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GOA'S VANISHING COASTLINE: 27% OF BEACHES SEVERELY ERODED AS TOURISM, CLIMATE PRESSURES MOUNT

A new study reveals alarming acceleration of shoreline degradation with iconic beaches at risk, as experts call for urgent nature-based interventions. KARSTEN MIRANDA reports

The idyllic beaches that have defined Goa's identity and powered its tourism economy are facing an unprecedented threat. Recent findings from the National Centre for Sustainable Coastal Management (NCSCM) reveal that coastal erosion now affects between 25-27% of Goa's coastline—a significant increase from the 21-22% recorded just five years ago.

According to the comprehensive NCSCM study covering 2010 to 2024, some 90 beach stretches across Goa, spanning 23.7 kilometers, are experiencing "persisting erosion." This translates to approximately 48-52 kilometres of Goa's total 193.9-kilometre coastline being affected, highlighting the escalating nature of this environmental challenge.

The geography of deterioration

The erosion pattern spans the entire state, though certain regions have been more severely impacted than others. In North Goa, Pernem taluka has emerged as the most critically affected area, with erosion impacting 41-46% of its coastline—representing 7.5 to 8.3 kilometers of its 18.3-kilometer shoreline. Popular destinations including Russian Beach, Manthan, Sweet Lake, Keri, Arambol, Mandrem, Azule, Ashwem, Montego, and Morjim are all experiencing significant erosion.

Salcete taluka in South Goa follows closely, with 18-38% of its beaches affected by erosion, impacting up to 8 kilometers of its 21.1-kilometer coastline. The beaches suffering degradation in this region include Gonsua, Betalbatim, Pandolim, Vespucci, Sernabatim, Benaulim, Varca, Cavelossim, Mobor, and Betul.

Bardez taluka, home to many of Goa's most famous tourist destinations, has also seen erosion affecting 19-25% of its coastline—up to 5.5 kilometres of the 22.2-kilometer stretch. Impacted beaches include Candolim, Calangute, Anjuna, Ozrant, Vagator, and Dream.

The NCSCM report indicates that stable coastline in North Goa has dramatically decreased from 30% to just 18%, while South Goa has witnessed an even more alarming decline from 23% to 9%. By contrast, coastal accretion—the natural process of beach growth—remains minimal, affecting only 6-7% of Goa's entire coastline.

The study points to a strong correlation between tourism activity and coastal degradation. Of the 90 beaches experiencing erosion, 88 were found to have significant tourism presence. This raises important questions about the sustainability of current tourism practices and infrastructure development along Goa's coast.

The NCSCM has attributed this degradation to "increased natural as well as human interventions" along the coastal zone.

Government response

In response to the escalating crisis, the State Environment Department established a 15-member expert committee in March 2025. The panel, chaired by the director of CSIR-National Institute of Oceanography (NIO), brings together specialists from institutions including Deltares (Netherlands), NIT Chennai, NCCR, CWPRS Pune, Anna University, and ISRO. Dr. R. Mani Murali from NIO Goa serves as the member convener.

This committee has been tasked with assessing existing reports, conducting field surveys, and formulating a comprehensive mitigation strategy. Among the solutions under consideration is the feasibility of employing sand motor technology, a Dutch coastal nourishment technique that has shown promise in similar environments.

COASTAL EROSION IN GOA

KEY FINDINGS

LATEST NCSCM STUDY: National Centre for Sustainable Coastal Management's comprehensive assessment covering 2010-2024 reveals alarming coastal deterioration

WIDESPREAD IMPACT: 25-27% of Goa's total 193.9km coastline (48-52km) affected by erosion

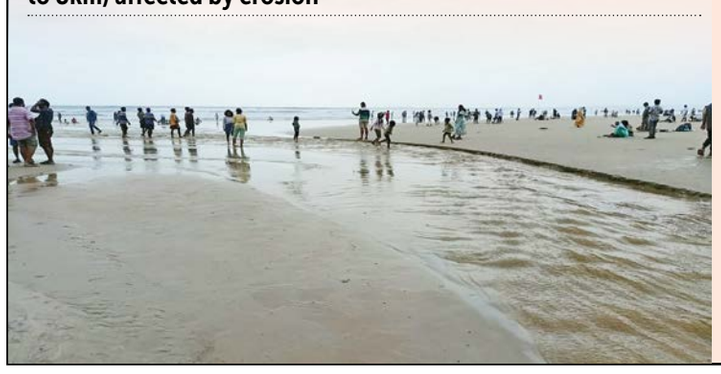
GROWING PROBLEM: Erosion increased from 21-22% five years ago to current levels

PERSISTENT DAMAGE: 90 beach stretches covering 23.7km show "persisting erosion" from 2010-2024

TOURISM CONNECTION: 88 of 90 eroded beaches have tourism activities

PERNEM MOST AFFECTED: 41-46% of Pernem's coastline (7.5-8.3km) experiencing erosion

SOUTH GOA IMPACT: Salcete taluka has 18-38% of beaches (up to 8km) affected by erosion



BEACHES AT RISK: Candolim, Calangute, Anjuna in Bardez taluka have 19-25% coastline eroded

DECLINING STABILITY: Stable coastline fell from 30% to 18% in North Goa and from 23% to just 9% in South Goa

LIMITED NATURAL RECOVERY: Only 6-7% of coastline shows accretion (natural beach growth)

EXPERT RECOMMENDATIONS

A recent workshop brought together scientists from NCSCM, NIO, Deltares (Netherlands), ISRO and coastal management specialists, who suggested the following mitigation measures

PRIORITISE NATURE-BASED SOLUTIONS: Implement sand nourishment, dune vegetation, and mangrove restoration

LIMIT HARD STRUCTURES: Use groynes and breakwaters sparingly to avoid disrupting adjacent coastal areas

CONDUCT LONG-TERM STUDIES: Develop systematic research to identify root causes of erosion

ADDRESS DATA GAPS: Improve monitoring of sediment transport, nearshore bathymetry, and river sediment supply

CREATE SITE-SPECIFIC SOLUTIONS: Complete Phase II of Deltares' study with numerical modeling for erosion hotspots

BUILD PUBLIC AWARENESS: Educate communities about benefits of nature-based approaches

ESTABLISH MONITORING PROGRAMME: Launch multi-institute effort to track coastal changes dynamically

International collaboration and funding

The Goa government has initiated consultations with Deltares, a Netherlands-based institute recognized for its expertise in coastal management. While speaking to reporters in February 2025, Environment Minister Aleixo Sequeira explained, "We recently held a conference on this issue and have initiated discussions with Deltares, which was chosen for its experience in tackling similar challenges in countries like Norway and Denmark. Their expertise has proven effective in controlling soil erosion to a large extent."

He emphasized that any intervention must align with the state's tourism interests, noting, "Tourism relies heavily on our beaches. While conventional protective measures such as tripods may safeguard the coastline, they could also disrupt tourists who prefer open and unobstructed shorelines." The minister disclosed that discussions are underway with the World Bank to secure a Rs 1,600 crore grant, part of which would be allocated to addressing coastal erosion.

November 2024 workshop moots scientific approach

A critical turning point in addressing Goa's coastal challenges came during a two-day national workshop on coastal management held in November 2024. Participants emphasized the importance of adopting soft, nature-based interventions for beach restoration, such as sand nourishment, dune vegetation, and mangrove restoration. These approaches aim to restore sediment balance, provide adaptive responses to climate uncertainties, and ensure long-term coastal stability.

The workshop cautioned against overreliance on hard structures like groynes and breakwaters due to their potential to disrupt adjacent coastal areas. Experts noted that trapping sand with such structures is less effective in Goa due to the lack of natural sediment sources. Instead, they advocated for systematic, long-term studies to identify root causes of erosion and develop tailored solutions for specific locations along Goa's coastline.

Significant data gaps were identified during the workshop, particularly in areas such as sediment transport, nearshore bathymetry, and river sediment supply from rivers like the Sal and Zuari. Experts called for collaborative research among institutions to address these gaps and recommended finalizing Phase II of Deltares' study, which would employ numerical modeling techniques to devise site-specific mitigation strategies for erosion hotspots like Mobor Beach.

Following the workshop, then-Director of Environment & Climatic Change, Johnson Fernandes, highlighted the environmental and economic challenges posed by coastal erosion in Goa. He explained that Phase I of Deltares' study had focused on data inventory, while Phase II would address mitigation measures. "The study assesses the impacts of human interventions like sand mining, as well as natural factors such as sea-level rise and storm impacts, which are exacerbating erosion rates along Goa's coast," he said.

In October 2024, following an incident where high sea levels submerged the shoreline of Majorda beach, Environment Minister Aleixo Sequeira invited NCSCM scientists to examine the affected area. The team, comprising five scientists, conducted an extensive investigation focusing primarily on Majorda beach, which had been identified as particularly vulnerable.

By November 2024, the NCSCM team had completed its study on sand erosion across Goa's beaches. Their research indicated that while the coastal belt experiences both beach accretion and erosion, the latter has become increasingly prevalent. The NCSCM scientists also sought to understand the wave patterns along the Goan coast, particularly whether waves breaking deep in the sea are encroaching onto the shoreline. They noted that erosion issues have been present since the 1990s but have significantly worsened over recent years.

Historical context: The sand dune ecosystem

Once considered pristine, Goa's coastal zone has undergone large-scale changes in its geological and ecological makeup over the decades. Dr. Antonio Mascarenhas, formerly with the National Institute of Oceanography (NIO) and ex-member of the Goa State Biodiversity Board, noted in an earlier interview with **O Heraldo,** "Time and again we have reiterated that the coast of Goa is under assault. Tourism and related human activities are a major cause. Several coastal areas have changed from virtual wilderness in the 1970s to haphazardly developed stretches, full of concrete buildings and related structures, in the last 30 years. "

Sand dune ecosystems, which are over 6,000 years old, have borne the maximum brunt of this development. These dunes serve as nature's first line of defense against cyclones, tsunamis, and other oceanic forces while also functioning as "sand banks" that maintain the dynamic equilibrium of beaches.

Studies by both NIO and NCSCM have documented how tourism development has led to significant sand dune degradation along coastal stretches from Betul to Cansaulim in South Goa and across the Sinquerim-Baga-Calangute-Candolim belt, Arambol, and parts of Morjim in North Goa.

Dr. Mascarenhas has warned against certain erosion prevention measures that could cause further beach degradation. "At Querim in Goa, a 300 metre long rubble wall was fixed in 2008, and tripods laid in 2010, blaming coastal erosion; in 2012, 2013, 2015, 2019, 2020 the beach in front disappeared completely, confirmed from satellite images; the strip has become overtly dynamic," he stated in his interview with Herald.

Expert solutions and warnings

Dr. Baban Ingole, associated with the National Centre for Polar & Ocean Research Goa, has emphasized the importance of adhering to Coastal Regulation Zone (CRZ) rules. "Constructions should not be allowed within 500 metres. What is 500 metres today will be 200 metres in years to come given the shoreline erosion, rise in sea levels... all effects of climate change," he told **O Heraldo.**

Ingole also referred to NASA projections showing that Mormugao faces the danger of being submerged by the end of the century. He noted that recent natural calamities like cyclones, combined with rough sea conditions, have led to the uprooting of coastal vegetation that would normally help stabilize the shoreline.

"You can plant a tree; it will grow maybe in 50, 100 years. But you can't grow a beach. Once it's gone, it's gone as the conditions that led to the beach erosion will prevent the beach from being replenished," Ingole warned.

"Sand nourishment, replenishment of eroded beaches needs to be a routine exercise. Promoting the growth of dune creepers as 'ipomoea' is imperative as these plants bind sand. Emplacement of sand fences along the frontal dune line is imperative to curtail trespass, avoid trampling of vegetation and 'trap eolian' sand."

He further suggested that "purely temporary structures, if any, should be located on the dry beach only," and advocated for "coastal shelter belts in the form of buffer wooded bio-zones that nullify inundations."

The road ahead: Balancing tourism and conservation

As Goa confronts this escalating crisis, finding the delicate balance between preserving its tourism economy and protecting its natural coastline remains the central challenge. The Coastal Regulation Zone declaration of 2011 classified sand dunes as CRZ I (a) areas—ecologically sensitive zones with restricted development activities. Despite this designation, adherence to these regulations has been inconsistent.

With coastal regions worldwide facing similar challenges due to climate change and development pressures, Goa's response to its erosion crisis could serve as an important model for other tourism-dependent coastal economies. As Dr. Ingole aptly stated, "There has to be a change in mindset not just with the administration but amongst the public too for there to be any real positive change in the future." This call for a fundamental shift in approach may well be the most important recommendation of all.

QUOTEROOM

"We have been walking and working on these beaches for generations. During the monsoon, it was common to see water passing through the sand or the shape of the beach changing a bit but it would go back to normal later in the year. But now in the last few years the changes have been more permanent in nature and all negative. Shoreline is receding
– **John Pinto,** *fisherman*

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– **Dr. Baban Ingole,** *scientist, National Centre for Polar & Ocean Research*

"Time and again we have reiterated that the coast of Goa is under assault. Tourism and related human activities are a major cause. Several coastal areas have changed from virtual wilderness in the 1970s to haphazardly developed stretches, full of concrete buildings and related structures, in the last 30 years. The Baga-Candolim coast is a classic example of frenzied development
– **Dr. Antonio Mascarenhas,** *formerly with the National Institute of Oceanography (NIO)*