Cyclone-Driven Coastal Erosion and Land Use-Land Cover Changes in the Talsari-Shankarpur Coastal Tract, West Bengal, India: Impacts of Amphan and Yaas

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Abstract: ***The Talsari–Shankarpur coastal tract, along the Bay of Bengal, has witnessed accelerated environmental and socio-economic changes due to Cyclones Amphan (2020) and Yaas (2021). This study examines the impacts of these cyclones on shoreline stability, land use, and community livelihoods through satellite imagery, field surveys, and socio-economic assessments. Results indicate severe coastal erosion, saltwater intrusion into agricultural lands, contamination of freshwater sources, and extensive damage to infrastructure and coastal establishments. Land Use and Land Cover (LULC) analysis between 2010 and 2022 shows a marked decline in paddy fields, vegetation cover, and sand deposits, with simultaneous increases in fallow lands, betel cultivation, marshlands, and built-up areas. These transformations highlight both ecological stress and a shift in livelihood practices. The findings call for integrated coastal management, disaster-resilient infrastructure, and sustainable land-use planning to mitigate long-term risks and enhance adaptive capacity in cyclone-prone coastal regions.***

Keywords: Cyclone, Amphan, Yaas, Coastal erosion, Agricultural decline, Salinity intrusion, LULC change

1. Introduction

The eastern coastline of India, especially the areas along the Bay of Bengal, is highly vulnerable to tropical cyclones due to its geographic and meteorological conditions. The coastal regions of Shankarpur, Digha (West Bengal), and Talsari (Odisha) lie within this high-risk zone, experiencing recurrent cyclonic disturbances that significantly impact both natural and human systems. The present study examines the nature, frequency, and severity of cyclones affecting this region over the past twelve years and to assess the impacts of Amphan and Yaas on the environment, coastal infrastructure, and livelihoods. It also brings out the impact on coastal erosion and its severity around the study area resulting into land use transformation.

2. Study Area

The study area extends from the mouth of the Subarnarekha River, south of Talsari, up to Shankarpur, covering both New and Old Digha. This area is located in the coastal tract of the Bay of Bengal, at the border between West Bengal and Odisha. The coastal region under study is represented on the Survey of India (SOI) topographic sheets No. 73-O/6 and 73-O/10. The latitudinal and longitudinal extent of the study area ranges from 21°31' N, 87°21' E to 21°45' N, 87°34' E (Fig. 1). The width of the study area extends 2.5 to 3.0 km from the low tide level towards the land, while its length is approximately 14 km (Fig. 1). The tidal range in this area varies between 3 to 5 meters (Chatterjee et al., 2013). It is a low-lying, meso-tidal tropical coast that is almost flat, featuring a wave-dominated sandy beach with chains of sand dunes and mud flats (Hazra et al., 2002; Niyogi, 1970). The geomorphic elements of the study area, including beaches, tidal flats, dunes, mud flats, beach ridges, and chenier plains, have developed over the last 6,000 years (Paul 2002; Dey et al. 2005). The study area has an overall uniform geomorphology, with the landward boundary consisting of shore dune complexes, followed by an old tidal flat and a series of chenier ridges, beach ridges, and intermediate mud flats (Sarkar et al., 2002; Ghosh et al., 2003). Its seaward boundary consists of recently remobilized sand and clay at various locations (Chakrabarti, 1991) and a growing tidal flat near the mouth of the Subarnarekha River (Naskar and Bhattacharya, 2023).

3. Methodology

This study employs a multi-pronged approach to assess coastal changes and vulnerabilities along the Talsari–Shankarpur tract.
It integrates temporal Landsat imageries for 2010 and 2022 to analyse land use and land cover (LULC) changes, supported by post-cyclone field surveys (2020–2021) to map erosion and community-level damage perception. Remote sensing techniques are used to delineate shoreline positions over time, offering high-resolution, large-scale data critical for tracking long-term coastal dynamics (Boak & Turner, 2005; White & El Asmar, 1999). Geomorphological assessments and LULC classifications from previous studies enhance the analysis, while statistical tools help quantify erosion and accretion rates (Maiti & Bhattacharya, 2009). Field photographs document the current condition of coastal infrastructure, aiding in visual assessments of vulnerability and defence effectiveness. A structured socio-economic survey, based on random sampling of 70 households, captures local experiences of coastal

erosion and cyclone impacts, particularly from Amphan and Yaas. These insights include property loss, infrastructure damage, and shifts in coastal morphology, offering a comprehensive understanding of the region's exposure to climate-induced hazards (Paul & Dey, 2021).

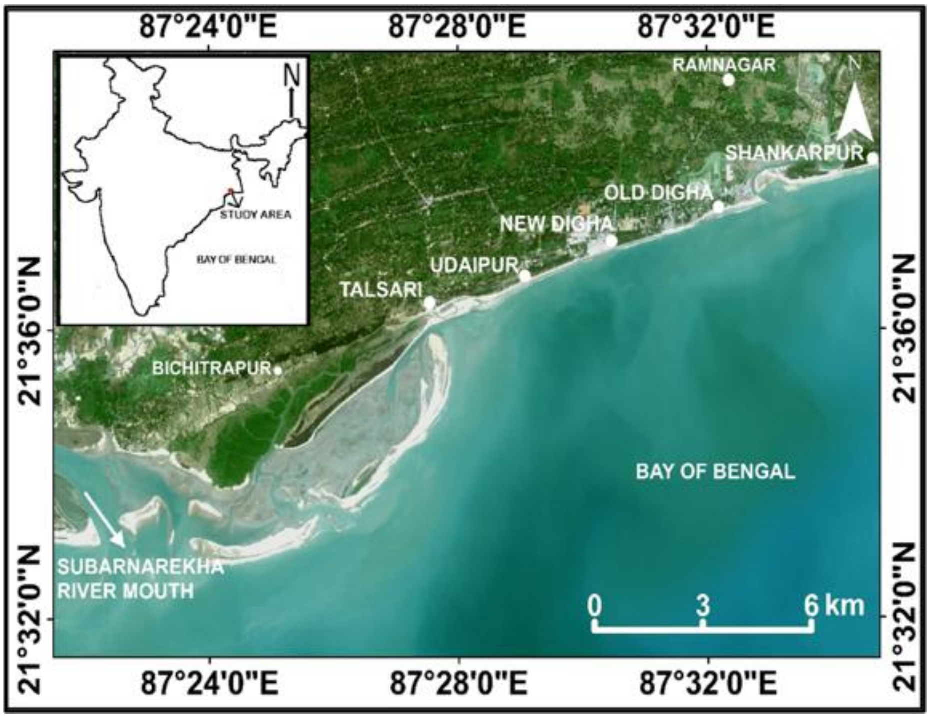

Figure 1: Figure showing the study area stretching from the mouth of river Subarnarekha to Shankarpur, along the coast of Digha, East Midnapur, West Bengal, India. Location of the study area is shown on the map of India in the inset.

4. Cyclonic Activity in the Bay of Bengal

The Bay of Bengal ranks among the most active basins globally for tropical cyclone formation, accounting for nearly 80% of cyclonic activity in the North Indian Ocean (Mohapatra et al., 2012; IMD, 2020). On average, 5 to 6 cyclones form annually in this region, with many intensifying into severe storms that pose significant threats to the eastern coast of India, particularly West Bengal and Odisha. Historic events such as the 1999 Odisha Super Cyclone and Cyclone Aila (2009) underscore the region's vulnerability. In recent years, the frequency, intensity, and rapid intensification of cyclones have increased, closely linked to rising sea surface temperatures due to climate change (Murakami et al., 2017; Krishnan et al., 2020). This has reduced the lead time for disaster response and increased inland impacts like flooding and infrastructure damage (IMD, 2020; Emanuel, 2017). From 2019 onward, the Bay has witnessed more frequent and intense cyclones—Bulbul (2019), Amphan (2020), and Yaas (2021)—with shorter intervals between events. These high-velocity storms accelerate coastal erosion, alter sediment dynamics, and intensify socio-economic vulnerabilities, particularly in fragile, low-lying areas like Digha, Shankarpur, and Talsari (IPCC, 2021; Dube et al., 2009; Sahoo & Bhaskaran, 2016). This emerging trend (Table 1) underscores the urgent need to reassess regional coastal resilience, as the Shankarpur–Digha–Talsari stretch exemplifies the compound physical, ecological, and human risks driven by climate-induced cyclonic activity.

Table 1: The table shows chronological list of major cyclones affecting the Bay of Bengal region with specific reference to their dates of occurrence and the approximate intervals between successive cyclonic events from 2009 to 2021. *Source: Data compiled from the India Meteorological Department (IMD)*

Name of the Cyclone	Year of Occurrence	Span between two successive cyclones
Aila	25th May, 2009	4 years approx.
Phailin	14th October, 2013	5 years 6 months approx.
Phani	26th April, 2019	7 months approx.
Bulbul	5th November, 2019	6 months approx.
Amphan	16th May, 2020	1 year approx.
Yaas	23rd May, 2021	

4.1 Cyclones Amphan (2020) and Yaas (2021)

Cyclone Amphan, a Super Cyclonic Storm, made landfall on May 20, 2020, near the Sundarbans with sustained winds exceeding 185 km/h and gusts up to 210 km/h, causing severe devastation across coastal West Bengal and northern Odisha (IMD, 2020; Mohanty et al., 2021). The storm surge reached up to 5 meters in areas like Shankarpur, Digha, and Talsari, inundating vast low-lying zones, destroying homes, farmland, and fishing settlements (UNDP, 2020; Hazra et al., 2021). A year later, Cyclone Yaas, classified as a Very Severe Cyclonic Storm, struck near Balasore on May 26, 2021, with winds up to 155 km/h (IMD, 2021). Although less intense than Amphan, Yaas triggered a storm surge of 3–4 meters, worsened by coinciding high tides. This led to significant flooding in Digha, Udaipur, and Talsari, breaching embankments and damaging infrastructure, agriculture, and coastal habitats (CWC, 2021; Sahoo & Bhaskaran, 2021). Both cyclones underscore the vulnerability of the Shankarpur–Digha–Talsari belt to high-intensity storms and their cascading impacts.

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5. Results of the Present Study

5.1 Coastal Erosion and Morphological Changes

The coastal stretch of Talsari-Digha-Shankarpur experienced notable geomorphological changes due to the successive impacts of Cyclone Amphan (May 2020) and Cyclone Yaas (May 2021). These cyclonic storms brought intense wind speeds, high tidal surges, and wave action that altered the shoreline configuration significantly (Hazra et al., 2021; Sahu et al., 2022) (Fig. 2). The coastline has been categorized into three sectors:

- Sector 1 (Talsari region)
- Sector 2 (Udaipur–New Digha–Old Digha)
- Sector 3 (Shankarpur)

5.1.1 Pre- and Post-Amphan Impact (2020)

Prior to 2020, the Digha coastline had been subjected to gradual but manageable erosion. Coastal protection structures such as sea walls, tetrapods, and boulder barriers had been installed, especially in Old Digha, to counter wave energy. The beach profile in New Digha was relatively wider, allowing for recreational use and tourism infrastructure development. Cyclone Amphan brought a severe storm surge and heavy rainfall. Although Digha lies north of the cyclone's landfall zone, it experienced severe wave-induced erosion, particularly in Old Digha, where portions of the promenade and protective structures were damaged. Temporary flooding and sediment displacement were recorded (Hazra et al., 2021; IMD, 2020).

- **Old Digha**: Experienced direct structural damage; the sea wall and the boulder pitching were undermined in parts. Localized beach loss and sand depletion occurred.
- **New Digha**: The wider beach absorbed some of the impact, but evidence of sand scouring and dune flattening was visible.

5.1.2 Pre- and Post-Yaas Impact (2021):

Cyclone Yaas had a much more direct and pronounced impact on the Digha coastline, particularly because its landfall occurred much closer—near Dhamra, Odisha, affecting the northern Bay of Bengal, including Digha. A significant coastal retreat was observed, especially around Old Digha, where the erosion line moved landward. Accumulated sediments were redistributed, and temporary deposition occurred at parts of New Digha and Udaipur, forming shallow berms. Despite the presence of hard engineering structures, the combined effects of back-to-back cyclones overwhelmed their capacity, leading to visible scouring behind the sea walls (Patra et al., 2022; IMD, 2021). Sediment loss was more pronounced than gain, especially in high-energy wave zones.

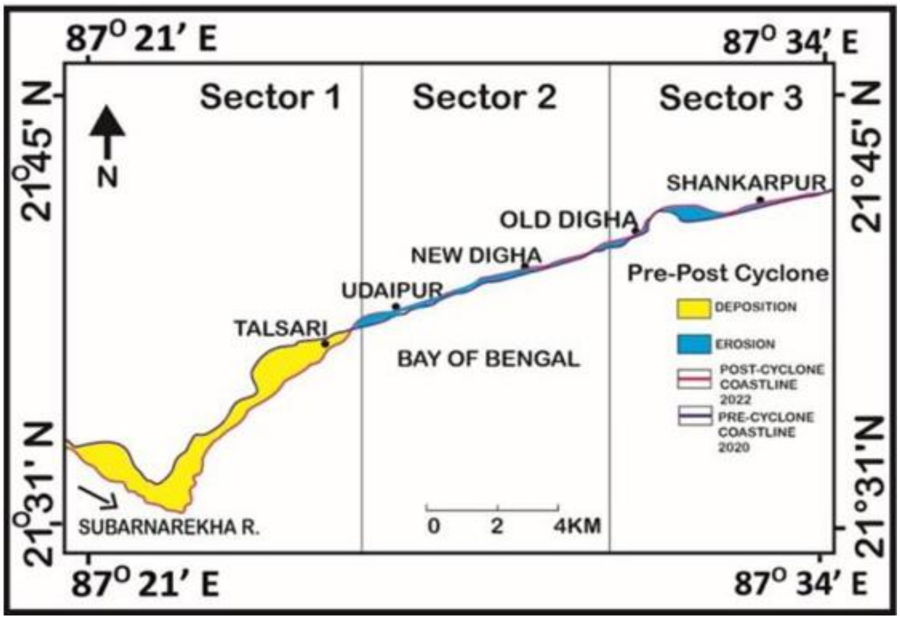

Figure 2: The figure shows pre-and post-cyclone shoreline change of the Talsari–Shankarpur coastal tract depicting erosion and deposition and positional shifts in the coastline following Cyclones Amphan and Yaas between 2020 and 2022.

5.2 Impact on Local Communities and Livelihoods

5.2.1 Impact on Cultivable Land

Old Digha experienced the most severe degradation of agricultural land, recording the highest number of heavily impacted cultivable plots (Fig. 3). Storm surges exceeding 4 meters led to extensive saltwater intrusion, compromising soil quality and rendering farmland unproductive for successive cropping seasons (Hazra et al., 2021). Shankarpur, another low-lying zone, suffered widespread salinization and prolonged waterlogging, further diminishing agricultural yield and food security (Panigrahi & Sahoo, 2022). In contrast, New Digha, aided by recent infrastructural developments and coastal protection measures, witnessed comparatively moderate agricultural losses (NDMA, 2022). Udaipur, being slightly inland, and Talsari, near the estuarine region, faced moderate to low levels of impact, although estuarine overflow and embankment breaches did affect soil productivity in patches (Patra et al., 2022).

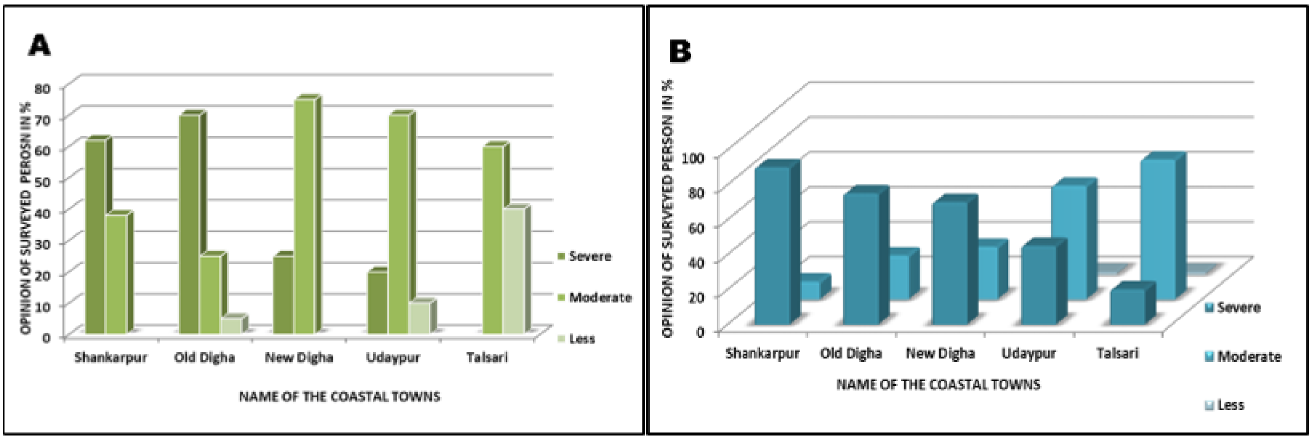

Figure 3: The figure shows the percentage distribution of respondents' opinions regarding the severity of impact (categorized as *severe*, *moderate*, and *less*) on (A) agricultural land, with emphasis on salinization, waterlogging, and soil fertility loss; (B) local water bodies, highlighting the extent of saline intrusion and flood-induced degradation; and drinking water quality, reflecting the perceived deterioration in potability and contamination due to Cyclones Amphan and Yaas. **Source:** Field survey data, compiled during post-cyclone assessment (2020–2021).

5.2.2 Impact on Water Bodies and Drinking Water Quality

The intrusion of saline water into freshwater bodies severely impacted domestic and agricultural water supply in Old Digha and Shankarpur (Fig. 3). Pond systems, aquaculture enclosures, and canals were inundated by tidal surges, resulting in salinization and sediment deposition (CWC, 2021). Structural damage to embankments further compromised water management systems. Consequently, drinking water sources such as tube wells, open wells, and piped networks were contaminated, posing public health risks such as waterborne diseases and skin infections (UNICEF, 2021). Although New Digha, Udaipur, and Talsari experienced less severe contamination, moderate impacts were still reported, often due to rain-induced runoff and the overflow of rivers and estuaries (Sahu et al., 2022).

5.2.3 Impact on Livestock and Domesticated Animals

Livestock losses were most acute in Old Digha, where many cattle perished due to floodwaters, lack of shelter, flying debris, and the unavailability of veterinary services (Hazra et al., 2021; UNDP, 2020). Shankarpur also reported significant cattle mortality linked to fodder salinization and evacuation delays (Panigrahi & Sahoo, 2022). New Digha exhibited a moderate impact, potentially mitigated by better preparedness and elevation. Conversely, Udaipur and Talsari, due to lower livestock densities and natural protective buffers like dune vegetation, recorded relatively minimal losses (NDMA, 2022).

5.2.4 Impact on Housing Infrastructure

Housing damage was most extensive in Old Digha, where older, non-engineered structures bore the brunt of high-velocity winds and tidal inundation (Fig. 4). The lack of robust embankments and dense construction close to the shoreline heightened structural vulnerability (Hazra et al., 2021). Shankarpur, with a concentration of temporary fishing settlements, also witnessed widespread damage (Patra et al., 2022). New Digha sustained moderate losses due to stronger building materials and improved urban design, while Udaipur and Talsari, with lower settlement density and natural vegetation buffers, showed comparatively limited destruction (Sahoo & Bhaskaran, 2021; World Bank, 2021).

Figure 4: The figure shows field photographs of cyclone-induced damage to local houses in coastal areas. (A) Partially damaged mud house with scattered household items and overgrown vegetation indicating neglect. (B) Severely damaged brick house with collapsed roof structure, highlighting structural vulnerability to extreme weather events.

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5.2.5 Impact on Transport and Communication Networks

Cyclonic impacts on roads and communication infrastructure were most severe in Shankarpur and Old Digha, where prolonged inundation, drainage failure, and direct wind exposure damaged over 40% of essential infrastructure (Fig. 5) (IMD, 2020; CWC, 2021). Electrical poles, mobile towers, and road surfaces were destroyed, disrupting emergency response and post-disaster recovery. New Digha reported moderate impact due to planned tourism infrastructure and partial protection from embankments (Hazra et al., 2021). Udaipur and Talsari, aided by natural topography and lower developmental pressure, showed limited disruption.

5.2.6 Impact on Coastal Commercial Establishments

Commercial establishments, especially those dependent on tourism—hotels, restaurants, and shops—suffered heavily, with Old Digha recording the highest number of affected units (Fig. 5). Many of these were semi-permanent or poorly constructed, located close to the high tide line, and thus highly vulnerable (Hazra et al., 2021; World Bank, 2021). Shankarpur, with its beachfront market and marine drive, also recorded considerable damage (Panigrahi & Sahoo, 2022). New Digha, despite better planning, reported significant losses among small-scale businesses. Udaipur and Talsari, being less commercialized and protected by natural buffers, experienced minor structural and operational disruptions (Sahoo & Bhaskaran, 2021).

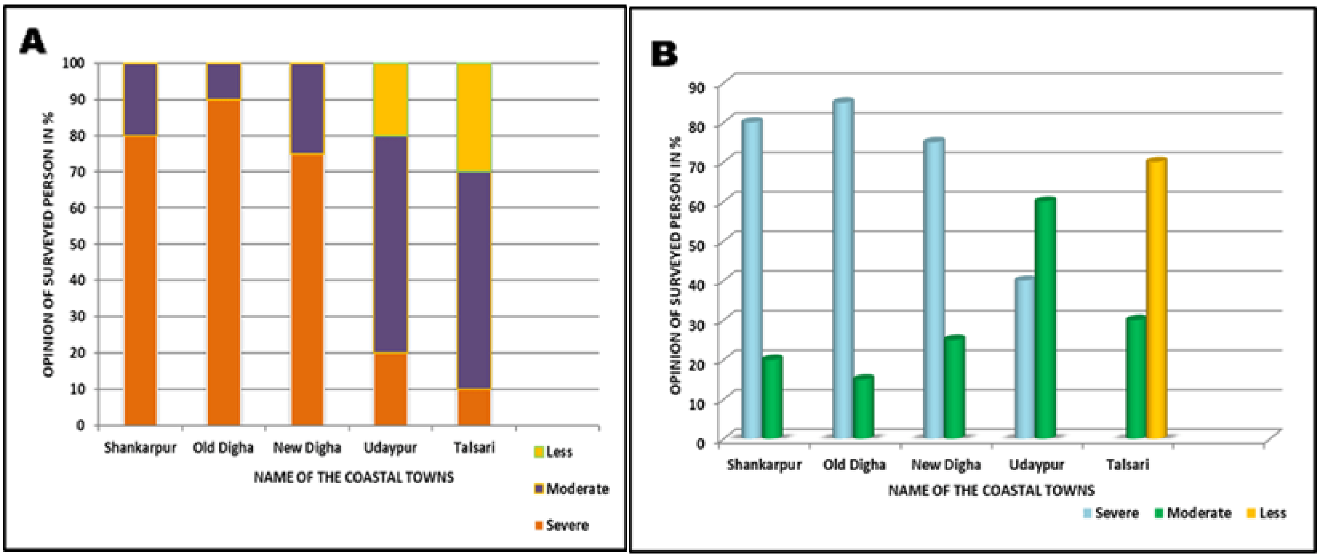

Figure 5: The figure shows the percentage distribution of respondents' views on the severity of impact (*severe*, *moderate*, *less*) on (A) transport and communication infrastructure and (B) shoreline-based commercial establishments such as shops, hotels, and restaurants, following Cyclones Amphan and Yaas. **Source:** Field survey data, compiled during post-cyclone assessment (2020–2021).

5.2.7 Impact on Coastal Structures

More than 50 % of coastal protection structures in Digha and Shankarpur sustained severe damage, indicating their inability to withstand cyclone-induced stresses (Fig. 6) (Hazra et al., 2021; CWC, 2021). These failures exposed adjacent settlements to direct wave energy and flooding. Udaipur showed mixed levels of structural impact, likely moderated by natural features such as dunes and vegetation (Sahu et al., 2022). Talsari recorded the least damage, benefiting from lower development intensity and estuarine protection (Panigrahi & Sahoo, 2022).

Figure 6: The figure shows field photographs of cyclone-induced structural damages (A) Erosion damage near commercial structures at Shankarpur; (B) Scattered debris along the beachfront at Digha, indicating severe erosional pressure on natural and built environments

5.3. Land Use and Land Cover Change Analysis (Pre- and Post Cyclone)

5.3.1. Decline in Agricultural Land (Paddy Cultivation)

One of the most significant changes is the drastic reduction in paddy cultivation (Fig. 7) declining from 54.43 sq. km in 2010 to 43.36 sq. km by 2022. This transformation is largely attributed to:

- Soil salinization caused by repeated storm surges and coastal flooding, particularly after Cyclone Amphan and Cyclone Yaas (Nath et al., 2022).
- Loss of arable land to erosion and waterlogging (Paul & Biswas, 2013; Nath et al., 2022).
- Economic shifts in the local population, with many transitioning from traditional farming to more resilient and profitable land uses (Nath et al., 2022).

Paddy fields are increasingly being converted into either current fallow lands or betel cultivation plots, reflecting changes in both ecological viability and livelihood preferences (Nath et al., 2022; Paul & Biswas, 2013).

5.3.2. Expansion of Betel Cultivation

Betel cultivation, often integrated with low-density rural settlement (Fig. 7) has increased from 41.57 sq. km in 2010 to 50.47 sq. km by 2022. This marks a nearly 8.9% rise over 12 years. The popularity of this land use category is due to:

- Higher economic returns and lower sensitivity to saline soil conditions.
- Suitability for smallholder farming systems.
- Proximity to local markets and road networks in peri-urban zones.

The increase also reflects a rural sprawl pattern, where small residential settlements develop alongside agricultural plots, particularly in the slightly elevated inland ridges that are less prone to inundation (Paul & Biswas, 2013; Nath et al., 2022).

5.3.3. Rapid Increase in Current Fallow Land

Current fallow land shows a strong upward trajectory (Fig. 7) increasing from 24.52 sq. km in 2010 to 30.92 sq. km in 2022. These lands represent formerly cultivated plots now left unused due to:

- Loss of productivity from saline intrusion.
- Farmer migration toward service-based employment and tourism-linked sectors.
- Interim stages before land conversion to alternative uses such as construction or horticulture. The spatial distribution of fallow land is often adjacent to built-up areas or interspersed within shrinking agricultural zones (Nath et al., 2022).

5.3.4. Rise in Marshland and Coastal Wetlands

The area under marshland is projected to expand significantly (Fig. 7) from 7.39 sq. km in 2010 to 14.64 sq. km by 2022. This change is linked to:

- Sediment accumulation at river mouths (e.g., Subarnarekha) and in low-lying coastal depressions.
- Stabilization of tidal flats, where fine sediments and vegetation foster wetland development.
- Reduced human intervention in marginal lands unsuitable for agriculture or construction.

These expanding marshes may serve as critical ecological buffers, offering flood protection and supporting biodiversity, though they also signal the conversion of previously productive or inhabitable land into inundation-prone areas (Nath et al., 2022).

5.3.5. Steady Water Body Coverage

The extent of water bodies, including rivers, ponds, and estuarine zones, remains relatively stable and slightly increasing (Fig. 7) from 208.20 sq. km in 2010 to 209.24 sq. km by 2022. This indicates:

- Hydrological stability in inland and estuarine water bodies.
- Slight expansion due to coastal flooding and erosion-induced land submergence.
- Maintenance or revival of homestead ponds, critical for domestic and agricultural use (Nath et al., 2022).

5.3.6. Shrinkage in Vegetation and Sand Deposits

Natural vegetation has reduced sharply (Fig. 7) from 87.75 sq. km in 2010 to 77.09 sq. km in 2022 primarily due to:

- Encroachment by fallow land and rural settlements.
- Land clearance for infrastructure and agriculture.
- Climate-induced dieback, especially near the coast (Paul & Biswas, 2013; Nath et al., 2022).

Sand deposits, especially along beach and dune systems, are also seen to decline (Fig. 7) from 13.38 sq. km in 2010 to 11.18 sq. km in 2022 because of:

- Coastal erosion and sediment redistribution.
- Stabilization of sandy areas into marshes or vegetated tidal flats.
- Disruption by human construction and tourism activities (Jana et al., 2013; Nath et al., 2022).

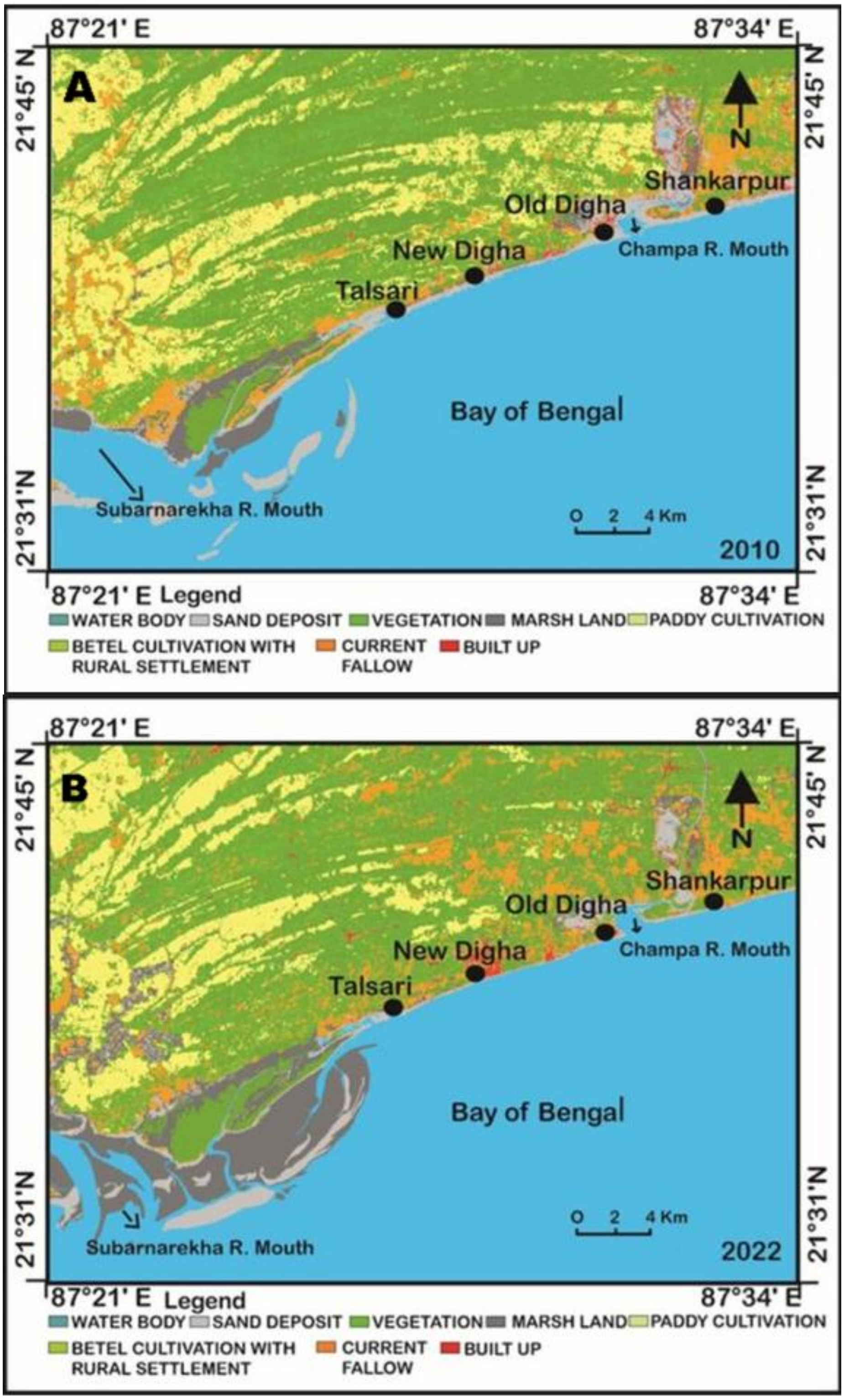

Figure 7: The figure shows land use land cover (LULC) changes along the Digha–Shankarpur–Talsari coastal tract between (A) Pre Cyclone 2010 and (B) Post Cyclone 2022 highlighting notable transformations, including the decline in paddy cultivation, expansion of betel cultivation with rural settlement, increase in fallow land, reduction of natural vegetation and sand deposits, and the growth of marshland and built-up areas. These shifts are influenced by both environmental stressors—such as Cyclones Amphan and Yaas—and socio-economic transitions in land use patterns.

6. Discussions

The Talsari–Shankarpur coastal region has been significantly reshaped by the successive impacts of Cyclones Amphan (2020) and Yaas (2021), which have acted as major drivers of coastal degradation, socio-economic disruption, and land use transformation. These high-intensity tropical storms brought with them extreme wind velocities, storm surges reaching 4–5 meters, and intense rainfall, leading to widespread flooding, shoreline retreat, and sediment displacement along critical stretches such as Old Digha, Shankarpur, and parts of New Digha (Hazra et al., 2021; IMD, 2020; Patra et al., 2022). Despite the presence of engineered coastal defences—such as sea walls and tetrapods—these structures were unable to fully withstand the wave energy, resulting in scouring, embankment breaches, and irreversible beach loss. The impact extended inland as well, with agricultural land bearing the brunt of saline water intrusion and prolonged waterlogging, causing a dramatic decline in paddy cultivation—from 54.43 sq. km in 2010 to 43.36 sq. km by 2022—and increasing conversion of farmlands into fallow or betel-growing plots due to both ecological stress and economic transition (Nath et al., 2022; Paul & Biswas, 2013). Simultaneously, freshwater bodies including ponds, canals, and shallow groundwater systems were contaminated, affecting both irrigation and potable water supply, particularly in Old Digha and Shankarpur, where the damage was most severe (CWC, 2021; UNICEF, 2021). The cyclones also caused the loss of large numbers of domesticated animals, as flooded cattle sheds, flying debris, and the absence of veterinary support led to high mortality rates, further impacting the agrarian economy (UNDP, 2020; Hazra et al., 2021). Structural damage to homes, especially non-engineered and informal settlements near the shoreline, was widespread—highlighting vulnerabilities in housing design and exposure. Likewise, transport and communication systems collapsed in several zones due to inundation and wind damage, cutting off access to emergency services and slowing recovery efforts (Sahoo & Bhaskaran, 2021; NDMA, 2022). Economic disruptions were particularly pronounced in tourism-dependent areas like Old Digha and Shankarpur, where coastal shops, hotels, and restaurants suffered heavy structural and functional losses (World Bank, 2021; Panigrahi & Sahoo, 2022). The cumulative and compounded effects of these cyclones have accelerated land use and land cover (LULC) transitions—marked by a rise in marshland, expansion of built-up zones, and a stark reduction in natural vegetation and sand deposits—signalling not only ecological transformation but also long-term socio-economic displacement and vulnerability. These trends underscore the pressing need for an integrated coastal management strategy that combines resilient infrastructure, ecological restoration, adaptive livelihood planning, and proactive disaster risk reduction considering intensifying climate threats (Jana et al., 2013; Nath et al., 2022).

7. Conclusion

The Talsari–Shankarpur coastal tract has emerged as a climate-sensitive zone undergoing rapid environmental and socio-economic transformation due to the successive impacts of Cyclones Amphan (2020) and Yaas (2021). These events have intensified shoreline erosion, damaged coastal infrastructure, and catalysed widespread land use changes. Agricultural land, particularly paddy fields, has declined sharply due to salinization and waterlogging, prompting a shift toward betel cultivation and fallow land use as communities adapt to new ecological realities. The intrusion of saline water into surface and groundwater sources has severely compromised freshwater availability, while livestock losses and housing destruction have deepened rural vulnerability. Commercial infrastructure, especially tourism-dependent businesses, suffered extensive damage, disrupting livelihoods and local economies. Land use analysis reveals a contraction of vegetation and agricultural zones alongside the expansion of marshland, built-up areas, and degraded sand dunes signalling a transition toward a more fragmented and risk-prone landscape. These findings underscore the urgent need for integrated coastal management strategies that combine climate-resilient infrastructure, ecological restoration, and community-based adaptation. Strengthening natural buffers, enforcing sustainable land use planning, and empowering local governance will be critical to building long-term resilience in this increasingly hazard-exposed region.

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CRediT authorship contribution statement

Baishali Mukherjee: Conceptualization, field investigation, writing original manuscript, review and editing.

H.N. Bhattacharya: Visualization, conceptualization, field Investigation writing original manuscript, review and editing.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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