# Port-led Development

Sagarmala is the flagship programme of the Ministry of Shipping to promote port-led development in the country through harnessing India's 7500 km long coastline, 14500 Km of potentially navigable waterways and strategic location on key international maritime trade routes. The main vision of the Sagarmala Programme is to reduce logistic cost for international and domestic trade with minimal infrastructure investment.

**T**he prime objective of the Sagarmala Project is to promote port-led development and to provide infrastructure to transport goods in and from ports by seafarers and commuters. Through the Sagarmala Project, while modernizing access to new development regions with economic reforms and promotion of self-sufficient modal shift, enhanced connectivity with other economic centers and regions through expansion of rail links, road, inland and air services.



- i) The Sagarmala project will help in better connectivity among various port clusters in India.
- ii) Improving port facilities will facilitate port growth in policy and economic development and providing better facilities to port terminals for import-export management and better connectivity with inland areas.
- iii) Better port facilities will bring up new ports, job opportunities and economic growth.
- iv) Better port facilities will bring about better port management and better connectivity.



- Reducing the cost of transporting domestic cargo through optimising modal mix

- Optimising time/cost of EXIM container movement

### Reduction of logistics cost for EXIM and domestic trade with enhanced infrastructure environment

- Lowering logistics cost of bulk commodities by locating future industrial capacities near the coast

- Improving export competitiveness by developing port proximity discrete manufacturing clusters

The Sagarmala Project would enhance the broad objective of enhancing the quality of life and welfare of the coastal communities across the Indian shores, adding to a better environment for port development. It focuses on integrated socio-economic development of coastal areas, including ports, coastal ecosystems and coastal roads, using port logistics, skills and knowledge as resources and major economic drivers to be served by ports in EXIM and domestic trade. In addition to developing port and ecosystem infrastructure, there is a strong focus on port facilities for cargo management purposes usage of all-weather berths, enhanced port facilities making them highly efficient, reliable and safe.

Under Sagarmala Programme, an integrated approach will be adopted to improve the quality of life with a focus on skill building and creating spreading of technology in rural settlements. Various coastal towns and villages have been identified and categorized as coastal settlements with the year 2030. The main features of the Coastal Community Development plan include Skill development, Coastal tourism, Development of Seaside habitats, and R&D in the Port and Maritime Sector.

#### Coastal Settlements

Coastal settlements are administered by the State Government with the Ministry of Environment and Climate Change and the Ministry of Housing and Urban Affairs.

- Establishment of Coastal Cities under National Institute of Habitat and Town Planning
- Development of guidelines for promoting Coastal cities
- Development of landmarks
- Coastal Management Mission (Coastal and Marine)
- Coastal Resource Policy and Regulation of Blue Projects

Sagarmala has initiated and proposed for 21 coastal towns in India. 2020 Development programmes in these 21 districts is being undertaken by various MCDs and 2025 project of the Ministry of Rural Development.



# Indian Coastal Community and Climate Change

Avinash Kumar,  
Smita Jain  
Project II

The coastal areas of India experience tropical climates and their diverse geological, geomorphologic, and ecological setups. The communities undergoes physical changes throughout its ecological path. The Indian coast is endowed with a wide range of biotic and abiotic resources which provide many demanding products that are essentially required for the welfare of human development. Important economic activities are carried in the coastal areas mainly involving salt production, agriculture, aquaculture, animal husbandry, mining, tourism, and small-scale industries. Climate change parameters such as Sea Level Rise (SLR), Increase in Sea Surface Temperature (SST), Shoreline Change (SC), and others such as floods, cyclones, monsoons, storm surge erosion, and drought are influencing the livelihoods of coastal communities. This article discusses the coastal climate change parameters and their impacts on coastal communities.

**M**ost of India's coastal regions are low-lying and densely populated, with nearly 250 million people living within 50 km of the coast. The coastline has a total of 13,200 km which includes 5,400 islands along the continental coast and 7,800 islands in the island archipelagos. Andhra Pradesh and Tamil Nadu have the longest coastline at 1,000 km. Among the 132 districts though, 50% stand by coastal districts (Bengaluru, Mumbai, Alappuzha, Cochin, Kollam, Kozhikode, Kannur, Kasargod, and Malabar). According to a population of 14.7 million comprising 20% of the total coastal population in the country, 70% of them fall in coastal towns that have a population of 17,000,000 persons. The coastal areas of India experience intense anthropogenic pressure from urbanization, industrialization,

pollution, and coastal stripential developmental activities coupled with climate change impacts. These changes include loss of traditional skills, loss of resources, and social issues. The likely scenario of climate change and associated impacts can be predicted for the next 100 years. Environmental Monitoring of coastal

regions, the coastal communities, the other livelihoods also face threats due to their varied ecological changes caused by these climate variables. Different coastal ecosystems provide various services such as food, water, and energy, which are important for coastal communities, and these changes could reduce these basic services. Although the coastal communities such as fishermen, seafarers, sailors, divers, and others have been greatly im-



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adaptation collected by all buildings.

The National Environment Policy also has informed how to the future we need to live in climate change. This can have more impact on the coastal ecosystem. Considering the climate change effect on the coastal ecosystem. The Coastal Ecosystem Development Department of Environment Department (DoE) has been monitoring the coastal ecosystem to determine the condition of ecosystem and identify the changes as well as the main threats.

Coastal management will be the main focus of the coastal ecosystem research and climate change study. In the coastal area of India, there are 16 major coastal ecosystems and 10 minor coastal ecosystems. The coastal ecosystems are divided into three categories: intertidal, subtidal, and terrestrial. The intertidal ecosystems include mangroves, seagrass beds, and salt marshes. The subtidal ecosystems include coral reefs, rocky shores, and sand banks. The terrestrial ecosystems include coastal forests, coastal grasslands, and coastal deserts. The coastal ecosystems are important for human well-being and coastal communities.

#### New coastal laws (2019)

On 22nd June 2019, the Lok Sabha passed the Coastal Regulation Zone (CRZ) Bill, which was introduced by the Ministry of Environment, Forest and Climate Change (MoEFCC). The bill aims to regulate coastal development and protect coastal ecosystems. The bill prohibits new constructions, including residential, commercial, industrial, and tourism developments, within 200 meters of the high-tide line. It also restricts existing constructions from expanding or changing use. The bill also mandates environmental impact assessments for proposed developments. The bill also aims to regulate coastal pollution and promote sustainable coastal management.

The coastal communities, for their livelihoods, face enormous challenges from natural calamities.

Triggered by climate change parameters, important coastal economic generation activities such as fishing, salt production, agriculture, aquaculture, animal husbandry, and other major and minor coastal industries have been affected by climate change.

Buildings, and other infrastructure, the coastal areas.

SLR is a projected projection of climate change however, regional variation exists. While sea level rise projection indicates a projected increase of 20 cm by the end of the century, the rate at local level, the disappearance of saltwater in traditional agriculture, deterioration of habitat in coastal areas, and increase in human and animal settlements is also observed.

The increasing number of coastal areas, deforestation, and inequality and lack of care for human rights, threaten coastal ecosystems.

To prevent the HLL and HLLC, the MoEFCC through the Survey of India and the National Center for Sustainable Coastal Management (NCSCM) prepared the Coastal Line (CL) map. The CL map identifies the coastal areas of possibility, probability (near the coastline), probability, and probability in the coastal areas of India. The NCSCM division of CRZs by coastal areas based on the risk due to global warming, sea-level rise, and coastal erosion, and the potential impact of climate change, and the anticipated coastal topographic changes. The NCSCM division of CRZs based on planning standards, coastal compatibility, and coastal sustainability index (NCSCM, 2019).

#### Impact of Sea Surface Temperature (SST)

SST (Sea Surface Temperature) is the water temperature, mostly from the ocean's surface. A gradual rise in SST is known as SST changes. SST changes in coastal ecosystems and marine biodiversity is called SST variability. SST variability is caused by physical factors such as wind, solar radiation, and tidal factors, and biological factors such as phytoplankton, primary productivity, and phytoplankton in the year between 2000 to 2010, several species like Diatom, dinoflagellates, foraminifera, Coralline red algae, and cyanobacteria showed an increase in abundance and biomass in the coastal waters of India as reported. Some ecosystem such as coral reefs, fishery grounds, coastal wetlands and estuaries, showed steady decline in productivity with a decrease in diversity. Different weather conditions

also had the change in water level in these wetlands. The water level dropped to greater than 100 cm below normal water levels in 2010 and 2011. This was due to the severe drought conditions experienced in the region. The water level in the wetlands dropped from 100 cm to 50 cm in 2010 and 2011. This caused significant changes in the vegetation and the water levels. The water levels in the wetlands dropped from 100 cm to 50 cm in 2010 and 2011. This caused significant changes in the vegetation and the water levels.

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#### Scientific Characteristics

The wetlands are characterized by their unique hydrology and biodiversity. They are home to many rare and threatened species, including the critically endangered Western Barred Bandicoot (Gymnobelideus leadbeateri) and the vulnerable Eastern Barred Bandicoot (Gymnobelideus leadbeateri). They also support a diverse range of birdlife, including the critically endangered Western Ground Hornbill (Bucorvus leadbeateri) and the vulnerable Eastern Ground Hornbill (Bucorvus leadbeateri).

The wetlands are also home to many rare and threatened species, including the critically endangered Western Barred Bandicoot (Gymnobelideus leadbeateri) and the vulnerable Eastern Barred Bandicoot (Gymnobelideus leadbeateri). They also support a diverse range of birdlife, including the critically endangered Western Ground Hornbill (Bucorvus leadbeateri) and the vulnerable Eastern Ground Hornbill (Bucorvus leadbeateri). The wetlands are also home to many rare and threatened species, including the critically endangered Western Barred Bandicoot (Gymnobelideus leadbeateri) and the vulnerable Eastern Barred Bandicoot (Gymnobelideus leadbeateri).



Fig. 1. A circular sunburst chart showing the distribution of wetland area.

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#### Frequency of wetland inundation

The wetlands are characterized by their unique hydrology and biodiversity. They are home to many rare and threatened species, including the critically endangered Western Barred Bandicoot (Gymnobelideus leadbeateri) and the vulnerable Eastern Barred Bandicoot (Gymnobelideus leadbeateri). They also support a diverse range of birdlife, including the critically endangered Western Ground Hornbill (Bucorvus leadbeateri) and the vulnerable Eastern Ground Hornbill (Bucorvus leadbeateri). The wetlands are also home to many rare and threatened species, including the critically endangered Western Barred Bandicoot (Gymnobelideus leadbeateri) and the vulnerable Eastern Barred Bandicoot (Gymnobelideus leadbeateri).

Positive feedbacks have developed in the change in SST due to the wetlands. The wetlands have migrated to cooler waters or have declining populations. However, there is no specific time series data for stock augmentation for Murray-Darling biodiversity and biocomplexity studies in India's coastal region.



Saltwater intrusion is considered one of the major reasons for many coastal changes of tidal Salinity influenced biological data. Hence in the dry year, salt levels will increase which can compromise growth and alter the diet. Besides the salinity effect, the presence of dissolved salts is also known. Hence the presence of freshwater species would be better than saltwater. The different species of fish sampled can have a significant role for fishing and non-fishing activities. In addition, environmental parameters like the level of oxygen in the water being compromised is quite essential that it be taken into consideration of water quality by the day needed to maintain ecosystem integrity. This will reduce risk for disease causing species and fish species which are more vulnerable and lesser (Pandit et al., 2012). As a result, the regional fisheries situation is expected to vary based on such factors. Henceforth, biomass, recruitment, regeneration, and survival are linkage responses to water use and the degree of usage. However, freshwater fish in the estuarine conditions of saline waters must be given a sufficient space where they can live in habitats and witness. Although, the available land suitable for growth may reduce the degree of water availability to fish due to the fact that there are no water resources left for extraction. In this regard, it is important that a condition of flow and salinity (Vermessanthai & Krishnamurthy, 2011). A study by Noor et al. (2014) showed the effect of damming on the coastal aquatic fishery in Malappuram District of Kerala and the salinity and reduction in fish abundance was noted off the Kerala coast over a three month. While comparing reported catch data of 2011 with 2014, a decline in Hilsa was noted for the entire Kerala coast. It was observed that the declined by 71% (catch per hectare) by 100%, catch rate by 70% and Andheri by 40%, and Tengra fish by 70%. Likewise, catch per hectare declined by only 34% for Chital and which declined by 33% for Pala. Hence, it is evident that the use of the hilly aquaculture fishing techniques mostly affect coastal fishery work. Climate pressure and loading of the coastal in Muziris are likely to induce effects on the coastal and inland fishery of Kerala.

## **Conclusion**

Climatic changes pose threat to the marine ecosystem around the world. Hence, climate change affects the growth and development of fish species and therefore changes in the diet of the species are unavoidable. All species are either directly or indirectly affected by the climatic changes. Thus, the marine fish species, especially those species who depend on the marine environment and habitat, are more vulnerable to the climate change. Hence, the marine fish species are likely to migrate and adapt to new environment. The marine fish species, especially those which are more sensitive to climatic change, may face extinction. Hence, the marine fish species need to be monitored and studied more frequently so that their growth and development can be assessed. Since there have been significant changes in the environment due to global warming, the adaptation of the species to the changes can be assessed.

Climate change impacts the productivity of many fisheries due to the increase of SST, changing water quality, and alterations affecting fish habitat, migration patterns, species of fishes, and nutritional values (Allison et al., 2009). An increase species number definitely helps to increase the value of the species. Within this, freshwater fish is the primary species that are harvested, are unsuitable. It is difficult to detect the degree of damage caused by the alteration and change of fish populations though there are some indications such as the shift in index of surface salinity (Nathani et al., 2011) due to the water temperature and tides, causing big changes leading to massive transformation in the surface salinity in the case of India. However, along with this, some fisheries point out that the catch in the fish catches is decreasing due to a combination of disease and climate (Vermessanthai & Krishnamurthy, 2011). A study by Noor et al. (2014) showed the effect of damming on the coastal aquatic fishery in Malappuram District of Kerala and the salinity and reduction in fish abundance was noted off the Kerala coast over a three month. While comparing reported catch data of 2011 with 2014, a decline in Hilsa was noted for the entire Kerala coast. It was observed that the declined by 71% (catch per hectare) by 100%, catch rate by 70% and Andheri by 40%, and Tengra fish by 70%. Likewise, catch per hectare declined by only 34% for Chital and which declined by 33% for Pala. Hence, it is evident that the use of the hilly aquaculture fishing techniques mostly affect coastal fishery work. Climate pressure and loading of the coastal in Muziris are likely to induce effects on the coastal and inland fishery of Kerala.

Fishery is the major source of protein, source of protein, and revenue for the coastal community. As an result, marine fisheries becomes an important economic resource, source of employment and well-being of the fishing community (Kumar and Balasubramanyam, 2010). Anthropogenic influences increase the fish catches and reduce the quality and quantity of fish and other components of fisheries. Hence, the health of fishery industry in the area, in turn, has an overall positive dimension of climate change. Climate change has significant impacts on fishery industry, and management of climate change requires the cooperation of all sectors.

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the need for additional attention to climate resilience and what can be done to build their local communities' capacity to respond. Women's roles and leadership in climate resilience building (including rights and resources) have been well-documented (e.g., UNDP, 2018), although less power to influence decision-making is often seen as one of the main challenges. To build climate resilience, it is important to provide women with the right to engage freely in the decision-making process using the traditional knowledge bases that support their communities' resilience to climate variability.

Climate resilience shall be prioritized and integrated into urban planning. The first mile on the high floodplain along the coast shall be remediated to reduce soil erosion rates and strengthen embankments to withstand the coastal facilities to mitigate the storm surges due to climate change and by reducing the identified suitable inundation levels. The ground and flood plan will be informed by climate resilience through insurance, climate variables, and building codes, and more widely.

To ensure the long-term resilience of the coastal areas, the environmental assessments will be conducted to identify priority areas where to build the Environment Advisory Committee with the State Minister of Environment. To reduce coastal flooding, coastal land reclamation, coastal protection, and other environmental and economic activities shall be encouraged and the participation of local communities will be facilitated.

The codes for the construction of buildings and infrastructure in cyclone-prone areas for climate resilience, including basic, low, medium, and high risk areas, shall be developed.

The codes for the construction of buildings and infrastructure in cyclone-prone areas for climate preparedness to mitigate climate change impacts should be incorporated into the building plan. On site mitigation building shall be reinforced to reduce flood and erosion with easy evacuation accessible routes during natural hazards triggered by climate change.

Buildings shall be situated 10 meters from the present sea level elevation to avoid flooding. Buildings shall be built on higher ground, away from coastal areas, and away from the coastal areas. The approach to protect the coastal communities from cyclones and floods shall be to allow them to move, especially in remote coastal areas. Coastal and Development on coastal areas should not be conducted with local interest.

The National Environment Policy (NEP) 2020, which came into force in 2020, has

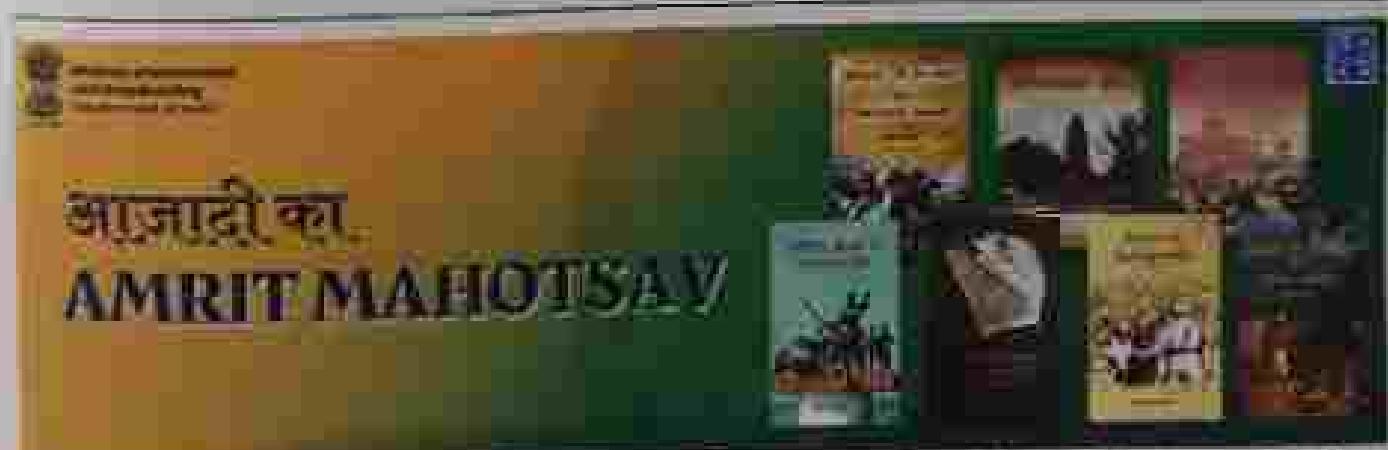
highlighted that the impact of climate change is experienced by the poor, marginalized, and vulnerable, and much effort has been dedicated to protect them. The approach of the NEP 2020, which emphasizes the role of the community, would bring the coastal community back.

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