

# SEA-LEVEL RISE AND REAL CHALLENGES FOR INDIAN COASTS

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## INTRODUCTION

The accelerated heating of our planet has led to an unprecedented rise in the average sea levels world over primarily by: (1) mountain glaciers and polar ice sheets that store much more water in them than any other source on land are melting at an accelerated rate over the last few centuries due to anthropogenic activities, and, (2) warm water expands thereby causing an increase in its volume. Presently this increase has been estimated as 3 mm per year but, this being an average value it does not reveal the regional variations occurring due to local factors like wind flow, ocean currents, subsidence or emergence of the ground, land erosion, etc. Rising sea level has an adverse effect on the entire coastal ecosystems and entities dependent on them. As saline water penetrates freshwater bodies and living areas, it disrupts the local ecosystem, most of which is irreversible. As the planet traps more heat due to GHG emissions and other reasons, mean sea levels will rise over a few more centuries before reaching an equilibrium level; the rate of which will depend on the future levels of emissions and ice melting. The peninsular position of India with its coastline of 7516.6 kilometres gives it a geostrategic location on Earth, but has also put the entire subcontinent at risk of rising sea levels and related climatic change-induced disasters. Almost 17 crore people in India are at the front lines of rising coast-

al erosion and mean sea levels, shore-line loss, and natural calamities like cyclones. The Coromandal coast, Malabar coast and most of India's eastern coastline is a 'coast of emergence', created land upliftment and/or by receding of the ocean waters. Konk-an area oppositely, is a 'coast of submergence' formed by subduction of land under the ocean water. The western coast of India exhibits both the phenomena of emergence and submergence, due to faulting of the sedimentary rock bed, which makes these areas more susceptible to inundation by increasing sea levels. Historically as well, in the past sea level rise has caused the submergence of huge areas:

1. Dwarka in the western sector is a popular example, wherein increased sea levels caused flooding and submergence, which was later proven by archaeological studies, a few miles into the sea.

2. About 25km east of Poompuhar on the Tamil Nadu coast, scientists discovered an ancient harbor-like structure under the sea, estimated to be around 15000 years old along with the original Poompuhar city that shifted location four times due to continuous sea level rise. Both these examples are evidence of the continuous process of geological changes that the planet undergoes continuously in a value-neutral manner; the natural balance is now being disturbed by pollution and global warming. The Green



Climate Fund estimates that around 25 crore of the Indian population lives within a radius of 50 kilometres from the sea shores and therefore are most threatened by the impacts of global warming making them more susceptible to be affected by extreme temperature variations, rainfall pattern disruptions, etc. Climate scientists from Stanford University calculated the economic impact of climatic change on India and found that the Indian economy would have been 31% bigger than its present size, had it not been affected by unusual climatic changes.

## ESTIMATES OF SEA LEVEL RISE ALONG INDIAN COASTS

From 1993 to 2012, the mean sea level rise in the Indian Ocean (northern areas) has been estimated to have increased by 3.2 mm every year- much faster than other ocean regions of the world, in the same time frame, as per a study report based on satellite altimetry data. The same report mentions a rise of 5mm for the eastern and northern parts of the Bay of Bengal. A joint report published by IITM Pune and the Union Ministry of Earth Sciences, in June 2020 said: “from 1874 to 2004, the mean sea level rise in the northern Indian Ocean was 1.06-1.75 mm per year – and 3.3 mm from 1993 to 2017”. “Climate Change 2021: The Physical Science Basis” in its report published on August 6th 2021 by IPCC (Intergovernmental Panel on Climate Change), mentions that sea levels in Asia, especially around the Northern Indian Ocean have risen at a much faster level, accompanied by loss of coastal soil cover and shore-line losses; than the global average.

## CHALLENGES FOR INDIAN COASTS

### ● THE EASTERN COASTLINE

The satellite-derived SCR data in 2017 on Indian coastline losses that occurred from 1989 to 2001 mentions the state-wise percentage of erosion: Orissa - 50%; Gujarat – 60%; Kerala – 65%; and West Bengal – 70%, the highest of all. The Bay of Bengal coastline is vulnerable to frequent cyclonic storms, sea level rise, coastal erosions, and other related threats. Prominent among these is the Sundarbans area, a prominent biodiversity hotspot that has the largest continuous mangrove forest, measuring around 10,000 square kms. This ecosystem supports rare plants and animal species, along with its 14 lakh human inhabitants, and also regulates the incoming seawater, storm and cyclonic surges, coastline erosion, etc. in the region, without which the cyclonic surge and the consequent sea water flooding would have been tremendous. Sundarbans delta (Indian side) is estimated to be submerging at an average rate of two to four mm every year. A significant amount of land erosion (around 170 kms) from 1973-2010, has been reported along the delta coastline. Considering this rate of sea level rise and coastland erosion, over a million people will have to be completely moved out of this area in the next 30 years. As some part of Sundarbans also lies in Bangladesh, which has been facing similar threats, it has created a huge wave of climate refugees there who seek to move to higher areas within the country or preferably cross over to India in search of safety. Bedford, Lohachara (the first residential island to disappear), Kabasgadi, and Suparibhanga islands have already gone underwater in



the last two and a half decades. Sagar Island (the largest one in Sundarbans, and a popular pilgrimage place that hosts the Ganga-sagar festival) is facing severe coastal erosion at a much faster than any other region in the world. The LAND-SAT terrain imagery released by NASA shows: that almost 12% of the total coastal line been lost to the sea in the last four decades. The local residents therein have been forced to out-migrate to other places as even the sea walls and other embankments here get flooded during storms, cyclones, and monsoons as water rushes in from the sea, ruining the settlement areas and agricultural lands. As saline water rushes in with the storm surge, it moves deep into the soil making it infertile for many seasons and also damaging the ground-water table. Thus, access to food, clothing, fresh water, and shelter has become difficult for the local poor residents thereby causing further social and health problems. Coastal flooding damages the physical infrastructure and livelihood sources of locals and makes the affected areas a breeding ground for water-borne diseases like typhoid and cholera and also the mosquito-driven diseases like malaria and dengue. With increasing global warming and sea levels the vulnerability to diseases also increases. Contaminated food and water sources along with increased salinity in the water cause gastrointestinal problems, and skin diseases thereby creating an epidemic-like situation. Salt-resistant crops were tried as an experiment in these areas, but the measure proved to be short-lived with minimal success. The 'Sundari' tree and other mangrove species along with the wildlife in this area have also been losing ground due to frequent climatic disruptions. 'Science Advances', in its June 2019 report mentioned

that the water outflow from the Himalayan glaciers has increased twice the rate, in the preceding four decades, with accelerated melting happening since the year 2000. Almost 25% of the glacial ice has been said to be lost in these areas. The areas downstream thus face a dual problem: inundation and sea level rise in monsoons and glacial water flooding in the summer season, thus disrupting the local ecosystems.

The Union Ministry of Earth Sciences in its report mentioned around 28% of Odisha's 550 kms of coastline to have been eroded between 1990 and 2016, with almost 50% of the coastal sediments becoming visible. Like Bengal, Odisha has been experiencing frequent cyclonic storms, prominent among which came in 1999, wherein coastal villages having sufficient mangrove cover were less affected by the storm and saw fewer deaths as compared to those who had less or almost no forest cover. The first-ever 'managed retreat' policy was tried in Odisha, by the state government after many villages in the Kendrapada district had to be completely relocated because of persistent coastline erosion and submergence of land by sea level rises. One of the last remaining villages in the 'Satabhaya' (zone of seven villages) area is said to have gone under water completely in 2011, after which the government responded more strongly in carrying out the relocations. However, such relocation programs often become controversial and also create dynamic psychological, economical, social, and political issues apart from rehabilitation grants, land rights, delivering promised services in the new areas, the negative reactions of locals to their new 'immigrants', etc. It is therefore very clear that the increase in sea levels isn't a sudden happening or an isolat-



ed crisis, but is very much related to climate change, and a hidden warning that, if we are not able to take proactive steps well within time, these issues will create a domino effect wherein the social and moral health of the society will also be affected.

- **WESTERN COAST**

The issues of sea level rise-induced relocations, migrations, submergence, etc. have also become manifest in major coastal cities like Mumbai, Chennai, Kolkata, and the Malabar and Konkan (3.7 mm rise) coasts as well which are at the maximum risk due to sea-level rise and frequent floods. Contrastingly, these areas are hubs of economical and technological growth in India, along with improper town planning, overpopulation, and concentration of wealth. Disasters strike everyone neutrally, but it's the individual context of the affected person that decides his ability to be able or unable to cope with the sudden changes. In August 2021, the Mumbai Municipal Commissioner Iqbal Singh mentioned: "Mumbai is the 1st city in South Asia to have a climate action plan of its own. The year 2020 was the first time in 129 years, that a cyclone (Nisarg) had hit Mumbai followed by 3 cyclonic storms in the following 1.5 years". The Chennai floods of 2015 also serve as a grim reminder as to what lies ahead if we continue to ignore these issues, owing to their slow pace of onset and manifestation.

## **1. OTHER CHALLENGES POSED BY RISING SEA LEVELS**

Apart from the risks of submergence, land erosion, etc. to understand the probable impacts of increased sea level rise, it must be

highlighted here some of the benefits that we derive from the ocean which will be significantly impacted if sea levels rise beyond a threshold: As per the 2011 national census, 15.5% (nearly 18.8 crores) of the Indian population lives in coastal districts and 4.4 lakh people live in the Island territories. With coastal erosion taking away most of the land, the existing areas will be under huge pressure to accommodate the internally displaced people, specially in the context of increasing population and scarce resources. Besides, smaller neighbouring countries of India are also facing these issues; climate refugees from which will most probably out-migrate towards India. About 90% of trade by volume and 75% by revenue in the South Asian region is seaborne via container ships. All of our 13 major ports and 100 plus minor ports and their connected infra are located directly on the coastline and handle huge cargo daily. It allows us to have the cheapest mode of transport and communication with the outside world, which will be negatively affected due to the rise in sea level. The coasts play a vital role in a nation's economy by encouraging tourism and allied professional activities thereby providing a livelihood to millions of people, directly and indirectly; bringing in huge foreign exchange and personal contacts. India's coasts are endowed with rich ecosystems that include a diverse range of mangroves, coral reefs, seagrasses, salt marshes, mud flats, estuaries, lagoons, and unique marine and coastal flora and fauna which has immense value, beyond its immediate economical benefits. India's fishing industry is one of the biggest in the world as it lies at the crossroads of the eastern and western economies; wholly de-



pendent on marine fishing, the availability of which has been negatively impacted by rising sea levels and heating. Security and energy infrastructure: Almost the entire security infrastructure of the Indian Navy, Coast Guard, marine police, etc. is located along the coastline. Other defense systems, missile launchpads, and testing areas, major nuclear power plants like Kudankulam, BARC, etc. are also located along the sea coasts. Natural disasters here can create havoc by disrupting the entire systems rendering them dysfunctional in no time at an unmanageable level. The disruptions caused by cyclone Tauktae in 2021, the flooding of the Fukushima nuclear plant in Japan, in 2011 and the damage caused to the USA Navy by the 1944 typhoon Cobra are popularly known examples of these kinds of threats. Unprotected and poor communities, tribals, heritage sites, etc. are more susceptible to scarcity of basic needs like food, shelter and water, making it tough for these communities to cope with climate change induced disasters. This will cause increased social, political and economic tensions in a already volatile society like India. As per an estimate by Dr. Tamma Carleton, climate change and related events will also increase suicide rates in India. As India seeks to dominate the global decision-making bodies with a desire for high-table participation and the Prime Minister articulates the vision of SAGAR (Security and Growth for all in the Region) while looking ahead to becoming a blue economy, the sustainability factor has also to be countered in, as any negative activity there will leave all these efforts and rhetoric useless.

## RECOMMENDATIONS

It has to be emphasized here that building sea walls, relocating entire cities as being done in Indonesia, and building concrete embankments are all short-term measures and are unsustainable in the longer run. Afforestation (location and context-specific; preferring local species of mangroves and other resilient species), active participation of citizens, global and regional collaboration, reformulation of other linked policies of family planning and population control, etc. are some of the measures that can be undertaken to deal with this issue in a comprehensive manner. All these are interconnected and action has to be taken by breaking the larger issue into small actionable steps. The very fact that a sea level rise is a slow-onset event, gives us sufficient time to plan and execute the counter strategies. Finding a balance between offsetting climate change and development schemes is a tricky act of balancing as immediate solutions have to be balanced with long-term planning and execution; mass-level awareness and sensitization is the first key step towards this. Mean sea level estimates are only an average of data collected over many years that are not necessarily error-free and therefore conceal many local differences which could affect how the grand strategy to mitigate climate change is planned and implemented. All of this will not be possible without strong global participation as rising sea levels is an issue that is happening at many places on Earth. Also, governments necessarily do not have the financial and technological where-with-all to deal with these issues, thereby making public-private partnerships inevitable.



National-level disaster management plans for such slow-onset disasters must have provisions for rehabilitation and managed retreats. Also, this issue needs to be understood in its entirety and merely looking at it from an economic or survival perspective

will not yield any results. Lastly, rather than countering these issues as a post-disaster response, proactive steps need to be taken well within time in a time-bound manner so as to stay safe from the future risks and costs that may accrue due to delayed responses.

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