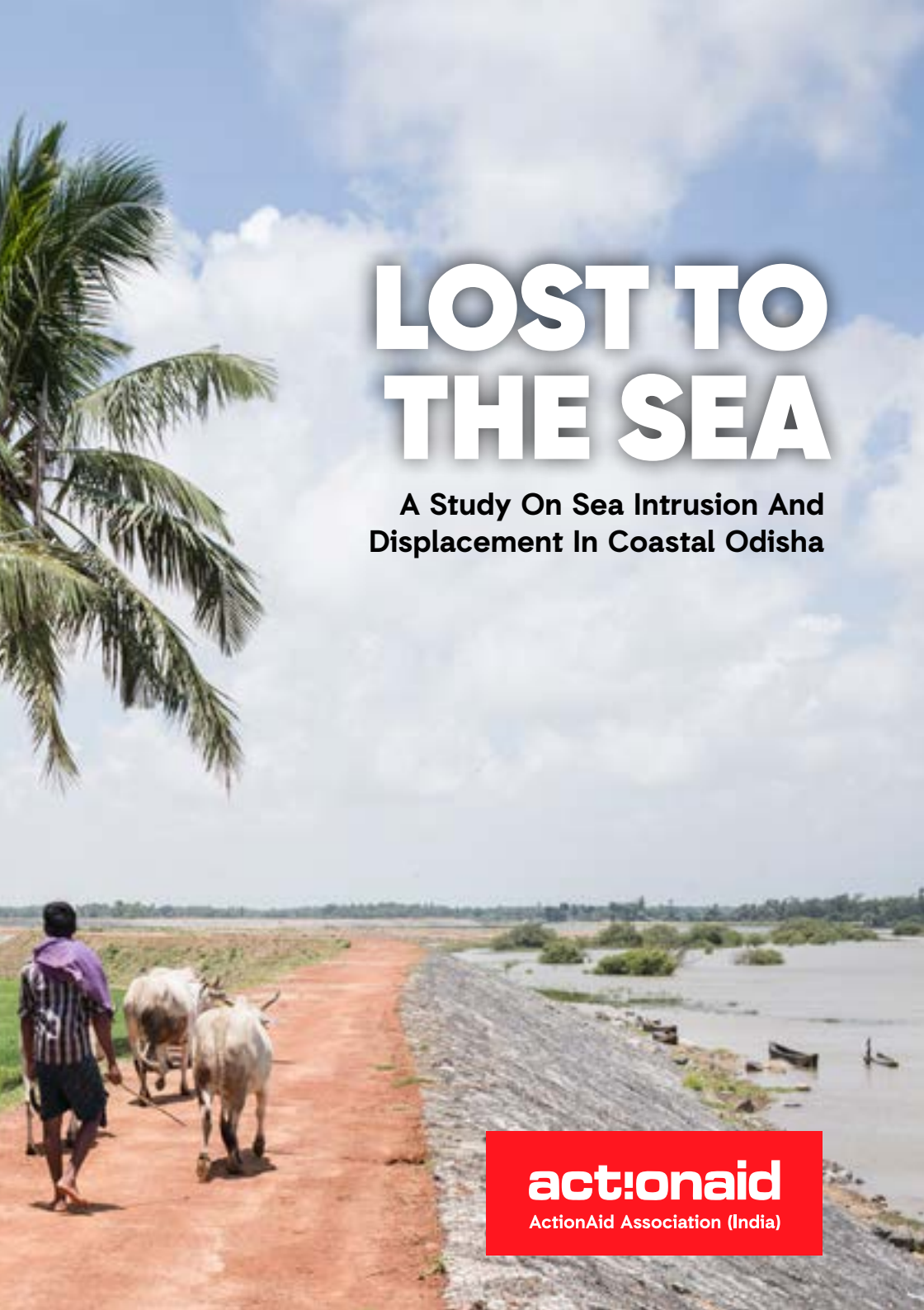

LOST TO THE SEA

A Study On Sea Intrusion And Displacement In Coastal Odisha

actionaid
ActionAid Association (India)

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FOREWORD

Coastal erosion and accretion are natural processes that occur in varying degrees and forms across the coastland. The real fear is that climate change is disrupting the planet's hydrological cycle, causing significant damage to coastal ecosystems and communities. As climate change continues to impact, with increasing frequency and intensity of extreme weather events, the severity of seawater intrusion in India will increase in multiple ways. First, sea levels will likely rise, pushing the saltwater interface further inland. Second, climate change is causing more extreme weather events, such as cyclones and storm surges, which can also contribute to seawater intrusion. Third, climate change is changing precipitation patterns, which could lead to less groundwater recharge in coastal areas.

The effects of seawater intrusion can be devastating. It can contaminate drinking water supplies, damage crops, and make it challenging to sustain coastal livelihoods. In some cases, it can even force people to relocate.

Lost To The Sea: A Study On Sea Intrusion And Displacement In Coastal Odisha is a study that seeks to present the voices of the people in the State affected by seawater intrusion in their communities and lands. The research team surveyed 23 villages across Bhadrak, Ganjam, Jagatsinghpur, Kendrapara and Puri, five coastal districts of Odisha. Our purpose was to know more about the vulnerabilities of communities affected by seawater intrusion and displacement, learn about the community's existing adaptive and coping strategies to deal with this issue, and understand community perspectives and resilience-building approaches.

The coastline of Odisha is only about 17% of the east coast. However, the State has been affected by nearly 35% of all the cyclonic and severe cyclonic storms that have crossed the eastern coast and associated storm surges that have often inundated large tracts of the coastal districts. The series of disasters and their impact have brought significant devastation to the lives and livelihoods of the people.

Through this publication, we would like to share people's perspectives and possible solutions to the crises they are facing. We hope that this would provide all concerned with valuable insight, and would lead to the recognition and prioritization of the issues of sea erosion, salination and displacement. A better understanding

of the dangers of sea intrusion would enable us to develop plans and allocate resources towards building resilience and create a loss and damage framework so that people can avail compensation whenever they are badly affected.

I congratulate and extend thanks to Debabrat Patra, National Humanitarian Lead and his team members, especially BN Durga, along with the people who were involved in the entire process of the study for bringing out such a report in a critical juncture of time when the whole coastal districts are battling with the impact of climate change.

My deepest gratitude is to the affected communities of the coastal districts of Odisha for sharing their lives and participating in this study so we could collectively move towards alternative paths and socially and ecologically just solutions.

I look forward to your comments and suggestions

Sandeep Chachra
Executive Director
ActionAid Association

ACKNOWLEDGEMENTS

Considering the vulnerability of the districts across the coastline of Odisha due to the impact of climate change, ActionAid Association undertook a study to understand the vulnerabilities of communities affected by seawater intrusion and displacement in villages of Bhadrak, Ganjam, Jagatsinghpur, Kendrapara and Puri - five coastal districts in Odisha. In addition, the study enquired about the existing adaptive and coping strategies employed by the community to deal with this issue. Besides, the study analysed the various government schemes and policies that are meant to provide support to the displaced groups. Also, the study captured the community perspectives on the issue and provide recommendations to strengthen resilience strategies centred around community needs.

The five coastal districts chosen for the study were done so due to the severity of impact of climate change and the history of displacement and land loss caused by seawater intrusion and their continued vulnerability due to proximity to the receding coastline. In each sample village, data has been collected from different sources - with groups constituted of village elders, women, and youth to discuss impacts of sea intrusion in their village, and sample population chosen using random sampling method to identify degree of individual losses and vulnerability through detailed interviews.

A total of 23 villages were studied across the five coastal districts, with four villages from Bhadrak, three from Ganjam, four villages from Jagatsinghpur, five villages from Kendrapara, and seven villages from Puri district. We conducted 230 structured interviews across the villages, along with group discussion for individual villages with groups with the participation of 10 to 30 individuals. The sample size consisted of equal participation of men and women participants with age groups ranging between 25 to 82.

This study report has been the result of the hard work, sincere efforts, and commitment of lot of people including the affected communities, our allies at ground level, community leaders, volunteers, and partners.

I sincerely extend my heartfelt thanks and gratitude to Himani Rathore for contributing to this study in terms of designing the study, developing interview

schedules and other formats used in the study, travelling to different districts for collection of data and writing the report.

I want to thank Aditi Roy for contributing significantly to the study including writing of the study reports, collecting, and analysing the secondary data and its interpretation, developing case studies etc.

My sincere thanks to my colleagues at ActionAid Association viz; Amita Singh, District Coordinator-Kendrapara; Ashim Amitav Dash, District Coordinator-Bhadrak; Debabrat Mahunta, District Coordinator-Ganjam, Sumita Ghosh, District Coordinator-Puri; Tapan Kumar Gochhayat, District Coordinator-Jagatsinghpur and last but not the least my colleague BN Durga for extending required support in selection of the sample villages, facilitating the process data collection, and contribution to the reports in terms of sharing required information when and where required.

I thank and acknowledge the contribution of N A Shah Ansari, President-Young India, Rosalin Pradhan, Community Radio Namaskar for providing required support and facilitation in undertaking the study in Puri district.

I specially thank Sandeep Chachra, Executive Director, ActionAid Association for visiting the displaced villages across the coastline of Konark, Puri and joining the meeting on sharing of the study report held at Konark, Puri and his further inputs to the study.

I sincerely express my thanks and gratitude to all the people from the communities who contributed to this study through sharing their views, experience, ideas, perspective and demands. Without their support and active participation this study would not have been possible.

Debabrat Patra
National Humanitarian Lead & Associate Director
ActionAid Association

Chapter 1

INTRODUCTION

"Lost to the Sea" is a dramatic way to describe the dangers of seawater intrusion. Seawater intrusion is the movement of salt water into land, inlcuding the freshwater bodies and aquifers located near the coast. This can occur naturally due to the difference in water densities, but it is often exacerbated by human activities such as groundwater pumping and climate change.

Climate change is expected to increase the severity of seawater intrusion in India in a number of ways. First, sea levels are expected to rise, which will push the saltwater interface further inland. Second, climate change is expected to cause more extreme weather events, such as cyclones and storm surges, which can also contribute to seawater intrusion. Third, climate change is expected to change precipitation patterns, which could lead to less groundwater recharge in coastal areas.

Loss of coastal land to the sea can be seen as an extreme form of sea water intrusion. India has a long coastline of over 7,500 kilometers, and it is estimated that the country is losing about 2.4 square kilometers of coastal land every year. In this publication we are presenting the results of a study into the phenomenon of sea intrusion and the resultant displacement in coastal Odisha.

Climate hazards are a serious concern in coastal Odisha due to its ecologically rich and thus vulnerable geography. The natural environment's vulnerability combined with complex socio-ecological factors make this region a hotspot for climate change's adverse impacts. Because of their high interdependence on their ecological habitats, communities in coastal Odisha are facing an immense life altering risk due to climate change as their reality today.

Climate change is not a term of common parlance in rural regions; it is still a largely science centric idea. However, places like coastal Odisha

where this complex phenomenon is not a future risk but a present reality, its impact can be seen in people's everyday lives. Coastal communities are extremely vulnerable due to the high occurrence of disasters. While sudden disasters like floods and cyclones are at the centre of disaster management strategies, the coasts are also affected by slow onset disasters like seawater intrusion. Intruding seawater with incremental loss of land severely affects people's lives and livelihoods. This makes the otherwise intangible concept of climate change visible and tangible, and has an impact on the ecological, social and economic lives of the displaced people.

According to a Ministry of Environment of Forest (MoEF) report, a one metre rise in seawater level will inundate 0.17 million hectares (Mha) of predominantly prime agricultural land and displace 0.7 million people in Odisha's coastal districts.[1] Protection measures are imperative for regulating the impact that such displacements can have on communities, especially in rural regions where a majority depends on agriculture and allied activities. The pertinent threats due to environmental change combine with other socioeconomic vulnerabilities to further marginalise rural coastal populations. Protection measures thus need to address foundational development challenges holistically along with actions for specifically addressing climate change and aid resilience.

The present study aims

1. To understand the vulnerabilities of communities affected by seawater intrusions and displacement in the villages of five coastal districts in Odisha.
2. To understand the existing adaptive and coping strategies employed by the communities to deal with this issue.
3. To analyse various government schemes and policies meant for providing support to the displaced groups.
4. To understand community perspectives on the issue and provide

1. Naik et al., (2013), 'Appraisal of the erosion status in the eastern coastal region of India', *IIndian Journal of Soil and Conservation.*

recommendations to strengthen resilience strategies centred on community needs.

Research field

The survey sites were villages in all the five coastal districts that are affected by seashore erosion, sea intrusions and loss and land and forests.

- Bhadrak
- Ganjam
- Jagatsinghpur
- Kendrapara
- Puri

This study specifically focuses on villages that have already been displaced due to seawater intrusion and continue to face threats due to increasing loss of land.

Sampling

Sampling was done to highlight the district-wise impact of slow onset erosion in coastal villages across the states. Districts were chosen as the nodal point for this study due to the different degrees of impact so unique strategies need to be implemented which are distinct for every district. Survey sites were villages chosen through purposive sampling based on their history of displacement and land loss due to seawater intrusions and their continued vulnerability because of proximity to the receding coastline. In each sample village, data was collected from different sources – groups of village elders, women and youth -- to discuss the impact of sea intrusions in their villages, and the sample population was chosen using the random sampling method to identify the degree of individual losses and vulnerability through detailed interviews.

A total of 23 villages were studied across the five coastal districts – with four villages from Bhadrak, three from Ganjam, four villages from Jagatsinghpur, five villages from Kendrapara, and seven villages from Puri district. The research team conducted 230 structured interviews across

the villages, along with group discussions for individual villages with groups sizes varying between 10 and 30 individuals. The sample size consisted equally of men and women participants with age groups ranging between 25 and 82 years.

Methodology

The study combined various methods to obtain empirical, community centred data. Along with a collation of historical data for a comparative analysis, the study also used methods such as participant observations, structured interviews, a survey questionnaire, focused group discussions and stakeholder communication to thoroughly understand the present state of these coastal villages.

Secondary data collection

- Collection of secondary data on rainfall, season-wise temperature as well as historical climate trends from departments like the disaster management authorities and the forest department.
- State-wise specific climate plans, policies and investments across the region.
- An analysis of natural disasters and their impact.
- An analysis of the local economy and major sources of livelihood and historical data on shifts in these activities/ sectors.
- An analysis of market networks and their influence on the local economy and livelihood patterns.

Resource mapping

- Mapping natural resources and collecting data on livelihood dependence.
- Seasonality mapping: Changes in rainfall, cyclones, floods and droughts (frequency and severity).
- Mapping changes in livelihoods through cross-generation and annual variations.

- Mapping goods and commodities (agricultural, industrial) that influence livelihoods and understanding changes in their production and distribution.
- Understanding migration and livelihoods, care economy and households of seasonal and other migrants – mapping changes in the household economy.
- Evaluating the differential social impact of seawater intrusion through socioeconomic status, asset ownership, ethnic groups and gender variance.

Topics During Focused Group Discussions

Water resources, forest cover, soil fertility, wildlife, fisheries and other natural resource changes in quality, quantity, erosion and runoff.

Consequences and impact of seawater intrusions and displacement, with particular attention to livelihoods and the socioeconomic impact on the communities.

- Impact on access to resources (for instance, water and land) for livelihood activities.
- Challenges to sustenance studied through changes in food security, incomes, livelihoods, crop yields and productivity of rural production systems.
- Changes in land use mix in labour/ time devoted for securing water supply.
- Changes in availability of fodder, fuel-wood and non-timber forest produce (NTFP).
- Changes in incidence of natural disasters and their impact on patterns of occupation, seasonal variations and vulnerability due to unpredictable natural events.

Tools and methods

- Participatory rural appraisal.
- Natural resource map.

- Mobility map for all services and infrastructure facilities.
- Seasonality map for agriculture/ fishing/ other livelihood activities.
- Timeline of displacement of the village due to seawater intrusions (focus on the last 50 years).
- Timeline of disasters (focus on frequency, intensity and losses to community, focus on the last 20-30 years).

Chapter 2

LITERATURE REVIEW

While ecological conservation and sustainable development have been at the centre of climate change research, discussions on issues of socioeconomic vulnerabilities, institutional inadequacies and power dynamics that shape the lives of vulnerable communities have been largely missing. As the impact of climate change combines with existing inequalities in global societies, community perspectives and people's concerns need more attention. An understanding of the unique combination of factors that make Odisha's coastal communities most vulnerable is needed to chart adaptive strategies including food security, livelihoods, health, education, ecological dependence, and culture and identity preservation.

Climate change vulnerabilities and communities

In a (2017) report, the International Labour Organisation identified certain unique characteristics that make indigenous peoples more vulnerable to climate change risks as compared to other groups. These characteristics include the fact that nearly 15 per cent of the world's poorest are indigenous people and that nearly 80 per cent of them live in Asia and the Pacific, a region particularly vulnerable to climate change. The study also identified how the high dependence on natural resources increases vulnerability now that these natural resources are at high risk. Besides, vulnerability to forced migration also renders them at risk to exploitation and loss of identity. All of these factors are also applicable to the marginalised caste communities of coastal Odisha.

A (2015) ActionAid Association study, 'Community Concerns on Climate Change,' studied the impact of climate change on marginalised communities across seven Indian states. Mapping community vulnerabilities across geographical regions from coastal Odisha to the arid regions of Rajasthan, the study gathered qualitative responses on how community members

perceive changes in their environment. The findings revealed a number of ecological, social and economic areas of vulnerabilities including issues of reduced resource access and quality, changes in ecosystem processes, food insecurity, health risks, sustenance and an overall impact on the quality of life among indigenous communities. The study also found that climate change's impact is gendered and disproportionately affects indigenous women and children. Apart from the direct impact on their economic activities, women also experience hardships owing to household and child rearing responsibilities, which impact their reproductive and overall health.

Coastal ecosystem's people

Another ActionAid Association (2022) study 'Troubles in the Sunderbans' focused on how ecologically dependent people can be transformed into environmental workers to mitigate the impacts of climate change. Based on the stressed mangrove ecology of Hingalganj, the study highlighted existing government policies and frameworks that shape community livelihoods, access to ecosystem resources and enable coping mechanisms. The study emphasised conservation policies that pit indigenous communities against forest and wildlife conservation and thus deprive people of access to essential sustenance resources.

Focusing on women and livelihoods, the findings of this research revealed complex realities of land ownership, debt burden, dual labour for economic activities and care, increased mortality risks, vulnerabilities of women-only households besides existing social complexities of early marriages, restricted mobility and freedom that interact with climate change to reduce access to education, health, resources like drinking water and sustenance sources. The study highlighted systemic vulnerabilities like exclusionary conservation policies, hazardous developmental activities and lack of coordination among different levels of the government. Local people were found to be effective enablers of forest and wildlife conservation, curbing poaching, monitoring forest fires and rescuing and rehabilitating individuals involved in human-wildlife conflicts. Acknowledging this close interdependence of forests and communities, the 2022 ActionAid Association study made some recommendations that refocused on

community involvement, promoting a green economy, combining livelihood resources with sustainability practices and ensuring women's participation in decision making, thus centring the conservation of the Sundarbans around its indigenous communities.

Disasters and the ecosystem's people

Community centred research on climate change has also become integral in understanding and mitigating disasters. In a dedicated effort to understand contemporary contexts of disaster prone communities of South Asia, the Special Centre for Disaster Research (SCDR) at Jawaharlal Nehru University (JNU) compiled works of scholars from across India, Bangladesh and Sri Lanka in the volume 'Disaster Research and Management Series on the Global South' (2020). Emphasising on disaster management in coastal areas, Haran (2020) discusses the key factors contributing to climate vulnerability of South Asian communities. Vast coastlines, high occurrence and proneness to disasters, denser settlements, high poverty despite being resource rich and the ineffectiveness of governance structures meant to protect fragile ecosystems come together to make coastal communities of the Global South anticipated victims of the impending climate doom. Swarnamayee Tripathi's (2020) contribution is based on challenges faced by the farmers as the land and water systems along coastlines become more and more volatile. Tripathi's research focuses on the new circular approach to disaster management that emphasises both pre-disaster risk reduction as a more cost-effective governmental strategy than post-disaster administrative response. The study highlights that 7,168 villages, 20 towns, 10.60 lakh households and 58 lakh people within 25 km of the coastline of Odisha are among the most vulnerable. With an extensive dependence on agriculture and rainfall for sustenance, and increasing vulnerability to disasters, coastal Odisha's farmers are the primary victims of the climate crisis. Marginal farmers and landless labourers comprise a majority of this population. Tripathi's research highlights their plight in the face of disasters 'though more than 85 percent of the land is cultivated by sharecroppers in Odisha, they do not receive any government assistance at the time of natural calamities....or loans from banks or fertiliser at subsidised rates, because there is no such provision under the existing law.' Institutional

marginalisation and lack of support further exacerbate the damage that disasters wreak on these farmers, evicting them from their livelihoods and often resulting in permanent displacement. Pre-emptive action, mitigation, better preparedness and risk reduction through targeted policies is thus the need of the hour to protect the farmers of coastal Odisha. Tripathi suggests an integration of disaster management with developmental planning, including measures like better crop insurance, building resilient agricultural systems and incorporating traditional community practices in adaptive strategies.

Climate change and development

Environmentally and socioeconomically vulnerable communities in coastal Odisha are caught between the vagaries of a changing climate and exclusionary developmental projects and policies. Changes in land utility, resource extraction, unregulated industrialisation and big infrastructural development constitute a large part of such projects. A 2013 ActionAid Association study titled 'Stolen Sand' highlighted the impact that sand mining has had on the ecology and economy of five major river ecosystems across the country, with an emphasis on states where rampant illegal sand mining has contributed to worsening disasters. With major rivers like the Mahanadi, Brahmani, Baitarani, Subarnarekha, Bamsadhara, Nagavali and Rusikulya, and with 44.21 per cent of the land area being constituted as a Scheduled Area, Odisha is a hotbed for such activities. The study highlighted how inadequate policy implementation has given leeway to unfettered sand mining, despite the existence of national and state level guidelines. Most important among these are the Environment Clearance System, Sustainable Sand Mining Guidelines and the National Green Tribunal's guidelines that clearly state the environmental sensitivity of riverbed mining and have thus suggested different levels of clearances, all the way to the district level for carrying out such activities. Stressing on the primacy of maintaining the river ecology's equilibrium, these regulatory frameworks centre around local use of the rivers' resources including sediments. The findings of the research highlighted the blatant disregard of guidelines in the mining industry today. The findings also highlighted the high cost to human lives and livelihoods dependent on river ecosystems,

including effects like diseases, safety hazards, reduction in agricultural use of sediments, burden on infrastructural facilities, high levels of extraction due to perennial mining, loss of land, and induced conflicts, besides an ecological impact like increased disaster frequency and severity, sea bank erosion, groundwater depletion and impact on aquatic life. It is evident from the study that decentralisation efforts have largely failed, especially in states like Odisha where local participation and say in sand mining activities is at a miserable 1 per cent. This has also contributed to local resistance movements against illegal activities that are directly impacting people's lives. These findings direct towards a framework centred around the local authority, with due decision powers relegated to gram sabhas to avoid extraction from smaller streams and rivulets, controlling pollution and balancing the needs of the local people and the environment.

Guleria (2022), in his research 'Sustainable Development Goals (SDGs) and Risks to Coastal Communities,' suggests an integration of United Nations' SDGs with climate change adaptation and resilience building to build a circular strategy that brings together development and adaptation. The emphasis is on 'coastal community resilience' or a community's capacity to adapt to and influence the course of the physical, environmental, social and economic changes.

Guleria's research emphasises adopting this approach for ensuring secure and safe lives for coastal communities and ecosystems. Highlighting developmental parameters such as access to water and health and poverty alleviation, the research focuses on agriculture, rural development and infrastructure and urban planning that can be crucial for both mitigation and adaptation to resilience building. The study also drew from various SDGs and linked them to resilience building. SDG 1 with its emphasis on poverty alleviation can include social protection schemes for island and coastal farming communities; SDG 2 can focus on promoting sustainable seafood and agriculture; SDG 6 can be linked to the betterment of ocean health and coastal resources, a sustained blue economy can alleviate the situation of small scale fishers who are the bottom 40 per cent of the population in terms of income; and SDGs 12, 14 and 15 can promote sustainable consumption and restoring forests and biodiversity. The study

also suggested Potential Fishing Zone Advisory programmes, modernisation and upgradation of fishing centres and regulation of mechanised fishing. Research bodies like the M.S. Swaminathan Research Foundation with their experimentation with salt tolerant rice hybrids and salt tolerant vegetables are coming up with newer ways of adapting to changing ecosystems.

All in all, contemporary research and development work on climate change and communities has an integrated, collaborative approach at its centre, with emphasis on livelihoods that work in tandem with ecological conservation and development that builds resilience for both human and non-human actors in ecosystems. IPCC's Sixth Assessment Report (2022) defines resilience as:

> Adaptation is often organised around resilience as bouncing back and returning to a previous state after a disturbance. More broadly the term describes not just the ability to maintain essential function, identity and structure, but also the capacity for transformation.

The present research aims to highlight ways in which coastal communities and ecosystems can be transformed to not just deal with a climate ravaged future but also contribute to the transformation of our socioeconomic, political and ecological systems towards building more resilient ecologies and economies.

Chapter 3

DISTRICT-WISE VULNERABILITY ANALYSIS

Puri District

Puri is one of the nine coastal alluvial districts in eastern Odisha with a geographical area of 3,479 sq. km. It has one sub-division, 11 tehsils and 268 gram panchayats with a population of 16.98 lakh, as per the 2011 Census. The district receives an average of 1,449.1 mm rainfall in a year. The Mahanadi forms the major river basin along with other rivers such as Daya, Devi, Kushabhadra, Bhargavi and Prachi.[2] The other important surface water bodies in the district are the Sar and Samang lakes, along with the Chilika lagoon formed by the Bay of Bengal. Puri is an agriculture dominated district with rice as the dominant crop cultivated in 171,172 hectares (ha). Agriculture is dependent on rainfed irrigation and only 9 per cent of the total cultivable land is irrigated. With its 150 km long coastline (and as found in the present research), Puri is highly vulnerable to climate change's impact like a receding coastline, seawater intrusion and increased disasters. Floods and cyclones are the most prominent disasters affecting the district, with a rapid increase in frequency and intensity in the post-1999 Super Cyclone period.[3]

History of displacement due to sea intrusions

Villages in Puri's Astaranga and Kakatpur blocks are situated in close proximity to the sea, within a 3 km radius from the coast. Some of the villages are as close as 50-100 m from the coastline. Sea intrusions are common in these villages, even on a daily basis in places such as Arakhakuda and during high tide (full moon and new moon nights) in Astaranga block's villages. These periodic occurrences have been largely adapted to because of their regularity and awareness among villagers.

2. http://cgwb.gov.in/District_Profile/Orissa/Puri.pdf

3. https://puri.nic.in/disaster-management/

But the sea has come in more violent forms in Astaranga's villages that were once situated in regions that are now below the sea.

Records go back to 1971, when village elders report the destruction wreaked by a cyclone in the Bay. That is reported as the first instance of complete displacement of entire villages. The first generation of displaced people rebuilt their homesteads at a safer distance from the sea till another devastating cyclone hit in 1982, causing a second wave of displacement. Villagers narrate stories from their childhood when going to the sea from their villages, with packed food for a 7 km journey took an entire day but today the sea sits close to them, as near as 100 m from their houses.

A third wave of severe destruction and displacement was struck by the 1999 Super Cyclone. A large number of people lost their lives, homes, all belongings and large swathes of agricultural land in the disaster. These are socioeconomic losses that people have not yet recovered from. Land lost has neither been compensated for nor replaced with bought land. People do not have the financial resources to buy more land. Moreover, agricultural land loss to the sea has been a continuous phenomenon for the last 50 years, intensifying in the post-1999 period. This means lesser land for agriculture which has changed the socioeconomic dynamics of these villages completely.

Key vulnerabilities

Socioeconomic vulnerabilities

Loss of livelihood assets and resources

Loss of land due to sea intrusions was high in the individual households surveyed. Amongst the households we spoke with, most had lost between 50 and 75 per cent of their land to the sea. Most farmers fall in the marginal and small categories, and own between 0.5 acre to 4 acres of land. Since there is no compensation for land lost or any other way to redeem it, most households have seen a drastic reduction in land ownership. In Tandahar, for instance, 70 per cent of the households have landholdings smaller than 0.5 acre and are dependent on agriculture as their primary income.

Table 1: A timeline of coast erosion in Puri

Village	First major displacement event	Second	Third	Latest
Tandahar	1971, large portions of agricultural land inundated	1999, agricultural land inundated		2019, agricultural land inundated
Chhenua	1971, entire village inundated	1982, agricultural land inundated	1999, entire village inundated	
Udaykani	1971, entire village inundated, villagers lost homestead land	1982, entire village inundated	1999, entire village inundated, everyone lost homestead land and lost 40 per cent of the forest cover	2019, agricultural land inundated, homesteads destroyed and progressive loss of forest cover in the last 10 years
Katakana	1971, agricultural land inundated	1982, agricultural land inundated	1999, agricultural land inundated, village destroyed	2019, agricultural land inundated, homesteads destroyed
Singharpal	1971, agricultural land inundated	1982, agricultural land inundated	1999, agricultural land inundated	
Keutajanga	1971, agricultural land inundated	1982, agricultural land inundated	1999, agricultural land inundated, homesteads destroyed	
Arakhakuda			1999	

Agricultural land of 3-4 acres/ household has been lost, most of which was patta land of the people. But villagers still have to pay revenue for this land. In the absence of any other viable alternatives, they are now looking for resettlement as the only option. However, the issue here is that resettlement policies in other parts of the state show that after losing entire villages, people are given only a small homestead land as compensation. Loss of agricultural land will still remain a big challenge and resettlement will also mean a possible severing of all socio-cultural ties due to the nature of the resettlement colonies.

In the fishing village of Arakhakuda, there are very few alternatives which are also highly unstable. Primary occupational work in the village depends on resources in the sea and Chilika lake. Alternatives are small, low pay, fish processing or reselling businesses. Calling these ventures businesses is misleading because work such as drying fish or vending fish bought in stock is largely labour work with no asset ownership or income stability. Women take up these ventures when men stop fishing or to support incomes from fishing. Climate change induced sea intrusions have added to the instability of these livelihood resources, affected incomes, women's participation and future possibilities for sustenance.

Distress migration for work

Migration from resource rich regions such as the coast of Odisha is an example of the kind of labour dynamics that climate change affected economic systems will create. People, mostly men who are 20-45 years of age, migrate to states such as Tamil Nadu, Gujarat, Rajasthan, Delhi and Kerala to work as construction or factory labourers. Spending a considerable part of the year away from their families, these labourers are a perfect example of inequalities that current economic production and social reproduction burden agri-dependent, unskilled and less literate groups with. Even with a relatively advanced policy framework on climate change, Odisha is not equipped to deal with the large-scale interstate migrant workers that its livelihood production systems are pushing out of its borders. Marginalisation in livelihoods is a fate of the migrant labourers.

As seen during the COVID-19 pandemic, a large number of people suddenly lost the sole source of their livelihood and led to a massive influx of workers heading back to their home states. People who still possess some portion of cultivable land and have support from cash crops like betel vine and prawn cultivation will still have means to support themselves, but migrant labourers are also susceptible to highly unstable work and loss of social and capital networks due to constant movement. In such a situation, means of social reproduction and economic capital generated by women plays a significant role. As is seen in villages such as Chhenua, Keutajanga, Tandahar and Katakana, migration to other states for labour has created a very different economic unit as a household in these villages. The men travel long distances for work and are gone for a good part of the year. The women and elders stay back taking care of the children and doing labour for livelihood like working in betel vines and prawn cultivation.

Connectivity and mobility

Issues of mobility mean the difference between life and death in this part of the coast. With turbulent waters and vulnerable geographies, being able to move to safer locations is crucial during natural disasters. As found during our fieldwork, most households have two wheelers even if they lack other assets. Connectivity in Astaranga's villages is poor to average at best. Narrow roads that are damaged in several places due to the monsoon are their only means of connecting to the nearest towns, petrol pump, market and for inter-village movements.

In Udaykani, the primary school is almost inaccessible during the monsoon months and during disaster induced waterlogging. Situated in the middle of rice fields, the school is one of the structures remaining from the older villages displaced by the sea and now sits just 200 m from the sea. Schools also double as cyclone shelters during disasters. But the nearest cyclone centre is not always the safest. People often have to travel longer distances from their villages to seek shelter from raging cyclones. Their two wheelers and the single connecting road is thus a crucial mobility factor for these villages.

Connectivity means economic productivity and social and political access. Access to markets depends on income and expenditure opportunities. Due to the lack of such opportunities in the local markets, individuals travel long distances in search of income generating work. Women often have lesser access to such marketplaces in Astaranga, even though they put in very crucial labour in all income generating activities. This lesser access means both reduced incomes and expenditure.

Access to important infrastructure such as schools and healthcare units remains an important part of connectivity. None of the villages studied had access to any healthcare facility within a 5 km radius. Political access defines the nature of support that these villages receive. Government schemes, policies and relief are more accessible to villages that have more political representation. In Krushnaprasad, political ties take control of all channels of communication and connectivity. From aid work to government officials, everyone has to go through these political channels.

Cultural changes

Besides changes in what people grow and eat, there have also been cultural shifts in the community due to the changing environment. Lack of something as basic as drinking water has brought unexpected problems for the people. Some even report difficulty in suitable marriages, especially for the men as families from other places are sceptical to give their daughters to a village with no water.

People have also started leaving these villages permanently. With 10-15 per cent of the population permanently resettled in locations further from the sea and a considerable proportion gone for large parts of the year, the community has a very different shape today than it did a generation ago.

Women and children's vulnerabilities

Sea intrusions, land loss and associated impacts have disproportionately affected women and children in coastal villages. From changes in access to water, food and basic amenities to intergenerational socioeconomic marginalisation, climate change has intensified the marginalisation of these groups.

Major issues faced by women:

- Lack of access to potable water, no supply and long distance travel for fetching safe water.
- Higher impact on women's education and health in case of dwindling household incomes.
- Reduced economic participation as migration becomes the central livelihood option.
- Impact on nutrition as households become more dependent on market bought and government rationed food, leading to lowered nutrition and high food insecurity among women.
- Availability of water and disaster risk also impact prospects for and domestic situation post marriage leaving women more vulnerable.
- Dropping out among college going women is very common for which lack of financial resources and restricted mobility are the primary reasons.

Major children's issues:

- Insufficient educational infrastructure: In many villages, the schools are either damaged or left inaccessible during sea intrusions and waterlogging, increasing the number of days children spend out of school.
- With reduced varieties of food and dwindling incomes, food insecurity has also had an adverse impact on children's nutrition and growth.
- Increased dependence on labour and distress migration has increased dropout rates and reduced educational levels among the youth in climate change affected villages.

Ecological vulnerabilities

Changes in water resources

Villages like Udaykani, Katakana, Tandahar and Keutajanga are surrounded by the Kadua river on the one hand and the Bay of Bengal on the other. Keutajanga is placed in a unique geographical border formed by the river on three sides and the sea. Kadua's water and groundwater are the

primary sources of water in this part of Astaranga block. Both river and groundwater are affected by salinity, which is a highly prevalent problem in this region. Owing to its proximity to the sea, water resources for both household use and irrigation are saline, have high electrical conductivity (EC) and the presence of minerals such as iron and fluorides in the soil.[4] Rainwater harvesting practices are loosely followed; the ponds in Chhenua and Singharpal are well constructed and maintained but they are in poor condition in places such as Udaykani and Katakana.

In Krushnaprasad block, the salinity hazard is a persistent problem affecting groundwater, along with Chilika's lagoon water. These villages are thus prone to consuming water which has saline and other mineral content on a daily basis. Saline water consumption in coastal areas has a widespread health impact such as hypertension and higher risks of strokes and has an adverse impact on pregnant women's health.[5] Fieldwork in Astaranga and Krushnaprasad blocks' villages revealed that hypertension is a common health issue and its prevalence is especially high among women in the 45-60 years age group.

Disaster related vulnerabilities

The history of major disasters that were reported during the research and that led to displacement go back to 1971, when widespread flooding led to massive losses in agricultural land in villages such as Tandahar, Keutajanga and Katakana. Entire villages were displaced in Udaykani and Chhenua. An analysis of disaster vulnerabilities showed that kutcha houses with a single wage earner or single source of income and with senior citizens/ persons with disabilities were the most vulnerable.

Issues of mobility, nutrition, health and post disaster recovery of livelihood sources were the major challenges that such households faced. As high as 95 per cent of the households had experienced losses of homestead, livestock and agricultural produce multiple times in disasters in the last

4. http://cgwb.gov.in/District_Profile/Orissa/Puri.pdf

5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6473225/#:~:text=Impacts%20of%20excessive%20salt%20on,partum%20infant%20morbidity%20and%20mortality.

10 years. Relief resources provided by the government are not enough to cover the costs that are at least 10 times the relief amount provided. For instance, Rs 1,000 was provided as compensation for houses damaged in Cyclone Fani, while the actual costs of rebuilding even a kutcha house ranged from Rs 10,000 to Rs 15,000.

COVID-19 also resulted in massive losses in livelihoods due to lockdowns and reduced demand and connectivity in local and interstate markets. Specifically, these losses impacted households solely dependent on migrant labour or with low land ownership and thus low agricultural incomes.

Major impact of disasters

- High degree of losses in crop produce and impact on primary livelihood sources.
- Damages to houses and lack of resources for rebuilding adding to risk to life.
- Salinisation of groundwater and soil due to waterlogging.
- Impact on developmental infrastructure – schools, health centres, roads.
- Increased risk to alternative livelihoods like betel vine plantations and prawn farming.

Access to aid

Astaranga and Kakatpur villages have not had regular access to government support provided to disaster affected communities. Relief was scattered and not provided after every cyclone, considering that their frequency and intensity have gone up significantly in the last decade. Compensation is not adequate to cover damages to homesteads, loss of crops and other livelihood resources. These losses are common across all households but certain socioeconomic factors put certain groups more at risk. People with kutcha houses, closer to the sea, coming from historically marginalised caste groups, the aged, ill and dependent are more vulnerable in disaster situations and need adequate support during and post the disasters.

Aid work by NGOs has been crucial in this region. Livelihood regeneration and support along with disaster relief has been a focus of developmental organisations. People have received support from NGOs that has helped them rebuild their livelihoods through alternatives in fisheries, cash crops and animal husbandry.

Key recommendations for Puri district

Water resource management

Due to the contamination of groundwater and lack of knowledge about managing water resources, villages studied in this research suffered from various issues pertaining to consumption, health and livelihood generation. Better infrastructure such as shallow wells constructed in Keutajanga, rainwater harvesting ponds, integrated farming systems and water tanks for tap water supply can improve both lives and livelihoods.

Infrastructure and welfare

Better access to and facilities in education and health infrastructure are crucial for the development of villages displaced by the sea. Lack of education has meant earlier marriages and lack of careers for women and dearth of resources for supporting large households for wage earners. Better education facilities can improve women's economic participation and provide local income generating resources thus reducing migration pressures on wage earners.

Better resources are crucial for the development and welfare of dependent populations like children, the aged and other groups such as persons with disabilities. The government's social protection schemes need to be better applied in these villages. Among those interviewed, 22 per cent were senior citizens who didn't receive a pension.

Alternative livelihoods

Rearing animals, integrative schemes that incentivise taking up work that meets demands in local markets and rearing milch and meat animals

through self-help groups' (SHGs) targeted subsidies are viable for women. Risks involved include losses due to a disaster. A similar fate befalls those who aim to increase their incomes through betel vine cultivation. There are sustained costs in the process (fertilisers, bamboo, other inputs and labour hours). While the returns are high on success, chances of failure also increase the risks involved. Losses are frequent and deter smaller farmers with no stable income from continuing the cultivation. Efforts at providing better livelihood opportunities will thus involve better connectivity to local markets, expert guidance and infrastructural support during the initial phases.

Community involvement and ownership

To deal with the present affirmations of climate change's reality, it is crucial that the process integrates those whose lives are affected the most. Involving the community in building better infrastructure in their villages through schemes such as the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) could be one possible way. These can include strengthening rain harvesting areas, better drainage, roads, water management systems and other community resources. The present research found that community interests can steer livelihood production and climate change mitigation in the region.

Community ownership of resources such as forests is another issue at stake. Our research found that communities such as Singharpal village's forest community have leased a considerable portion of the *jhaun* (casuarina) forests surrounding their village. The Singharpal patch has witnessed afforestation creating a small-scale industry for the women in the village in cashew nuts found in the forests. Forestation is also found to be one of the most reliable methods of mitigation. Replanting forests that once shielded these villages is one such action and needs the community's complete involvement and ownership of the process.

Deforestation integrated in people's everyday lives as their only source of fuel needs to be dealt with more inclusive measures like small-scale leases for forest use, reforestation and local plantations for community use. Effective allocation of community resources like common spaces, forests,

water bodies, infrastructure and capital flow are crucial for environmental strategies for the future.

Jagatsinghpur district

Jagatsinghpur is a coastal district with a geographical area of 1,759 sq. km and is the smallest district in Odisha in terms of territory. As per the 2011 Census, its total population is 11,36,971 of which Scheduled Castes comprise 2,48,152 and Scheduled Tribes 7,862 individuals. Jagatsinghpur is a primarily rural district with 89.80 per cent of its population living in villages. Lying in the deltaic region of Mahanadi, the district has highly fertile and productive land and paddy cultivation is the primary source of livelihood. Over the last two decades, intensifying disasters like cyclones and floods, along with industrialisation has led to heavy losses of mangrove and casuarina forest covers in the district, making villages in Erasama, Paradip and Kujang blocks highly vulnerable to sea intrusions. An increase in sea intrusions has had severe impact on agricultural livelihoods, with vast portions of land regularly subjected to saline ingress and disaster damage. A major shift has occurred in Jagatsinghpur's land use pattern with farms being converted to prawn cultures to deal with agricultural uncertainty.

History of resettlement

Nagari was one of the first villages to be resettled after the 1999 Super Cyclone. Even though the village was situated several kilometres inland, the 1999 Super Cyclone resulted in its complete displacement. 'We all lost several members from each of our families, all our land and had to leave behind our old village,' says 79-year-old Vikas Samanta, who lost 13 members of his family. All households pooled Rs 3,500 each provided as relief to buy 5 acres of land from a villager. This land was used by the Tata Relief Committee to build houses for the 52 families left behind.

Socioeconomic concerns of the Nagari resettlement colony:

- 90 per cent of the houses built by Tata Relief Committee post-1999 have been damaged and face severe waterlogging.

History of displacement due to sea intrusions

Table 2: A timeline of coast erosion and village displacement in Erasma, Jagatsinghpur

Village	First major displacement	Second	Third	Latest
Gadaharishpur	1971, entire village inundated, all kutcha houses destroyed, mangrove forest loss	1982, all kutcha houses destroyed, loss of forest cover, agricultural land destroyed	1999, loss of 50 acres of village land to shoreline erosion, 25 per cent forest cover lost, mangroves destroyed completely	2012, 2014, 2015 and 2019, major cyclones increased shoreline erosion, 100 acres of land lost, 50 per cent forest cover lost
Siali	1971, coast eroded up to 500 m inwards, village destroyed, mangrove forest loss	1999, sea intruded further by 500 m, all houses destroyed, major loss of lives, forest cover destroyed		2019, village inundated, agricultural land and fish cultures destroyed, forest cover reduced to 10 per cent of pre-1990 levels, distance from sea reduced to below 500 m
Nagari	1971, village inundated	1982, sea intruded 2 km into the shore, village inundated, 150 acres of agricultural land affected	1999, complete displacement of village, sea intruded 5 km inwards, 207 people died, 60 per cent forest cover lost	2010s, most major cyclones inundated village, severe water logging and erosion now, no agriculture or fish cultures sustains in the village

(Contd. ...)

(...Contd.)

Village	First major displacement	Second	Third	Latest
Ramtara			1999, human death toll in hundreds, 80 per cent agri-cultural land affected by saline ingress and rendered uncultivable, 50 per cent forest cover lost	2000s, sea intrusion in 95 per cent of agri-cultural land, 90 per cent forest cover lost

- Government assistance for housing denied post-1999 due to pre-existing Tata relief houses.
- Sea intrusions during high tide up to 2 ft water in village has led to natural barriers being reduced drastically.
- 90 per cent of the households Below the Poverty Line (BPL).
- Wage labour only source of income, 50 per cent of the households rely on sharecropping in agricultural land situated 10-40 km from the village.
- Very low land ownership and 95 per cent land not cultivated.
- Severe shortage of water due to saline ingress and damming of the Mahanadi river upstream.

'Ever since Chhattisgarh has started building dams on the Mahanadi, our fields have run dry. We have no water during summer months. Our children, our animals, and our land have no water to drink,' says a resident of the village.

Fig 1.1 State of a Tata Relief Committee house in Nagari

Key areas of vulnerabilities

Physical vulnerabilities

One-fourth of the population in the villages of Ramtara, Nagari and Siali and a half of Gadaharishpur's population live in thatched houses, which increases their vulnerability to climate change induced weather events. Death figures and injuries reported from 1999 indicate physical vulnerabilities of young children, women, disabled individuals and the diseased. Low income and lack of access to healthcare further inhibit physical wellbeing. In Siali, villagers report increased instances of diseases such as hypertension, diabetes, cancer and heart diseases and an increase in uterine tumours among women. 'We lost our fields to the sea, and now we have to rely on farming prawns for an income. The chemicals in our diet and in the prawn ponds has destroyed our health. There is a diseased person in every single family today,' says Bishnu Jena, an 80-year-old resident of Siali.

In Nagari, all families lost their members during the Super Cyclone and among those who survived, several endured grievous injuries, which affected their ability to work and their overall health. 'I was stuck on a coconut tree for 2-3 days. I got several injuries on my hands, chest and head. They don't let me work even today. Our bodies never recovered from what happened,' says Suchitra Dalai, who lost four of her children in the Super Cyclone. There are several households where only one or two members, mostly senior citizens, have been left whose mobility is restricted by health, low economic resources and physical inaccessibility of their village.

As the sea erodes the shore in Jagatsinghpur's Erasama block and villages are threatened by an intruding sea, physically dependent or disabled individuals without proper shelters, or access to care are highly vulnerable.

Gender vulnerabilities

Even in vulnerable climate change affected communities, women continue to face double marginalisation due to their exclusion from socioeconomic structures of agency and the new forms of disempowerment that climate change imposes.

Key issues

- *Loss of economic agency:* One of the reasons for reduced economic access among women is the loss of traditional agricultural and fishing livelihoods. Agricultural land loss has been a major impact of saline ingress and a most of the population in Siali, Nagari and Ramatara has shifted to prawn cultivation or other monocultures, which exclude women. In traditional livelihoods, women played a significant role in weeding, harvesting and marketing paddy and shallow water fish collection and sorting, drying and packaging in traditional fishing livelihoods. Prawn cultures are marked by a male dominance in labour and control. They are located at a distance from the villages, require overnight stay and constant monitoring/ guarding the equipment and inputs and are considered more laborious and unsafe for women. All these factors contribute to exclusion of women from a major economic activity (Pradhan and Flaherty, 2007). Further, dependence on migrant labour, even local labour that requires long distance travel, leads to women losing their share of economic participation.

- *Health:* Loss of subsistence farming has increased food insecurity and forced market goods in the lives of these village communities. Changes in diet have reduced nutrition for women and affected overall health, specifically reproductive health. Instances of uterine tumours, heart risks, cancer and other diseases have increased among women in these villages. Low income and lack of healthcare facilities mean women's health problems go unattended.
- *Social security:* In the absence of economic participation, women are completely dependent on male wage earners. If due to any reason such as separation, death or disease, the male member of the family does not contribute financially, women have no financial resources.

Case Studies

1. Saida Bibi

Saida Bibi, 42, lives in Gadaharishpur. She belongs to the minority Muslim population, which makes up about 10 per cent of the village's population. Her husband committed suicide five years ago. Their four-person family consists of two sons and one daughter. Her eldest son dropped out of school after graduating in Grade 10 to go to Hyderabad looking for work. Saida has kept the younger children in school, although they have to walk 5 km to school every day. She is financially dependent on her parents, but she works as a daily wage worker on the side. They are an immigrant Bengali family that moved to Odisha two generations ago in search of better living conditions.

Like many migrants, Saida's family does not have land and relies on daily wage labour to make ends meet. A small mangrove forest, 1.5 km from her house leads to the Devi river and the seacoast. Specifically, the forest is used for only domestic help like fuelwood and the forest is protecting the village from cyclones and sea intrusions; the women rely on the forest for firewood.

Saida planned to build a two-room house with government assistance, but she was unable to finish it due to lack of funds. She and her family are now living in a half-finished house with a leaking roof. Saida's family relied on her husband's fishing earnings to survive while he was alive, but that is no longer a source of income for them.

The areas surrounded by mangroves are relatively safer than areas without any natural barriers. Also, over a period of time the density of the mangrove forest

(Contd. ...)

Socioeconomic vulnerabilities

Increasing landlessness and loss of productive land

Siali was an agricultural village till the 2000s. In the last two decades, 60 per cent of the farmers have converted their land to fishery units. 'We have not had a single successful crop in our fields in the last 20 years. Seawater has destroyed our land; it is barren. Even the fish ponds we build are regularly flooded by the sea. Our children will have no way to earn a living in this village,' a concerned elder voiced his worries.

Traditionally agriculture dependent villages have been among the worst hit by the seacoast erosion and saline ingress. Land ownership patterns reveal that a vast majority of the farmers studied in this research are marginal farmers; a few who own some land cannot qualify even as small farmers. In villages like Nagari, where 95 per cent of the agricultural land is lost to various ill-effects of climate change, erstwhile farmers have become wage labourers. In Gadaharishpur, almost 100 acres of productive land has been lost to sea intrusions since 1999. At least 70 per cent of the households that depend on agriculture have shifted to shrimp farming in the last decade.

In Erasama block, shifting to prawn cultivation was boosted by the proposed POSCO steel plant in 2005, many local politicians and bureaucrats bought land and were instrumental in marking the conversion of productive agricultural land to prawn *gheris* (Chhotray, 2022). Although the project was stopped due to large scale local protests, the *gheris* stayed, controlled by buyers from the Paradip Port based seafood exports companies (Chhotray, 2022).

Livelihood risks

A vast majority of the farmers in the four villages which formed a part of this research have shifted to shrimp cultivation as their primary source of income. This shift is a result of a complex interplay between environmental changes and trends in export markets. As high as 80 per cent of the agricultural land in Ramtara village is regularly affected by saline intrusions and has been replaced by shrimp cultures. The shift to monocultures is a major risk for small and marginal farmers as it leaves them at the mercy of price fluctuations in domestic and global markets. Shrimp culture

(Contd. ...)

across this seacoast has shrunk and there has not been any effort to rejuvenate the mangrove forest, thus vulnerabilities due to the impact of salination and sea intrusions are increasing. As a result, agricultural fields and crops in nearby villages like Noliasahi, Gadaharishpur, Ahanda and Patharkunda have been frequently affected. It is pertinent to mention here that in recent years the frequency of salination and sea intrusions has increased to an extent that the seawater submerged the whole agricultural land at a frequency of every 15 days. This recent devastating phenomenon is more alarming for the people who depend on agriculture for their livelihoods. This has also contributed to a decrease in agricultural production.

Saida is a wage worker in the agricultural fields, and when crops fail, she loses her only source of income. 'Fields are destroyed by the sea, and our home is also flooded, leaving us with nowhere to go. Because of the work I do in the paddy fields, my family and I can eat. What will we do if that is lost?' Saida asks. She is eager to work in any other capacity that might be available, but there are few economic resources in their community, which is also losing control over the ground it is built on as the sea continues to encroach. 'There are several women in our community who raise cows, goats and hens to make a living. I want to start doing the same. However, due to lack of financial assistance I have not been able to start this,' Saida says, begging for assistance.

2. Chakradhar Gudia

Chakaradhar Gudia, 42, a daily-wage labourer, has been residing in Gadaharishpur village, Erasama block, Jagatsingpur. He had lost his left eye as a kid. His wife is a stay-at-home mother with minor mental health difficulties that interfere in her personal life. He is the father of two children, a son and a daughter. Sonali Gudia is 19-years-old and is pursuing nursing training at a nursing institute after finishing high school. Sidhant Gudia is 17 and due to unforeseen circumstances he did not complete his higher secondary education. He is currently employed as a waiter in a local hotel in Bhubaneswar. Their ancestors moved from West Bengal to Odisha two generations ago in quest for more prosperous lives.

The village is one km from the seashore and has 210 dwellings with a total population of 1,051 people. A majority of the residents rely on fishing and daily wage work.

During the 1999 Super Cyclone, his and nearly the whole village's kutcha houses were submerged and destroyed. The entire family was relocated to a higher elevation. Trees were uprooted, villagers lost agricultural fields and freshwater

(...Contd.)

is a high investment activity, with annual input and maintenance costs going up to an average of Rs 2-3 lakh per year, which is almost twice or thrice the average annual income in these villages. Input costs include dyke preparation, medicines, fertilisers, fuel for running the machinery and feeding and harvesting costs. Losses in shrimp cultivation have been high in these villages. Controlled by export companies and 'finance-men' or middlemen who supply funds and market access to a majority of the farmers, shrimp cultures have become a high-loss enterprise for small and marginal farmers in case of crop failures.

'We invest Rs 2 lakh in a *chingudi gheri* per cycle and if the crop gets destroyed, the investment becomes a debt for us. Losses are very high, especially due to disasters, virus infestation and other diseases. We don't have proper expertise for managing these cultures but we have no other option,' says a village elder from Siali. In the absence of any kind of insurance, crop losses amount to a high debt burden for shrimp cultivators. In Gadaharishpur, as many as 70 per cent of the farmers have been adopting shrimp cultivation post the 1999 Super Cyclone, but high intensity and high frequency of disasters in the 2010s resulted in massive losses and a large number of cultures had to be abandoned. Increase in salinity of both soil and water, along with disease infestation, has been a major reason for such losses. When shrimp farming did not

Fig 1.3 Agricultural land affected by an intruding sea and converted to shrimp ponds in Ramtara village

(Contd. ...)

ponds became salinised, causing freshwater fishing to suffer, resulting in a significant loss of livelihood for the inhabitants. At that time, in addition to losing their livelihoods, the entire family had to endure several personal losses; Chakaradhar lost one of his sons in the Super Cyclone.

Post-cyclone for about 15 days, they cooked food at the place where they were shifted, and they received some support like dry food items from the government and other NGOs.

Before the Super Cyclone, they relied on paddy farming and fishing for a living, but they were unable to continue with these as seawater seeped into the ponds and agricultural land. Even though Chakaradhar lost his kutcha house and got no compensation from the government or from any NGO, he did obtain some funding in 2014 to build a new home, 15 years after the cyclone under the Indira Awas Yojana.

He started building a two-room house but has yet to finish it. They are preparing dinner outside their home, in a little hut. He is currently employed as a daily wage labourer and a fisherman; he has never received daily employment under MGNREGA and is compelled to work on building sites. He holds a ration card and therefore qualifies for the Kalia Yojana.

He stated that for the last 19 years, seawater has entered the nearby Noliasahi village, Gadhiharishpur, and there is no embankment to protect the village. He also stated that the villages have filed a memorandum with the politicians and government officials proposing the construction of a green corridor-like mangrove plantation along the seashore to safeguard the village from seawater, but no one is listening. He asked ActionAid Association to bring the matter to the attention of higher authorities.

provide adequate returns, as many as 30 per cent of the farmers moved to migration labour as their source of livelihood.

Ecological vulnerabilities

Loss of forest cover

Loss of forest cover has been a major concern in Jagatsinghpur's Erasama block as it is both an effect and a cause of climate change related problems. Erosion of forest belts that acted as natural barriers has exposed all four villages to the turbulent sea. Sea intrusions into the villages have become more frequent even in non-disaster periods as forests recede. While

Table 3: Timeline of forest cover loss in Erasama, Jagatsinghpur

Village	Forest cover		
	1990s	2010s	Present
Gadaharishpur	200 acres	150 acres	<100 acres
Siali	2 km wide forest formed a natural barrier along the coast	Reduced by 50 per cent	Width reduced to 500 m, as less as 20 m in parts along the coast
Nagari	2-3 km wide forest belt between the village and sea	Reduced to 60 per cent	Forest cover reduced to 50 per cent of the 1990s density
Ramatara	Mangrove belt lost completely between 1980 and 1999	2 km stretch of jhaun (casuarina) forest belt lost	10-20 per cent forest cover re-maining

forest loss has been continuous since the 1990s, with the 1999 Super Cyclone resulting in major losses, afforestation efforts have been missing in Jagatsinghpur. In the Erasama block, the proposal for the POSCO steel plant in 2005 was also followed by large scale deforestation which led to the destruction of mangroves resulting in the present exposed coastline (Chhotray, 2022).

In the neighbouring district of Bhadrak, large scale plantations post-1999 have been able to reduce sea intrusions in coastal villages. But such efforts are missing in Jagatsinghpur. A village elder from Gadaharishpur, showing how much the forest had changed around his village in the last two decades, said, 'We were saved from the 1999 Super Cyclone or mahabatya due to the forest. The sea has eaten up most of our forest since then. We see trees falling down with each passing day as the sand and seawater damage them. There is no use building walls and dams. Only the forest can save our village.' Villagers attribute changes in the seawater, land characteristics and their forest to unregulated infrastructural development in Erasama block and Paradip Port.

Fig 1.4 Continuous damage to forest cover in Gadaharishpur

Fig 1.5 Eroding coast and forest cover in Siali

Fig 1.6 Extensive loss of forest cover and soil pollution in Ramtara

Depletion of water resources

One of the biggest challenges that climate change presents in most coastal villages is that of securing water for the present and future. Saline intrusion has had a major affect on groundwater resources, small rivers and freshwater ponds in Erasama. Villages such as Gadaharishpur and Siali have seen major changes in groundwater quality since the 1990s as water levels have gone down with potable water being limited to up to 20 ft and increased saline and iron content in levels below 20 ft.

Nagari has an acute water shortage due to reduced water in the Hansua river, which villagers attribute to damming of the Mahanadi in Chhattisgarh. Delayed monsoons and reduced rainfall have also led to severe water shortages during summer months, when the village relies on water tanks supplied by the panchayat. Reduced water access is a major cause for loss of agricultural livelihoods and also for the deteriorating quality of everyday life in the village.

Destruction of land and water resources due to unsustainable prawn cultivation

The post-liberalisation period witnessed a rapid increase in seafood exports which had a significant impact on coastal regions, including Odisha. Erasama block also saw a large number of farmers shifting to prawn farming owing to a mix of environmental factors that made paddy cultivation less profitable and involvement of seafood exporting agencies, government policies and middlemen who encouraged this conversion. However, unregulated shrimp cultivation has a significant ecological cost. Since most gheris are unregistered, they do not comply with the Coastal Regulation Zone's norms. For instance, most unregistered farms do not have effluent treatment systems and the discharge remains untreated or only treated with bleach, affecting estuaries and groundwater (Chhotray, 2022). These effluents contain excess lime, organic wastes, pesticides, chemicals and disease micro-organisms, which degrade local water bodies and marine life along with soil degradation. Once converted to shrimp ponds, agricultural land in most cases cannot be used for cultivation again. Shrimp monocultures and effluents are also a threat to forests, plantations and mangroves, which in turn makes these villages more susceptible to disasters (Pradhan and Flaherty, 2007)

Disaster related vulnerabilities

Increased frequency and intensity of disasters has been the most evident effect of climate change in coastal villages. With almost an annual recurrence, cyclones are the most devastating sudden onset disaster events in Jagatsinghpur.

Major impact of disasters in the post-1999 period:

- Major losses in forest cover and no afforestation in the aftermath of cyclones.
- Livelihood losses resulting from inundation of standing crops, death of livestock and inundation of shrimp cultures.
- Damages to houses, especially kutcha houses amounting to losses of a minimum of Rs 10,000-20,000 per household in every cyclone.
- Loss of work for agricultural labourers when crops are destroyed.

- More losses in high investment livelihoods such as betel vine and shrimp cultivation, losses amounting to Rs 2 lakh per household when shrimp cultures are destroyed in cyclones.
- Lack of compensation or relief for losses incurred during cyclones, only 10 per cent of those interviewed got any kind of relief in cash or kind in the last 10 years.

Saline embankments

A 10 km stretch in Gadaharishpur panchayat was used for constructing a saline embankment made from stones secured in place by an iron wired net. A 2 km patch in the middle of the proposed embankment has been left out along Gadaharishpur village's boundary, which has increased sea intrusions. Villagers feel that these saline embankments are only temporary measures and only natural barriers like a forest cover can protect their villages.

Shift to shrimp cultures

As changing climate affects rainfall, water availability and disasters in the district, a lot of paddy farmers have adopted other livelihood options such as shrimp and betel vine cultivation. In villages in Siali and Ramtara, almost 90 per cent of the farmers have converted their agricultural land to shrimp cultures in the last 10 years owing to rapid intrusion of saline water in productive land. Besides being affected by loss of incomes from rice cultivation such a shift has also been shaped by external agencies, local middlemen, larger landowners, seafood export companies and the government. But the ecological and economic costs of this adaptation are high, especially for small and marginal farmers who are in a predominant number in Erasama villages.

Key recommendations for Jagatsinghpur district

Registration and regulation of shrimp aquaculture

For paddy farmers of Erasama, crop failures due to changes in rainfall patterns, lack of irrigation facilities, saline ingress and disaster damage has resulted in losses and mounting debts. In the aftermath of cyclones, most of the land is rendered uncultivable for almost two years, as reported by villagers. Monocropping practices and overdependence on

only a single crop during a particular year is an issue that needs to be addressed. Awareness campaigns should be undertaken among farmers about the benefits and strategies for multiple cropping (like lentils, millets and vegetables) and using less water intensive and saline water adapted varieties of rice for ensuring food security.

Among shrimp and betel vine cultivators, training in setup and maintenance along with disease control measures is needed for reducing losses due to diseases. Further, crop insurance measures can help farmers recover from losses due to disasters and sustain these alternative livelihoods over longer periods. In Erasama, a large number of unregistered shrimp cultures are a threat to not just the local ecology due to their non-compliance with regulations but they also deprive farmers of benefits such as a 50 per cent subsidy under the Rashtriya Krushi Vikas Yojana, training by the Coastal Aquaculture Authority of India and insurance in case of losses due to disasters. In the absence of such support, shrimp farmers fall prey to local lenders for setting up farms and middlemen for financing and seed supply and bear the brunt of massive losses. A better evaluation of shrimp cultivation among small and marginal farmers by the government is needed to bring more farmers under the registered and regulated policy framework of coastal aquaculture.

Promoting integrated fisheries and farming

Loss of traditional multiple cropping systems including paddy, pulses, oil seeds and vegetables and a complete shift to paddy monocultures, largely post the 1990s has both economic and ecological costs. Paddy cultivation being replaced by unregulated shrimp monocultures is a further deterioration. Promotion of integrated, multiple crop farming and fisheries systems can be an important step towards sustainability. Integrated crop-fisheries-livestock systems are suitable for the coastal plains of Jagatsinghpur and can provide a better security net to small and marginal farmers, empower women, reintroduce traditional and sustainable livelihoods and act as an important resilience building strategy.

Planting natural barriers

The most urgent task at hand for the villages of Erasama block is the planting of natural barriers of forests to control sea intrusions and disaster

damage. Mangrove forests are the most important buffer against sea intrusions in areas affected by tidal wave ingress while casuarina and cashew plantations can be used for creating shelter belts in areas with sand intrusions. Besides afforestation, regulation of livelihood activities like shrimp monocultures that are damaging land and water resources is crucial for saving existing forest resources.

Kendrapara district

Kendrapara district, which was created in 1993, has a unique geographical landscape and a unique history of dealing with different forms of climate events. Kendrapara was one of the first districts where a climate refugee or resettlement colony was planned. The district is located in the deltaic region of major river systems like the Mahanadi, the Brahmani and the Baitarani and their tributaries draining into the Bay of Bengal. It is categorised as a coastal plain zone.

Stretches of wild jungle line the seacoast in Kendrapara, which is also home to the Bhitarkanika National Park, one of the largest mangrove reserves in the country. Other varieties of forests are found in the deltaic region and form a natural barrier from the Bay of Bengal. These forests have seen considerable erosion due to changing sea levels, saline ingress and other impacts of climate change. According to estimates based on the 2011 Census data, there are 14 lakh people living in the district, 94 per cent of whom live in villages.[6] As per the District Disaster Management Plan, out of 100 workers in the district, 68 are engaged in the agricultural sector.[7] With rise in climate related extreme events and recurring disasters, Kendrapara district is highly vulnerable to climate change. A majority of the state's farmers are marginal farmers and fishing is becoming increasingly unreliable as a source of income.

Climate change has already displaced a number of villages in the district and resettlement colonies have been created. The district continues to be susceptible to cyclones and floods and has seen a significant impact of sea level rise, coastal erosion and loss of resources.

6. Office of the Registrar General & Census Commissioner. 2011. Census of India.

7. District Disaster Management Plan 2022-2023 <https://cdn.s3waas.gov.in/s3812b4ba287f5ee0bc9d43bbf5bbe87fb/uploads/2023/02/2023021059.pdf>

Table 4: A timeline of coastal erosion in Kendrapara

Village	First major displacement event	Second	Third	Latest
Satabhaya	1960s, 2 out of 7 villages lost, 5 displaced	1971, Govindpur and Mahnipur displaced completely	1982, people from remaining 3 villages start leaving for higher land in Magarkanda	2011, Satabhaya completely lost to the sea, 571 families resettled in Bagpatia between 2010 and 2018
Okilapal	1960s, loss of 2 villages	1971, Govindpur lost and displaced to Okilapal, 272 houses resettled	Another 72 households resettle in Okilapal	
Jamboo	1966-71, people migrated from West Bengal and settled in Jamboo	1999, losses of agricultural land and coast erosion		Increased tidal height and sea level changes in the past year, prone to inundation
Bahakud		1999, agricultural land loss		Increased saline intrusions
Batighar	Coastal erosion in the 1970s led to the loss of a 4-5 km stretch of land	1999, coast receded by another 2 km, loss of agricultural land and forests		Loss of forests and seacoast erosion doubled – current distance from sea is 500 m

Major factors for sea intrusions:

- Rapid coast erosion and sea intrusions – the low water line has advanced by 340 m, indicating a coastal erosion rate of 85 m per annum.
- 0.4 million hectares (Mha) affected by salinity problem due to sea intrusions, spreading over four coastal districts of Odisha.
- Loss of land and forest cover in three major disasters between 1971 and 1999.
- Increased disaster intensity and frequency in the post-1999 period.

History of resettlement

Satabhaya, Bagpatia

Thaithan, as the resettlement colony of Bagpatia is called, is now home to the erstwhile villages of Satabhaya panchayat. Beginning in 1971, villagers from the panchayat started leaving for safer locations as their own land was eaten up by an intruding sea, fields were turned into sand and life was increasingly at risk. The villages of Govindpur, Mahnipur and Kuanriora were lost in the early 1980s and two more villages of Kharikula and Sarpada in the mid-1990s. In 1992, resettlement plans began for the inhabitants of Satabhaya at Bagapatia and an amount of Rs 1 crore was sanctioned by the then Chief Minister of Odisha.[9]

Of the 571 families who were to be resettled, 390 have found their way to the 10 decimals of land provided to them in Bagpatia. In the initial proposal, land pattas were supposed to be in the name of both spouses in a household but that does not seem to be the case today. Their erstwhile villages have completely emptied out but some people continue to have some land and livestock back home that the male members look after. Families who had started migrating in the pre-2015 period have livelihood bases in other places such as Magarkanda. Most of the present day residents have come in and settled post-2015, as administrative inconsistencies and protests from the residents of Bagpatia, whose land was acquired for resettlement, slowed the project down.[10]

9. https://generic.wordpress.soton.ac.uk/deccma/wp-content/uploads/sites/181/2017/07/INDIA-Resettlement-Working-Paper_FEB2016.pdf

10. Ibid

In a visit in May 2023 to Satabhaya of Kendrapara, Shri V.K. Pandian, Secretary to the CM for the 5T Transformative Initiatives, declared that the Chief Minister had sanctioned Rs. 22.5 Crores for the rehabilitation of the people displaced by the climate change impact. Also, the office of the Chief Minister had claimed that this would be the first rehabilitation colony in India for the people affected by climate change.

With this money, an additional 247 families will be rehabilitated. This includes 148 families who were left out and to be included as part of compliance with the order of the Hon'ble High Court of Odisha. In addition, 99 families residing in Bhitarkanika National Park will be rehabilitated in Bagapatia. As part of the rehabilitation process, each family will be provided ten decimals of land and land for all 247 families has been identified and demarcated.

Socioeconomic indicators of the resettlement colony

Marginalised caste population

Sl. No.	Revenue Village	Total House-holds	S.T. House-holds	S.C. House-holds	General House-holds	Total Population
1	Kanhupur	16	-	4	12	109
2	Satabhaya	220	4	15	201	1177
3	Barahipur	93	15	7	71	552
4	Rabindrapalli	26	-	17	9	153
5	Magarakanda	216	-	110	106	1252
	Total	**571**	**19 (3.33%)**	**153 (26.80)**	**399 (69.88%)**	**3243**

Source: District Administration, Kendrapara

Out of the 571 families rehabilitated in Bagapatia by the state government from five displaced villages viz; Kanhupur, Satabhaya, Barahipur, Rabindrapalli, Magarakanda, 3.33% (19 families) belong to Scheduled Caste, 26.80% (153 families) Scheduled Tribe and 69.88% (399 families) are from general castes. In total 3,243 people from 571 families have been rehabilitated by the state government. The Scheduled Caste households

Fig 1.7 Bagpatia resettlement colony houses

traditionally undertook fishing, while Other Backward Class households relied on agriculture. But after displacement, all groups have lost their livelihood and depend entirely on interstate migration work for income. In the colony, sub-divisions have been made based on caste groups, and households from the same caste group reside in the same lanes.

Living conditions

Each of the 571 households resettled in Bagpatia was given Rs 1.2 lakh and allotted 10 decimals of homestead land. 751 households displaced from seven coastal villages have been rehabilitated in the Bagapatia resettlement colony. Our participatory study found that 33.45 per cent of the houses were yet to be completed, of which for two per cent of the househlds construction work was yet to start. So around a third of the people in Bagapatia continue to live in partially constructed houses without toilets and drainage systems. With the newly constructed public overhead water tank damaged and groundwater contaminated due to high iron concentration and water tables dropping significantly in summer months, people rely on water supplied through community taps for an hour every day at the rate of Rs 50 per month per family. At least 70 per cent

Table 5: A timeline of coastal erosion in Kendrapara

Sl No	Loss due to Shifting								Compensation by Government						
	Head of the HHs	Total Members of the Family	Men	Women	Children	Area of Homestead Land-Dec	Number of Rooms	Agri Land (Acre)	Common Land	Homestead Land (decimals)	Agricultural Land	House	Land Development	Toilet	Livelihood Support
1	Nalini Kanta Biswal	9	6	3	3	50	4	4	3 Acres	10	0	124000	10000	12000	5000
2	Radhashyam Muduli	5	4	1	0	15	4	2	3 Acres	10	0	124000	10000	12000	5000
3	Saraswati Mahanty	2	1	1	12	Stayed on government	4	was doing share cropping and wage work agriculture	3 Acres	10	0	124000	10000	12000	5000

(Contd. ...)

(Contd. ...)

Sl No	Loss due to Shifting								Compensation by Government						
	Head of the HHs	Total Members of the Family	Men	Women	Children	Area of Homestead Land-Dec	Number of Rooms	Agri Land (Acre)	Common Land	Homestead Land (decimals)	Agricultural Land	House	Land Development	Toilet	Livelihood Support
4	Basudeba Mahanty	4	1	1	2	Stayed on government	2	was doing share cropping and wage work agriculture	3 Acres	10	0	124000	10000	12000	5000
5	Bhujadeba Mahanty	4	1	1	2	Stayed on government	2	was doing share cropping and wage work agriculture	3 Acres	10	0	124000	10000	12000	5000
6	Manguli Mahanty	4	1	1	2	Stayed on government . land	2	was doing share cropping and wage work agriculture	3 Acres	10	0	124000	10000	12000	5000

of the households depend on food grains procured through ration cards. Lack of access to safe water will be climate change's biggest challenge across varied geographies and the coast is bound to be the worst affected.

Sl No	Status of House Construction	Number (%)
1	Completed	380 (66.55%)
2	Constructed up to roof level	9 (1.58%)
3	Constructed up to lintel level	90 (15.76%
4	Constructed up to plinth level	82 (14.36%)
5	Not started	10 (1.75%)
	Total	**571 (100%)**

Basic Facilities & Infrastructure Development:

The 400-year-old Maa Panchu Barahi temple, earlier in Satabhaya, was shifted in 2018 to the Bagapatia rehabilitation colony by the state government. In this process, a new temple was constructed at Bagapatia rehabilitation colony. However, the other work and provisions around the temple are yet to be completed.

A composite government school from classes one to ten with 679 students has been functioning. However, only three teachers are available to teach students at the high school level. The existing primary teachers take classes of the students up to class 10. However, additional classrooms are required for the smooth functioning of the school. The boundary wall around the school is very much needed for the safety and security of the children in school. Even though education levels have increased in the younger generation, access to education remains poor. Most children drop out of school after completing class ten. Low incomes, livelihood requirements and lack of access often push children to drop out after class ten.

Land has been identified for the sub-centre near the Bharat Nirman Rajiv Gandhi Seva Kendra (BNRGSK) within the Bagapatia rehabilitation colony. However, the construction work is yet to be started. The closest primary health centre is two kilometres away in Gupti.

Piped water supply has been provided for 571 rehabilitated households by constructing an overhead tank with an expense of Rs. 1,40,32,269/-. In addition, 32 tube wells have been installed in different locations within the colony. The newly constructed overhead water tank was damaged, and groundwater is contaminated due to high iron concentration and is also affected by the water table dropping significantly in summer months. People rely on water supplied through community taps for an hour daily at Rs 50 per month per family. The women of the rehabilitation colony testified that they faced the challenge of inadequate drinking water supply due to damage to the overhead tank.

The government has constructed a bituminous fair-weather road as the border of the resettlement colony. And 19 internal roads inside the settlement have been built with earth and crusher dust topping. All the roads need to be developed further as an all-weather road with complete drainage provision. This is important for the movement of people during any kind of disaster.

Four transformers have been installed and charged to provide electricity facilities to the rehabilitated households. However, the street light facility is yet to be provided, which is crucial for safety and security.

A multipurpose cyclone shelter has been constructed by the Odisha State Disaster Management Authority (OSDMA), which has been viewed as very useful by residents of the rehabilitation colony. This can be used by people to take shelter during any disaster. At other times, the community members use the ground floor of the multipurpose centre judiciously. Also, the rooms of the multipurpose cyclone shelter are being used as a classroom for teaching students, as adequate classrooms are unavailable. As part of the measures to ensure the people's protection from different kinds of disasters, the embankment on river Pathshala need to be strengthened. Also, other requirements around strengthening this embankment must be studied well and done on a priority basis as part of the disaster risk reduction effort. The community members shared during the study that they face the issues of water logging over the roads as a draining system alongside the internal road has yet to be done. Also, work like residual earth filling work needs to be completed to avoid water logging around the rehabilitation colony. With expenses of the provisional amount of Rs. 390.80 lakhs, some part of the earth filling and drainage work has not been done so far. The construction

of two culverts has been completed with an estimated cost of Rs 12 lakhs from 13th Finance Commission grants to gram panchayats. This is very useful for draining water.

One post office has been made functional in the Bagapatia rehabilitation colony to ensure postal services to the community. A waiting space for bus passengers is yet to be completed. A rural park with an estimated cost of Rs.15 lakhs is provided. This will be very useful for recreational activities of the community members, most specifically aged persons, children, and women. There has been construction of a boundary wall around the park. However, other development work is yet to be done. One community centre has been completed and made available to people for undertaking different community-level meetings and programs. As part of the measures to create space for the community to undertake other social functions and gatherings, the construction work of one Kalyan Mandap has been initiated out of 4th State Finance Commission funds of rupees ten lakhs. However, the project is yet to be completed. One community pond has been excavated with an estimated cost of three lakh rupees to make available water for multipurpose use. Also, one rural library has been constructed with an estimated cost of five lakhs. However, this library needs to be functional and accessible to the community for reading. One cremation space (Shamshan Ghat) has been constructed and made available for the use of the community when required. One building has been built for the benefit of village-level workers. *(The above data has been obtained from district administration, Kendrapara.)*

The table on next page depicts the land allocation that the government has made for undertaking different infrastructural development work within the rehabilitation centre.

Loss of traditional livelihoods

More than 90 per cent of the households in the colony now rely completely on wage labour from migration for income as traditional livelihood bases have eroded with displacement. Local wage labour and small businesses are other sources of work, but available to very few households. The workforce is primarily male members from 18 to 45 years of age. Women don't have access to any income source or livelihood besides animal husbandry.

Land Allocation for Infrastructure Development		
A	**Government Office**	**Area in decimals**
1	Gram Panchayat Office & Godown	Ac.1.30
2	Rajiv Gandhi Seva Kendra	Ac.0.60
3	Post Office	Ac. 0.25
4	Water Supply	Ac. 0.60
5	Electric Sub-Station	Ac. 0.35
Total		**Ac. 3.10**
B	**Educational Infrastructure**	**Area in decimals**
1	Anganwadi Centre – 5 Nos. @ Ac.0.10	Ac. 0.50
2	Primary School – 4 Nos. @ Ac 1	Ac. 4
3	UPS / High School 1 Nos.	Ac. 4
4	Playground 1 Nos.	Ac. 1.50
Total		**Ac. 10**
C	**Community Infrastructure**	**Area in decimals**
1	Cyclone Shelter 1 Nos	Ac. 0.50
2	Market Complex 4 Nos. @ Ac 1 each	Ac. 4
3	Bus Stand	Ac. 0.50
4	Tank 5 Nos. @ Ac 2 each	Ac. 10
5	Burial Ground 2 Nos. @ Ac 2	Ac. 4
6	Temple (Panchu Barahi)	Ac. 2.50
7	Other Temple 5 Nos.	Ac 2.50
8	Roads, including periphery and internal	Ac. 45
9	Reserved area for future requirement	Ac.23.60
Total		**Ac. 92.60**

Source: District Administration, Kendrapara

In the process of rehabilitation, people have been shifted to new places because of which they have lost access to many resources which were available to them free for years. In the original location, people had access to common property resources and other natural resources like land, water and forests. Dependency on natural resources and their conservation was an integral part of their social and cultural lives. After the Super Cyclone people had realised that mangroves around the seacoast were very effective for protection from the impact of the cyclone. So, the communities consciously took care of the mangroves around their habitat. Also, the mangroves are very useful for the communities in their day-to-day lives. The leaves, trunks of the trees and ropes are used for making shelters. So, the communities conserve the mangroves consciously considering their uses in their social life as well their significance in protecting them from the impact of cyclones. However, due to rehabilitation and shifting to a new location, the culture of conservation has been affected. The communities need to be mobilised and go back to the age-old practice of community conservation of the mangroves. A long stretch of the river connected to the sea is available in the current location. Efforts should be made to grow mangroves alongside the river and the communities need to be engaged in this effort.

Besides, the communities were leading a communitarian life sharing resources and many other intangible social, cultural and psychological support. There should be an effort for revival of their cultural life in terms of promoting more community-based activities and festivals of cultural significance. Social cohesion needs to be strengthened with more capacity building to face disasters and extended support to each other in emergency situations.

The study also found that people were earlier staying in homestead area almost 3 to 5 times the size of the area allocated at the resettlement site. At the resettlement site, people haven't been provided with any agricultural land other than a house built in an area of 0.10 decimals. However, the people haven't been provided with *pattas* for these.

Satabhaya is only one example of the villages lost to the sea, leaving behind communities to find new homes and ways to survive. It is the tip of an iceberg of displacements that is unfolding due to the worsening climate

crisis. ActionAid's 2020 report 'Costs of Climate Inaction: Displacement and Distressed Migration' stated that India had 1.4 crore people internally displaced due to environmental disruptions and more than 4.5 crore people will be forced to migrate from their homes by 2050. Anthropogenic climate change has not only increased frequency and hazard intensity of rapid-onset events like cyclones, landslides and storm surges, it has also made India highly prone to displacement due to slow-onset events like water stress, coastal and riverine erosion, continued crop failures and ecosystem loss.

Distress migration and displacement caused due to such events can increase the already high levels of social and economic vulnerabilities as a large number of people might lose their habitual place of residence. Hence, policy interventions need to be proactive. Recognising the impending situation, a Private Member's Bill was introduced in the Lok Sabha last year to establish an appropriate policy framework for the protection and rehabilitation of internally displaced climate migrants.

A need for a participatory assessment framework which covers economic, social and psychological losses and damages is a first step for paving the way for a sensitive policy appreciation for designing resettlement and rehabilitation. A feminist and rights lens to such an assessment would be crucial in building progressive futures. A resettlement plan which is oblivious to visible and invisible losses that women and girls face due to displacements, let alone blind to the need for an equal future for them, will be a step backwards. A framework of climate justice, which recognises that communities that have the smallest ecological footprint and have only served humanity as frontline ecology defenders, are the ones who suffer the most, so they must inform our thinking and action for compensation and rehabilitation.

As per news reports, while the plan announced also includes provision of agricultural land to displaced households, it will be key for ensuring that a principle of land for land is observed on the basis of past land records, as also the promise of land to landless families in the resettlement plans.

Art, artefacts and cultural practices can also be reclaimed from the sea. In this context, the news of the development of the famous Panchubarahi

temple in the model colony, which was also resettled from the Satabhaya panchayat, is reassuring.

What the Bagpatia model hopes to achieve is a beginning which needs to advance urgently. India, together with other countries of the Global South won a hard fought victory at the COP'27 in Egypt in setting up an international fund for compensating climate induced losses and damages, and now it is imperative to create mechanisms for its implementation in the country. We stand at the cross-roads of an impending climate catastrophe. The policy decisions we take today will pave the way for the future course of our lives, livelihoods and civilisation.

Okilapal, Debendranarayanpur

In 1971, as a war raged in one part around the Bay of Bengal, a cyclone ravaged large swathes of the eastern coast of India, displacing thousands in Odisha. Over 10,000 deaths were reported. Other losses included destruction of several villages and deaths of over 50,000 cattle heads. Govindpur was one of the villages displaced in Kendrapara. It was one of the first villages of the Satabhaya panchayat which was displaced by an intruding sea and a disaster that worsened its impact.[11]

Villagers report deaths of several members from each of the 272 families that fled Govindpur in the aftermath of the catastrophe. They travelled around 15 km inland to Okilapal village and were allotted 24 acres of land by Rama Devi Choudhary as part of her *Bhoodan* and *Gramdan* efforts to rehabilitate the landless. The fact that these villagers were rendered landless is today reflected in the way their lives have panned out in this new settlement. Since the resettlement over a period when there was no policy defining its rules, people had the land but no place to work or money to build their houses. Some assistance was offered recently by state government schemes such as Biju Pucca Ghar Yojana, but the beneficiaries are few and include families who migrated later, bought more land or own pattas in their name.

11. https://en.wikipedia.org/wiki/1971_Odisha_cyclone

Key areas of vulnerabilities

Socioeconomic vulnerabilities

Clustering of marginalised communities in climate vulnerable coastal areas

Most villages in Kendrapara's Mahakalpara and Rajnagar blocks have a significant population of SC, OBC and religious minority groups. According to the 2011 Census, Bagpatia was a village comprising 135 households with a significant SC population. In 1992, when plans to resettle the lost villages of Satabhaya began, Bagpatia was chosen as the destination resettlement colony. With a majority of 53 per cent of its workers employed only in marginal work and literacy rates far below the district averages, the resettlement colony was not centred on an economic vision. Today the population of climate vulnerable villages along the coast comprise mostly SCs, OBCs, some STs and smaller groups of religious minorities. During this research, most respondents in the Rajnagar block were second or third generation migrants from West Bengal, settled in villages across the coast in what used to be forest land.

A clustering of marginalised populations in areas of environmental vulnerability is also because of developmental projects and economic centres such as the Paradip Port, as these populations provide the labour required to run these centres. Economic productivity still remains low and most households have a per capita monthly income between Rs 5,000 and Rs 10,000. A combination of multiple vulnerabilities along with dependence on climate impacted livelihoods, lower socioeconomic indicators and a historically marginalised identity. These coastal villages are clusters of climate change's marginalisation.

Resource conservation and exclusion of local communities

People living just outside the boundaries of Bhitarkanika are under constant pressure to conform to environmental policies. Ambika Mohanty is a 78–year-old third generation parent and a first generation climate refugee. Along with fellow villagers from the now inundated Satbhaya, Ambika migrated to Bagpatia to escape their uninhabitable village to live on government allotted, boxes of 10-decimals land. 'In our village we had

our fields, we caught and farmed fish, prawns, crabs, but here we can't even go near the river. There are cameras there,' she says.

Sitting in close proximity to the nature conservation reserve, the Bhitarkanika National Park, lives and livelihoods of climate refugees of Satbhaya's lost villages are closely shaped by what conservation policies can allow. Villagers have experienced extensive changes in the way they lead their lives due to resettlement. Loss of agricultural land is one major change. In Satbhaya, most households and villages relied on agriculture and fishing. When they lost their land to the sea and left, they left behind their means of subsistence in its entirety. Now, they have no agricultural land in Bagpatia and rely on migration labour in states such as Kerala.

Loss of access to forests, river resources and to other forms of agricultural activities is because of land policies and conservation regulations in the area. These factors deprive communities of their traditional resource bases and make them dependent on market products for all their needs. In villages where settlements were formed by migrants from West Bengal, issues of land ownership have become increasingly complex due to the involvement of forest land. As coasts recede and disasters become frequent and intense, forested areas are being fortified from all human interaction in villages such as Jamboo, Batighar and Satbhaya. Residential and agricultural land is being claimed by the forest department and people have been dispossessed of their land and livelihoods through completely exclusionary measures.

Migration dynamics

Resettlement colonies for climate refugees do not have sufficient livelihood resources and traditional farming villages of Satbhaya have lost their agricultural land and access to fishery resources. This erosion of traditional livelihoods has been exacerbated by the lack of any provision for compensation for land lost to the sea. People have thus opted for migrant labour as the only viable source of income. Migration dynamics reveal a significant increase in such numbers post the 1999 Super Cyclone and now again in the last 10 years as climate change and government policies have affected coastal agrarian livelihoods.

Changes in livelihoods for one generation inevitably affect investments in education. In villages such as Jamboo, Bahakud and Batighar, even

though investments and enrolments in higher education are seen in more households, lack of viable income resources and opportunities has meant lower social mobility through higher education. Even graduates are mostly involved in unskilled jobs after completing their education and dropout rates are high among poorer families.

Loss of land, loss of identity

Besides its visible economic and environmental effects, loss of land has also meant a loss of identity for these agricultural communities. Considering the fact that more than 90 per cent of the population still relies on agriculture and allied activities means that a large number of people have been witnessing this loss. Displacement has an adverse impact on land associated identity and general sense of control of one's subsistence that marks agricultural communities. Climate change's victims are also victims transforming into numbers and squared boxes of land, without any alternatives to choose from.

This loss will bring profound changes in social organisation, gender dynamics and political will in these villages. In Satbhaya's resettlement colony, all 571 families have lost their source of sustenance and have been completely displaced from the land they had inhabited for generations.

Even their gods have been displaced and now live with them in their refugee colony. The Panchu Barahi Temple of Satbhaya was relocated with the village by the government. Bengalata, the priestess of the temple, is carrying forth a tradition that has made women from her family the sole priestesses of the goddesses for the last several generations. She fears her daughters or daughters-in-law will not be able to carry this tradition forward as they don't know much about it. Loss of traditional land and community has had several unforeseen impacts on the socio-political identities and cultural lives of these communities.

Developmental losses

Developmental projects such as the Paradip Port built to enhance economic opportunities in the region have provided local rural populations with only labour and have contributed to the pollution of surrounding water and land resources. Bahakud and Batighar villages have seen increased land and water resource pollution as a result of waste discharge by the industries.

Jamboo's 60 per cent households are completely dependent on river fishing. Increasing pollution by surrounding industries in the river has reduced the fish catch and incomes in these households, which in turn has impacted expenditure on health and education. Amongst those interviewed, 90 per cent of the households had experienced a reduction in spending capacities as far as education and health are concerned.

Gender vulnerabilities

Even in caste and class entrenched societies, access to economic value generating activities is crucial for women. With labour work in agriculture, horticulture, animal husbandry and forest produce collection, women become economic contributors in coastal societies. As displacement changes livelihood patterns completely, women are deprived of participation in livelihood activities. There are no viable economic options for women and lowered income also means lower investments in livelihood alternatives that are managed by women. Some women in resettlement colonies migrate to Kerala to work in textile units but loss of agricultural land and loss of access to forests and rivers has deprived them of economic participation.

- Increased costs of managing households due to complete dependence on markets after resettlement is also a gendered issue at its core. This is because most household economies are managed by women. If fund management is largely their task and if there is a need to costs, women cut down on their own needs — especially education and health. Dropout rates are higher among women during times of financial constraints and access to funds for healthcare reduces. Women's health issues are more likely to be ignored in case of higher medical costs and lack of stable livelihoods.
- Changes in diets, especially among scheduled castes (SCs) and other backward classes (OBC) groups are a source of double marginalisation for women. From rice, abundant and varied fish, crabs and vegetables all grown on their own land, communities who have lost their land to climate change have experienced a shift to market dependent diets. Since everything is bought from markets, households have reduced their consumption of meat, milk and fresh vegetables, which has a disproportionate disadvantage for women.

- Changes in health due to lack of access to healthcare has led to a number of child births at home under the supervision of auxiliary nurses. Villages that have limited connectivity due to rivers and forests also show higher instances of diseases such as hypertension, diabetes and heart diseases among women; a bad economic situation leads to lack of treatment.
- Young women reported lack of proper latrines and water supply as the biggest challenges to safe menstrual health management as most households and schools lack proper sanitation and water facilities. Nutritional deficit and high prevalence of child marriages also shapes women's health in this region.
- Factors such as resettlement, lack of economic resources, lack of space and changes in livelihoods have reduced women's mobility outside the domestic sphere even in villages. Gender specific vulnerabilities point to a situation where a majority of the population and communities as a whole lack resilience against climate change's impacts.

Ecological vulnerabilities

Lack of resilience to climate change and long term impacts

Current policy frameworks do not account for resilience measures in any significant manner. Even if policy measures do try to incorporate such measures, their implementation is not meeting the needs of climate affected communities. Resilience here refers to the ability to maintain their essential structure and identity, while still adapting to the changing climate. Resilience measures for livelihood, education, healthcare and recovery from disasters are highly scattered and leave out large parts of Kendrapara's vulnerable villages.

Long term impacts of this include reduced intergenerational socioeconomic mobility, education and changes in livelihood patterns. As more and more farmers are left without their land, this can potentially define marginalised lives for their next generations as labourers. These populations already have a high incidence of diseases, which has gone up in the last 10-15 years. In villages with low access to healthcare, changing dietary patterns and exposure to different chemicals are primary causes of such diseases.

This research found a high occurrence of heart diseases, hypertension, diabetes and cancer in villages of Mahakalpara and Rajnagar blocks. Diseases are more prevalent among the population aged 40+ but are not uncommon in younger adults.

Lack of access to fresh water will be an even more complex issue in the near future as coastal populations are already suffering from it. Water access will define lives and livelihoods in these regions. Climate change's impacts are the most palpable in changes in water resources and are expected to only become worse and more unpredictable in the future.

Key recommendations for Kendrapara district

More efficient resettlement planning based on a proper rehabilitation and resettlement policy based on a loss and damage framework

As more and more communities get displaced and people lose their land, resettlement will be the only way out for several villages. In such a scenario, resettlement cannot be carried out in the haphazard and unplanned manner in which it happened in Satbhaya with no vision for the future of these communities. If resettlement is taken up by the government, plans for distribution of homestead and agricultural land pattas, livelihood support, infrastructure and other facilities are crucial for improving the lives of climate refugees. Issues of climate change are thus tied deeply to other areas of development, as changing environments change not only lives but also entire systems of socioeconomic production and reproduction.

Ecological services and duties

Conservation and mitigation processes underway must include plans to integrate human resources in the local ecosystem's activities. Increased community involvement, instead of the prevalent system of exclusion, can be used for afforestation, wildlife conservation, land development and disaster mitigation in communities that have traditionally been living in close proximity to natural habitats. Integration of conservation and climate change mitigation with livelihoods is the most urgent task at hand today. Training and inclusion of women through channels such as SHGs in forestation has seen success in other coastal states and can be implemented in this region. Plantation of mangroves and other natural

barriers is the only effective way of creating disaster buffer zones in climate change affected villages and including the villagers in this process is crucial.

Improving livelihood participation

For the displaced communities dependent on agriculture who lose their land livelihood, plans can include alternatives such as horticulture, betel vine cultivation and integrated fisheries and farms. It is crucial that in the new settlements all households are allotted at least some farm land. Besides traditional livelihoods, women's livelihood development through SHGs is really important for improving living standards in these areas. Giving women support for small scale businesses, animal husbandry and agri-fisheries, can provide the much needed support to resettled households.

Better opportunities for the youth

Educational, nutritional, health and employment infrastructure are the key to improving social mobility among climate vulnerable communities. Resettlement from one vulnerable coastal village to another impoverished one without access to resources inhibits the youth from seeking education and better employment. Climate change resilience building can provide the window for breaking historical systems of labour production in marginalised communities and provide opportunities for expertise in dealing with today's urgent social and environmental ecosystem's needs. Training youth in climate resilience and providing educational and livelihood opportunities is crucial for development and mitigation policies.

Integrating climate change mitigation and adaptation to development

Mitigation and adaptation are the keys to development of vulnerable coastal communities. Improved access to holistic development services and support are the only ways to adapt to climate change. Resettlement that leaves communities worse off is a continuation of past instances of negligence. The climate change discourse has brought these communities back in focus and if financial resources are being used, this might be an opportunity to make development more inclusive. Better access to basic amenities such as water, sanitation, education and healthcare is not only the foundation of climate resilience but it is also the biggest challenge.

Reinforcement of funding for these resources is the essential foundation of climate resilient communities.

Bhadrak district

Bhadrak's densely populated coastline is facing sea intrusions and salinisation issues that impact the socioeconomic development. The total geographical area of the district is 2,50,000 hectares (ha). The coastal villages within 10-20 km from the sea and the topography of the district are principally affected by the sea.

Bhadrak district has a population density which is among the highest in Odisha –as much as thrice the state average. Chandbali and Basudevpur blocks, studied in this research, have the largest population size in the district. The clustering of high vulnerability populations in these regions increases their vulnerabilities to losses due to climate change induced sea intrusions and disasters.

Table 6: A timeline of coast erosion and village displacement in Chandbali and Basudevpur, Bhadrak

Village	First major displacement	Second	Third	Latest
Kantipur	1972, entire village inundated, all kutcha houses destroyed, loss of livestock, animals died	1999, loss of agri, forest cover, lesser loss of lives	2000s, 2.5 km wide stretch of mangroves planted along coastline	Reduced intrusion in the past 10 years due to mangrove plantation
Rabindranagar	1972, village destroyed, mangrove forest loss, houses, livestock destroyed	1999, sea intruded 500 m further, all houses destroyed, forest cover destroyed	2000s, Dhamra Port construction increased shore erosion due to excessive sand mining, loss of forests	2021, Cyclone Yaas resulted in major livelihood losses

(... Contd.)

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Village	First major displacement	Second	Third	Latest
Radhanathpur	1972, no forest cover, water inundated the entire village	1999, all houses destroyed, loss of lives, livestock, agricultural land		2021, Cyclone Yaas resulted in major land damages Regular water intrusion in low lying areas of the village, during full moon and monsoons
Mohanpur	1972, many people died, village inundated, fields destroyed	1999, cyclone centre built already in 1997, no human lives lost in 1999 but village destroyed completely	2010s, 70 per cent jhaun (casuarina) forest cover lost in disasters, agricultural land productivity majorly affected by saline intrusion	2021, Cyclone Yaas in summers - losses to agri, livestock and fishing, kutcha houses damaged

The net sown area in the district is 1,73,000 ha while the total cultivable land is 1,74,063 ha and the irrigated area is 1,11,000 ha. Paddy is grown as the main kharif crop, covering approximately 94 per cent of the total cultivable area. But people in the seacoast area (Dhamara, Chudamani of Basudevpur and Chandabali area of Chandabali blocks) also depend on fishing for their livelihood. High dependence on agriculture, effects of salinisation and climatic variations in water availability and land changes are primary factors in Bhadrak's present environmental challenges.

Factors affecting sea intrusions

- Medium risk zone with sea-level rise between 0.1 to 1.0 mm/ year (Hazra et al., 2022).

- Increase in sea level increase rate post 1994.
- Loss of natural forest barriers.
- Developmental projects like ports affecting the mangrove ecology, increasing sand mining and increasing coast erosion.

Key areas of vulnerabilities

Physical vulnerabilities

As many as 70 per cent of the houses in Kantipur, 40 per cent in Radhanathpur and 20 per cent in Mohanpur are kutcha houses, which are highly vulnerable to damage during cyclones. Kantipur and Radhanathpur also lack access to cyclone centres in the villages and people have to travel over 5 km during cyclones, which further increases risks to individual lives. Older people, people with disabilities and children are the worst affected by such mobility issues. Due to inadequate implementation of housing support schemes such as Biju Pucca Ghar in these villages, a majority of the people do not have the means to build pucca houses that can shelter them from cyclones.

Socioeconomic vulnerabilities

Low landholding size and risks in agriculture

The majority of farming households in the villages studied fall in the marginal and small farmers' category. As many as 90 per cent of the households in villages like Radhanathpur and Mohanpur depend on agriculture as the primary source of livelihood. The villagers work as farmers, sharecroppers and agricultural labourers. As saline intrusions, changes in rainfall and disasters affect agricultural productivity, small and marginal farmers and landless agricultural labourers are the worst affected.

In Kantipur, a majority of the residents come from landless households in the neighbouring villages of Nuagam, Padhuan and Kumaripur, who were resettled by the government and allotted 4 decimals of land each. Land ownership patterns show that 50 per cent are marginal farmers. Over the last decade, as much as 300 acres of land in the panchayat has been rendered uncultivable due to lack of water. Delayed monsoons, changes in rainfall patterns and saline ingress have meant that 70 per cent of the farmers have now shifted to fishing based livelihoods. 'Rain is coming in late July now. Our land lies barren till then, chasa kicchu guarantee nahi (there is no guarantee in paddy cultivation),' says a distressed villager.

Major challenges to agriculture:

- Delayed onset of monsoon and change in patterns almost annually making rainfall unpredictable.
- Lack of access to irrigation facilities, underutilisation and lack of maintenance of canals, like the coast canal in Basudevpur block.
- Reduction in groundwater levels and saline intrusions in aquifers, severe shortage during summer.
- Increase in prawn monoculture built on agricultural land.
- Overdependence on paddy cultivation – monocropping is affecting both land and prospects for farmers with complete reliance on a single crop increasing vulnerabilities.

Decline in fishing resources

Seventy per cent of Kantipur's farmers made the switch to fish collection and fishing dependent livelihoods due to low yields in paddy cultivation. Fish catch has however reduced by as much as 90 per cent for a small boat owner as compared to the level in the 1990s. 'Climate change is one reason. The sea is warmer now and fish cannot survive. There are also too many boats. Movement of large trawler boats and pollution destroys fish seeds, and reduces both quality and quantity for small boat owners,' says a member of a fishing party journeying through the 2.5 km mangrove plantation to reach the shore. Integrated fishing and farming systems, based on traditional methods of fish cultures, can be a good alternative but lack of water for fishing ponds discourages smaller farmers from taking up such activities. 'There are very few fish and too many boats. Our small boats cannot travel very far in the sea. The bigger boats can travel where there is better catch quantity,' says a fisherman from Radhanathpur.

Unequal and unsustainable prawn cultivation

The two sides of prawn cultivation

Sakuntala, a 50-year-old resident of Gangamata Gheri, Radhanathpur, is a widow and mother to two young men. Sakuntala's husband passed away during the COVID-19 lockdown due to a heart disease. Her younger son recently passed Class 12 and her elder son dropped out after Class 10 due to his father's sudden demise. They

Case Studies

3. Arjun Mandal

Arjun Mandal, a 67-year-old man lives with his 60-year-old wife Meghamala Mandal. They live in a thatched home in the Bhadrak district of Odisha, have one son and five daughters, all of whom are married. Their son moved to Bengaluru and found employment in the manufacturing sector.

In the house, Arjun and his wife are the only residents. Due to their old age, they are both unable to find employment and are dependent on their son, who sends them between Rs 2,500- Rs 3,000 every month. He also receives Rs 500 every month as part of the Government of Odisha's old age pension scheme. He receives government-provided rations at subsidised prices via the public distribution system.

All their children finished their education at UG ME School up to the sixth or seventh standard and left the village school after which they failed to go to a high school as it is far from the village. Both parents are illiterate.

This family belongs to the Schedule Caste, and a majority of the families are from the fishermen group. As older citizens who have crossed the age of 60, Arjun is physically unfit as he underwent a heart surgery and has a pacemaker. As a result, he is unable to work outdoors and has to depend on his wife.

He has no agricultural land and resides in 4 decimals of the area, which was provided by the government for 10 years in a rehabilitation scheme. The government did not give any compensation or any support for making a pucca house. As he migrated here, he lost his parental property at his birthplace. But that is not due to climate change issues. They are living in a thatched house as they have not got any assistance from the government for building a house under the Awas Yojana. They only benefitted from the Swachh Bharat Mission by building a toilet under the government scheme.

They have a tube well and depend on the common tube well sometimes which is located in the middle of the village because of saltwater issues.

The hospital is situated at Eram village which is 3 km from the village and it is difficult to reach the hospital as there is no public transport.

Mangrove forests are very close to the houses and there is a village more than 500 metres away near the sea wall. The forest service has completely protected the mangroves, and no one is allowed to use the trees or their branches for domestic use. Mangrove forests are not used in any domestic context.

(... Contd.)

live in a kutcha house, which is regularly affected by water logging due to saline water intrusions. They own 3 acres of land, which is also affected by sea intrusions and thus agricultural income is very low. Sakuntala's elder son is the sole wage earner and does several small jobs like local wage work and agricultural and prawn cultivation labour. Three years ago, they converted a part of their agricultural land to a prawn pond. That requires a high investment every year. In the absence of any other source of capital, Sakuntala's family relies on loans from the women's SHG and other local lenders, which in the case of crop failure leads to a high debt burden. Their annual household income is around Rs 2 lakh, which supports six family members, including Sakuntala's mother, who is a senior citizen and requires constant healthcare.

Sibaprasad is one of the large farmers in the village who owns 12 acres of land. For his livelihood, Sibaprasad cultivates paddy, rears animals and also does prawn cultivation. Over the last decade, he has expanded his prawn plant and employs people like Sakuntala's son as wage labourers. His family house is pucca, spread over an area of at least 2,000 square feet. His annual income ranges somewhere around Rs 6-7 lakh, which comes majorly from prawn cultivation. His income supports a family of four. Farmers like Sibaprasad have registered prawn cultures, have a steady flow of capital and labour, access to good quality seeds, financing options and insurance to continue cultivating prawns even if agricultural produce is low and for recovery in case of loss.

More than 50 per cent of the farmers in Radhnathpur are in a situation similar to Sakuntala and farmers like Sibaprasad are very few in number but control a major proportion of the prawn cultivation market and profits.

As these cases show, prawn cultivation in its present state is damaging for the ecology and the economy of these villages. Even though it offers a higher income alternative to failing agricultural livelihoods, a majority of the marginal and small-scale farmers are often unable to enter and benefit from this market due to constraints such as limited access to credit and insurance, insecure land tenure and poor infrastructure. Shifting to prawn

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The mangrove forest is cooperatively monitored and preserved by the village committee and the forest committee since everyone is aware of its advantages. They occasionally gather mangrove branches that fall off when they become dry. The growth of the forest is encouraging for them since it will protect them against incursions by the sea. During the 1999 Super Cyclone, everyone received blankets, polythene, rice and kerosene.

The sea wall is built of stone and mud and was the only thing that kept Arjun and his wife, as well as the locals, from being displaced. Since they have lived in this area for more than 20 years, the villagers also believe that the mangrove forest and sea wall can shield them from any sea encroachments. Earlier they were completely dependent on fishing, but in recent years, large traders and mechanised boats have taken control of the industry. Arjun has a terminal illness and his age prevents him from finding any other source of income.

His son had to relocate to Bengaluru since there was no job available in the region. Fishing was also limited in that area because the quantity of fish was reducing, according to Arjun. Almost 30 per cent of the community's family members relocated outside the area for jobs, working in industries to support their families financially.

Village meetings were held in their community to discuss sea intrusions and mangrove forest conservation, but they never considered permanent displacement from their village. They demanded a cyclone shelter in the community, but no steps have been taken for it. These people only temporarily get displaced at the time of any cyclone and at that time Arjun and his wife have to face great difficulties in transportation, sanitation and food availability as well as domestic animals staying in vulnerable situations.

4: Bulu Mandal

Bulu Mandal is Santosh Mandal's wife and is about 60-years-old. She lives with her husband. She has two daughters and one son. Although the son lives in a different house in the same border and the daughters are married, they do not financially support their parents. Along with her children, her daughter occasionally lives with her. In the village, most of the locals are Scheduled Castes and are from the Bengali community.

Bulu and her husband work as daily labourers in agricultural fields and on fishing ships, but because she is unable to routinely work with her husband, Bulu is only able to earn Rs 3,000 every month. She receives Rs 500 as part of the Government of Odisha's old age pension scheme. She has received government-subsidised ration through the public distribution system.

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monocultures, thus, leads to many households facing food insecurity and worsening poverty.

Lack of registration for smaller prawn cultures also means that there is no regulation of their compliance with the Coastal Regulation Zone's norms, which leads to unsustainable practices that degrade land and water resources. For instance, most unregistered farms do not have effluent treatment systems and discharge untreated water into local water bodies; most productive land once converted to prawn gheris cannot be used for cultivation of other crops in the future due to soil pollution. Thus, when small farmers are unable to sustain prawn cultivation and abandon the gheris, it leads to loss of productive agricultural land.

Lack of support under government schemes

Even though there are provisions for supporting farmers, lack of proper implementation, corruption, middlemen, politics in panchayats and political ill-will prevent farmers from receiving the benefits of government schemes such as the Kalia Yojana and the Pradhan Mantri Kisan Yojana for agriculture and Krishi Vikas Yojana for prawn cultivation. These schemes are meant to provide pre-cultivation capital support to reduce the burden for small and marginal farmers and also agriculture dependent labourers. The Krishi Vikas Yojana has provisions for subsidy in setting up prawn cultures, technical training for cultivators and insurance benefits.

While a majority of the farmers in Rabindranagar and Kantipur have received these benefits, none of the farmers in Radhanathpur and Mohanpur have. Even though the schemes also include benefits for farm labourers, none of the households interviewed for this research who depend on agricultural labour were aware of such compensation. Radhanathpur village has been excluded from the schemes after being included in the Notified Area Council for Basudevpur municipality. Being denied status and benefits of being a gram panchayat even though the area does not meet the criteria to be a NAC seems like a politically motivated move and leaves the marginalised farmers without any support or elected representatives to voice their concerns.

The benefits of support schemes are thus highly scattered and contribute to food insecurity and debt among marginal and small farmers. Farmers

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All the children attended the local school till the sixth or seventh grade, after which they all left school. A Binobha Nagar UG ME School is located in the village and most of the children are admitted there, however, after Class 8 they do not continue with high school because it is located outside the village.

She has only 10 decimals of agricultural land which cost around Rs 10 lakh as per the present market price. Due to the demand for saltwater prawn culture, businessmen from outside are purchasing the land at a high rate and cultivating the prawns in ponds.

Buku's land lay vacant for years because of seawater intrusions. She feels stressed since her income is insufficient and she hasn't received any compensation. They do not have a farmland for cultivation or age permits for fishing in the sea. Both of them work as daily labourers. Her husband gets an old age pension of Rs 500 which supports her in her day-to-day expenditure. Though she owned a midsize pond on her premises it is unusable due to the intrusion of seawater with the pond's fresh water turning into saline water.

No family members of Bulu Mandal have migrated outside the village for work but her daughter-in-law migrated to Tamil Nadu and is working in a factory. Less number of people migrate because most of the people in the village are engaged in sweet water prawn culture. This prawn culture in the locality causes a lot of pollution to water and land.

Bulu lives in a thatched house which is prone to damage due to disasters like cyclones and floods. She was provided money for the construction of her house under the Awas Yojana but she has not been able to complete the construction due to financial constraints; other than this she has not benefitted from any other government schemes.

The mangrove forest is about 400 metres away from the settlement and Bulu's home, close to the sea wall. No one is permitted to use the mangrove trees or their branches for domestic use since the forest is completely protected by the forest department. Mangrove forests are not used for any domestic purposes. As everyone is aware of the advantages of mangroves, the village committee and the forest committee cooperatively monitor and protect the mangrove forest.

The thickness of the mangrove forest is 3-4 km. The forest department preserves it with the support of the Bana Surakhya Committee consisting of villagers and the department. Plantations are done by the forest department. The mangrove forest is increasing as committee members informed us. The density of the forest has become high as compared to earlier.

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also have the provision to take a Rs 50,000 interest free loan under the Kalia Yojana but there is no awareness of or access to this loan scheme. A majority of the farmers in need of credit thus rely on local money lenders or private lenders such as Bharat Finance and end up in debt traps when their crops fail.

Gender vulnerabilities

Climate change's impact, whether ecological, economic or physical, is highly gendered. In villages Chandbali and Basudevpur too there is a visible difference in the way livelihood losses, changes in livelihood activities, shift towards monocultures, lack of water and health issues put women at a higher risk.

Major areas of gender vulnerability

- Loss of livelihood participation for women as traditional rice and fish cultivation is replaced by prawn cultivation or migrant labour, which are largely inaccessible to women due to different labour requirements and long distance travel involved.
- Lack of water resources and saline content in water has distinct health impacts – women report higher instances of hypertension and rheumatoid arthritis, which are affected by the saline content in their water.
- In low income families, changes in food habits, lowered access to fish, meat, milk and vegetables affects women more due to patriarchal disadvantages.
- When women are involved in labour work at prawn cultures, they risk exposure to chemicals, which has increased the health impact such as uterine tumours and other reproductive health complications.
- Lack of connectivity in villages like Radhanathpur and Kantipur has deprived young girls of pursuing higher education beyond primary schools available in their villages.
- Lack of proper healthcare access for pregnant women due to poor connectivity and long distance travel.

'There is no drainage in the village. Water comes in and stays, even during the rainy season there is heavy waterlogging for days sometimes. There are

(... Contd.)

Bulu and the villagers were on the verge of displacement and the sea wall made of stone is the only hope to sustain the village. Bulu thinks of changing her residence, but financial issues compel her to stay. Villagers also think that the mangrove forest and sea wall can protect them from any sea intrusions as they have been living here for more than 30 years. A few years ago, they were fully dependent on fishing, but fishing is now controlled by big peddlers and mechanised boats in the harbour. The government is also planning to convert the Kasia fishing harbour into a jetty.

no roads. Even if it is an emergency like child delivery, we can't leave the village,' says a female head of a household in Radhanathpur village.

Ecological vulnerabilities

Increased intensity of disasters

There has been an increase in the rate of sea level rise (SLR) which has been steady over the last two decades, with a significant increase in the last 10 years. This has had a significant impact on cyclonic winds and tidal height in Bhadrak. According to Hazra et al., (2022), the northern part of Odisha's coast Kendrapara, Bhadrak and Jagatsinghpur are at a higher risk of cyclonic winds and these will be more potent in the coming decades. Both Chandabali and Basudevpur are among the most vulnerable blocks on the state's coastline.

Major challenges due to disasters

- High population density in these two blocks means higher vulnerability of village populations during sudden disasters.
- Lack of forest barriers in Chandabali block and further depletion due to Dhamra Port's construction and operative pollution.
- Increased shoreline erosion due to loss of forests.
- Kutcha houses more vulnerable to damage, large number of people in villages of Basudevpur and Chandabali still live in kutcha houses within a 5 km radius of the sea.
- Rampant loss of agriculture, livestock and prawn cultures during disasters and lack of adequate compensation or support for coping.

Large scale development projects in eco sensitive areas

From the beginning when it was proposed, the Dhamra Port has been a site of contestation for environmental stakeholders. According to a report by the eastern regional office of the Union Ministry of Forests and Environment, the port's site is on mangrove forest land. But the report was rejected by the Supreme Court that ruled in favour of the Tata sponsored port. The port built by the Tatas and later acquired and expanded in capacity by Adani presents a major challenge to the ecology of the region. It is reportedly the deepest draft port in the country. Dhamra Port's expansion presents the following challenges to the mangroves and the aquatic ecosystem of the area:

- Close proximity to the Bhitarkanika Conservation Area, with a significant part of the forest lying within a 25 km impact region.
- Clearance of and long term impact on other mangrove plantations in the land sanctioned for the port.
- Water, sand and noise pollution in the region.
- Sand mining for construction along with forest clearance contributing to shore erosion and rendering surrounding populations more vulnerable to the impact of disasters.
- Close proximity of the Olive Ridley nesting sites and the non-consideration of the impact of high noise and light pollution on their breeding practices.
- Degradation of the aquatic ecosystem and impact on fish, cretaceous and even dolphin species that are a part of this region.
- Construction of affiliated networks of transport and communication and their impact on local forests and wildlife and people's livelihoods that depend on them.

Depletion of water resources and erratic rainfall

In villages of Basudevpur block, severe shortage of water is already a reality and one of climate change's most visible manifestations. In Radhanathpur, Kantipur and Moahanpur, saline intrusions into groundwater resources, reduction in groundwater levels, delayed or erratic monsoons and lack of any other sources of water supply have severely hampered lives and livelihoods. In Kantipur and surrounding villages, as much as 300 acres of

land used for paddy cultivation has been abandoned due to erratic water supply during the sowing season.

Impact on mangrove systems and other forest areas

In Chandabali and Rabindranagar, the mangrove varieties are under threat due to expansive port activities, land and water pollution and illegal prawn cultivation, deforestation, seashore erosion and saline intrusions. The remaining width of the forest acts as a buffer zone but is not wide enough for sustained mitigation of sea intrusions and disasters.

Key recommendations for Bhadrak district

Protection of existing mangrove systems and more plantations:

Mangroves are the most effective way of reducing coastal erosion as they act as a buffer against sea ingress and reduce the impact of cyclones. With Bhadrak district lying in the direct impact region of major cyclonic winds, plantations of mangroves and other types of species that act as barriers is the only way to protect this densely populated area. The sediment rich flat regions along the coastline are highly conducive for mangrove plantations and need to be expanded to other parts of the district like Basudevpur block.

Regulation of prawn cultivation

There is an urgent need due to both human and environmental concerns to regularise prawn cultivation to save productive agricultural land, water resources and for more sustainable livelihood systems. Most prawn farms are not registered, which makes their technical monitoring and regulation a blind spot for the government and also burdens the farmers with losses and debt due to lack of resources, finance and technical support. Legalised prawn cultures can help reduce these ill impacts. Further, instead of current forms of prawn monocultures, traditional fishing practices with more farm and fish integrated systems can be important mechanisms for sustainability and resilience building.

Water resources

Regulation of industrial, agricultural and prawn cultivation induced pollution of existing water resources such as canals and village ponds is creating

severe shortages of clean and safe water resources in Bhadrak's coastal villages. Rainwater harvesting methods, maintenance of existing canals and building proper water infrastructure are all crucial for preparing for a water scarce future and for saving lives and cultivation based livelihoods.

Ganjam district

Ganjam district comprises of coastal plains and the eastern ghats' hills, with an area of 8,070.60 sq. km. At least 4.77 per cent of the district is a forested area while 78 per cent of the district's population lives in villages and more than 70 per cent relies on agriculture as its primary economic activity. The district has alluvial soil in the eastern part (coastal region) and laterite soil on the west (hilly tableland). This helps in obtaining a

Table 7: A timeline of coast erosion and village displacement in Ganjam

Village	First major displacement	Second	Third	Latest
Bada Arjipalli	1982, kutcha houses destroyed, loss of forest cover	1999, all houses destroyed, village inundated, deaths reported	2000s, sea intruded by almost 0.5 km, 400 m of shore eroded, half of the forest cover lost	2013, a majority of the houses destroyed, fishing boats destroyed, sea to village only 50 m away now
Kalipalli	1982, kutcha houses destroyed, loss of forest	1999, sea intruded further by 500 m, all kutcha houses destroyed, agricultural and forest cover loss		2013, all kutcha houses destroyed, loss of vegetation, sea intruded by almost 1 km
Reukatur		1999, village inundated, livestock and fishing boats lost, forest cover lost, sea intrusion, shore erosion		2013, most houses damaged, fishing boats destroyed, sea to shore distance only 200 m

substantial agricultural yield. Availability of mineral and forest resources has contributed to the industrial economy of the district with centres like Gopalpur Port. The district is regularly impacted by cyclones, droughts and flooding. In 2018, floods affected over 60 lakh people in the state and Ganjam was among the worst affected due to flooding in the Rushikulya river. Sea intrusions and loss of natural buffer zones has intensified the losses of agriculture dependent households besides disaster induced events of flooding.

Major changes due to sea intrusions

- Shore erosion and loss of land: In Ganjam's coastal villages sea has intruded by 0.5 km to 1.0 km in the last two decades.
- Loss of forest cover due to disasters and saline ingress.
- Damage to agricultural land due to salinity and waterlogging issues.
- Loss of vegetation cover.

Key areas of vulnerabilities

Socioeconomic vulnerabilities

A. Padma is a 45-year-old widow from Reukatur village in Kalipalli, Ganjam district. Reukatur is a fishing village situated in close proximity to the Gopalpur industrial complexes and port. Padma's household was dependent on fishing till her husband died due to a kidney ailment, a health issue that plagues other families in the village too. Now, the household consists of her three children, all graduates and doing small local jobs in the village. Padma herself does labour work, travelling around 6 km every day. Her daughters give tuitions to local children and her son works in a salon.

An intruding sea has meant new forms of vulnerabilities for families like Padma's. The shore has eroded up to 0.5 km and the sea is now a mere 50 m from the village. Disasters are frequent and losses incurred are high. In 2013, Padma's house was destroyed by Cyclone Phailin, and her family also incurred livelihood losses in their daily wage work. They received Rs 1,000 and some household items as relief measures from a private organisation.

'It is difficult to manage a household today. We don't even have jobs all the time. On many days we are sitting idle at home. I can no longer continue doing this work or travel due to my health,' says Padma. Livelihoods have declined further after the COVID-19 pandemic. Padma now mainly works as construction labour, which is highly variable. Climate change and developmental problems have collectively created difficult living conditions for fishing dependent villages and Padma's village is one of the many such in the region.

Case Studies

5: P Gopala

P Gopala is a 60-year-old man who lives in Ganjam district's Bada Arjyapalli village with his wife and two children. His unmarried daughter is 35-years-old, and his son is married but separated from them. Gopala has been paralysed on one side of his body for the last 10 years. When a person lives below the poverty line and is handicapped, his or her vulnerabilities double. He has not been covered by the government's pension scheme. In this regard, he failed to satisfy his family's needs by making ends meet. Despite his disability, he worked as a daily labourer in collecting and cleaning fish on the fishing boat, earning Rs 150 per day. Given that this amount is insufficient to meet the basic needs of three people, his daughter started catching and selling fish locally. Due to lack of infrastructure and a solid marketing strategy, she was compelled to sell the fish at a very low price.

As catching and selling fish is their sole source of income, climate change is having a negative impact on their lives. Because the Gopalpur coast is prone to cyclones, as well as rising sea levels, seawater intrudes into the village and their kutcha house is mostly affected every year by cyclones. The cyclone shelter is located half a kilometre from the village. Every year, Gopala and other families in the area spend their money on building dwellings. They have also lost some of their land due to coastal erosion. As per the villagers, the sea was 5 km from the village earlier. But now it's only half a kilometre from the village. This is due to increasing coastal erosion and therefore villagers have lost their agricultural land and livelihoods.

Many families have been thrown out of agriculture and they have chosen fishing as an alternative and the only source of livelihood option. The communities have developed enough coping capacity within their locality so they do not want to

(Contd. ...)

Livelihood challenges

Ganjam's coastal areas have been shaped by the parallel processes of big infrastructural development and loss of household based traditional livelihoods. While Gopalpur Port and affiliated industries like rare earth mining, exports and fisheries have expanded, they have brought little incentive to the local population. Combined with adverse effects of climate change like sea intrusions, land and forest loss and disasters, these factors create high instability in local livelihoods.

In agriculture based communities like Kalipalli, livelihood sources have shifted completely to migration labour. All the 375 households in the village have a member migrating to other states for work. People who stay back, in this case only women, are dependent on minor produce from nearby plantations like cashew, coconut, kewda or screw pine flowers, which are regularly impacted by sea intrusions and disaster damage. So, those who do not migrate for work have to rely on other affiliated work like rearing animals and engaging in local labour on construction sites, factories, and the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) work for local infrastructure development. Pushing more workers towards labour work, especially small farmers and fisherfolk, has been the sea's intrusion's most visible impact in this region.

In a fishing village like Reukatur, 40 per cent of the families have migrated to outside states for work. These households migrate with the whole family and return to the village only on rare occasions. The remaining households rely on labour on construction sites in nearby urban centres like Berhampur as an alternative income from fishing as that has been affected by a changing sea. Work involves almost 30 km of travel every day and incomes are highly variable. Women who were traditionally engaged in fishing affiliated work like drying, sorting and selling fish, have moved towards daily wage labour.

Major issues in fishing villages

- Increased number of fishing boats in the sea with bigger trawlers affecting catch size for fishers with smaller boats.
- Changes in sea temperatures have dwindled catch populations and reduced daily catch size.

(... Contd.)

leave the place and end up with more struggles in a new area. There has been an effort by the district administration in terms of discussions with the communities on solutions for the problem. However, the community demands a more resilient housing facility with emphasis on protection from coastal erosion. There has been a suggestion by the communities to construct stone barriers and any other natural barriers across the coast for protection from coastal erosion.

Some of these households were relocated to other sites offered by the district administration. However, due to a lack of skills in other livelihoods, most of the residents declined to rehabilitate to the new location. The administration has the condition that allocation of housing under the Pradhan Mantri Awas Yojana will be done if the beneficiary is ready to relocate to a new place and due to this most of the people have been deprived of getting housing support. People fear that if they are shifted to a new location, they will face challenges in livelihood options.

6: G A Rama

G A Rama, a 55-year-old widow living in Ganjam district's Bada Arjyapalli village, is located half a kilometre from the village and is not spared from the effects of climate change. Climate change and coastal erosion caused by seawater incursions into the community render women vulnerable in a variety of ways. Rama lost her husband and now lives with her daughter. She needs to work to survive. She is a member of the fishing community and is only experienced in capturing and selling fish. However, the lack of market facilities has made her susceptible in terms of earning enough money to survive. For addressing this, she worked for a local Mahajan, who captured a large number of fish using a fishing boat, collecting fish from the boat, washing and packing it, for which she only gets Rs 150 per day that too not on a daily basis.

She has had a traumatised life following the death of her husband and separation from her son. Her health concerns prevent her from working daily, which has had a negative influence on her life in many ways. She was unable to build a home for all seasons, and she lived in a house without a door due to frequent disasters. Due to her low income, she also wishes to have access to clean drinking water and a toilet. For her, education and entertainment are like day dreams. As there is no sufficient government support for her and others like her, she demanded that the government take effective action to rehabilitate them on their properties rather than relocating them.

The village is prone to various disasters like cyclones and floods. The cyclone shelter is half a kilometre from the village. However, people hesitate to take

(... Contd.)

- Increased pollution and traffic due to Gopalpur Port.
- 'There is no place to keep our boats and nets safely. The port's ships and shops have taken our space. We don't have any common public space on the shores now, 10 villages around us have the same issue due to the port.' narrates a member of the fisherfolk community.

Youth unemployment

Climate change's impact on the coastal ecology and economy has meant higher unemployment rates among the youth. As traditional agricultural and fishing livelihoods are affected by sea intrusions and other impacts of climate change, it has become increasingly difficult for the younger generations in these villages to find a source of sustenance. Even educated youth find it difficult to get a job. 'A labourer's son will remain a labourer even if he studies and a fisherman's son will remain a fisherman with no fish in his catch,' Reukatur, a fisherman says with concern.

Even with the coming up of Gopalpur Port affiliated industries like prawn cultivation, local people have not had any significant livelihood options. It is mostly outside corporations who do prawn cultivation, and there are around 30 hatcheries in the nearby 3-4 villages. 'We work as labourers in these hatcheries. We get paid Rs 200 for eight hours of work. Only if there is enough produce do we get paid, otherwise nothing. If the plant makes a profit, some people get hired and are paid Rs 6,000 for the whole month,' says a village youth, a graduate working in a prawn hatchery. With the lack of options in the local networks, most of the youth consider migrating to other states as the only way to find work on completing their education.

Altered community dynamics and social networks

As entire families migrate for work, or people leave these fishing villages to move to safer land with more economic opportunities, the village demography has been altered. Within a decade, just 100 members of Reukatur's 270 households have been left behind. Most people have either permanently gone to work or migrated with their entire families for several months. 'Reukatur is becoming a ghost village,' says a villager. With increased disaster losses and reduced ability to rebuild homes and livelihood resources, migration has increased in the last 10 years and is still rising.

Kalipalli has become a no-man's village, with families divided due to economic hardships. Male members from all households migrate for work and no men can be found in a village meeting even on a busy afternoon. Women are left behind in the village and have to deal with issues of dependent populations like children and the elderly on their own, marking a changing family, and community structures and dynamics.

Fig 1.8 women in a shelter with stilts

Gender vulnerabilities

Sea intrusions and their complex interactions with the socioeconomic and ecological vulnerabilities have a distinct disadvantage for doubly marginalised groups like women and children in affected communities in Ganjam.

Major challenges for women due to land and water salinisation

- Wage labour for livelihood: Due to loss of land and fishing resources, women are now dependent on labour work in construction, local industry and in larger fishing hatcheries. In Kalipalli village, women have shifted from agriculture and minor produce collection to

(... Contd.)

shelter during any disaster because they have the experience of being deprived of basic amenities like clean toilets, safe drinking water and a safe space for women. Another reason for the hesitation in being relocated is that if they are shifted to any other place the government may not allow them to come back to the village as a result of which they will lose their livelihood.

travelling between 5 to 15 km every day to do labour work. Pay is low and unstable, around Rs 200 for eight hours of work on a good day. Women are also engaged in construction labour at the Indian Rare Earth Limited at nearby Matikhalo and minor jobs in markets around the port. Even labour work has declined post the COVID-19 pandemic.

- Adverse health impacts: Women report increased instances of hypertension, paralysis and heart problems. As women lose traditional agricultural or fishing related work and move towards industrial labour, exposure to chemicals and harsh working conditions has had an adverse health impact. A significant proportion of factory labourers from Ganjam's coastal villages are women and they report issues like stomach pains, headaches and skin diseases due to unsafe work conditions.
- Nutritional changes: Challenges to agriculture and fishing based sustenance has led to changes in diet. Reduced access to nutritious food, reduced fish and meat consumption and lack of fresh water resources has challenged growth and development. Young girls from low income families have a higher vulnerability to lack of nutrition.

Disaster related vulnerabilities

- Regular losses due to disasters: Damages to houses, boats and land resources are rampant due to disasters, villagers report logging of up to 5 ft water in villages during cyclones and heavy rains.
- Infrastructure losses and lack of rehabilitation measures: Villages also report damage to public infrastructure like schools, health centres, roads and others due to disasters. Lack of post disaster recovery of such infrastructure has deprived these communities of basic public amenities.

- Waterlogging and loss of vegetation: Lack of proper drainage results in waterlogging post disasters, along with damages to vegetation which is an important source of livelihood for the communities.
- Long distance travel to cyclone shelters and safe locations during a disaster are especially challenging for the aged and those who lack a means of transport.
- Livelihood losses are high during disasters: Agricultural produce, plantations of kewra flowers, coconut and other natural products used by local communities. There is also a high dependence on rearing livestock for extra incomes. Livestock loss during disasters is high and often not compensated for by relief measures.
- Natural shelter belts have also been damaged in disasters and reforestation has not been adequately undertaken, exposing villages to disaster impacts further.
- Lack of compensation for non-agricultural losses: Villagers in Reukatur report that 'even if we don't fish for a month, there is no compensation for that under disaster relief funds. We travel 5 km and get a fistful of rice as compensation.' Exclusion of fishing and other livelihood resources from disaster loss calculations and thus compensation pushes poorer households into poverty further without any means to recover.

Key recommendations for Ganjam district

Livelihood resources

Increased livelihood challenges are among the most tangible and thus addressable impacts that sea intrusions and other factors induced by climate change have had on coastal villages. Government assistance, better capital infrastructure and insurance against failure are crucial for agriculture and forest/ plantation based livelihoods. Urgent measures in crop diversification, use of saline resistant seed varieties, building irrigation infrastructure and creating natural buffer zones between cultivation land and the sea are crucial for saving agriculture based livelihoods. Integration of horticulture and pisciculture can be an important adaptive strategy for low income, single livelihood source based households.

Fishing based livelihoods need more support from government schemes like disaster relief measures to ensure that disaster related losses are fairly

compensated. Access to common port spaces for secure storage of boats and equipment is very important for protecting small scale fishers.

Women's economic participation in more equitable and sustainable livelihoods for them are essential and need more focused attention from social security schemes. Women's role in agriculture, fishing and produce collection needs to be officially recognised and incorporated in both developmental and mitigation strategies against climate change induced uncertainties.

Protection of land and forests

Planting of natural barriers along the coast can have an immediate impact on mitigation strategies against sea intrusions and needs to be implemented urgently. Protecting productive land and water resources is crucial for ensuring sustenance of Ganjam's coastal communities. Planting and maintenance of barriers like casuarina plantations, along with better drainage and water flow infrastructure can be an essential coping strategy against an intruding sea and disappearing land.

Existing open forests and plantations need urgent protection strategies, along with reforestation post disasters. Plantations of coconut, kewra, and others being an important channel of women's economic participation, need better protection and development for addressing both ecological and gender based vulnerabilities.

Chapter 4

CONCLUSION AND RECOMMENDATIONS

The previous pages have presented the impact of sweater intrusion across a few villages in five coastal districts of Odisha. As climate change continues to impact, with increasing frequency and intensity of extreme weather events, the severity of seawater intrusion in India is slated to increase in a number of ways. First, sea levels are expected to rise, which will push the saltwater interface further inland. Second, climate change is expected to cause more extreme weather events, such as cyclones and storm surges, which can also contribute to seawater intrusion. Third, climate change is expected to change precipitation patterns, which could lead to less groundwater recharge in coastal areas.

As stated earlier the effects of seawater intrusion can be devastating. It can contaminate drinking water supplies, damage crops, and make it difficult to sustain coastal livelihoods. In some cases, it can even force people to relocate.

In this chapter we will examine some of the ways to take action to mitigate, adapt and build resilience to improve the lives of coastal communities.

Using existing policies and resources for reinforcing sea intrusions and displacement

Central Policy on Mitigation and Rehabilitation Measures for People Displaced by Coastal and River Erosion 2022

Major Actors: The Odisha State Disaster Management Authority, District Disaster Management Authority and Panchayati Raj Institutions (PRIs) with assistance from the National Disaster Management Authority.

Policy Focus

The policy has been designed to target action steps for people displaced due to coastal and river erosion through allocation of a dedicated fund and institutional structure. Climate change is an undeniable factor in such displacements and hence the policy highlights other impacts of erosion and loss on vulnerable coastal communities. The policy discusses the following aspects:

- Enhancing resilience of communities through social, economic and structural protection strategies, for instance, infrastructure to mitigate the impact of disasters and extreme events that add to erosion.
- Livelihood support systems for sustaining economic sustenance and growth of rapidly changing seashores and river banks due to various natural and anthropogenic factors contributing to environmental change.
- Addressing issues specific to women and other susceptible groups to socioeconomic change.
- Institutional support emphasised to bring about long-term change in disaster strategies to include shore erosion.

Process implementation:

- Decentralised approach to planning and implementing adaptation, mitigation and resettlement strategies is the core mechanism of the policy.
- PRIs will be given more responsibilities and access, along with the district level allocation of human and capital resources for preparing targeted action plans for addressing erosion.
- Planting of mangrove shelter belts is a primary recommendation and needs implementation at a larger scale, expanding on current initiatives in some districts. More funds need to be diverted for promoting mangrove plantations, especially with the help of local communities and honing livelihoods that integrate environmental and economic gains.

What is needed in Odisha's coastal districts is an expedition of action – structural and processual – to mitigate the impacts of seashore erosion

and land loss in all spheres of community life. Such action today is crucial for ensuring a better equipped battle with climate change.

State Climate Change Action Plan by the Forest and Environment Department, Government of Odisha (2018-23)

Key steps

- The State Action Plan on Climate Change must prioritise slow onset disasters like sea intrusions, shore erosion, salinisation and displacement and develop plans for mitigating their impact in the 2023-2028 Action Plan.
- The government should adopt an appropriate loss and damage assessment process and consider loss of land to sea, salinisation of agricultural land, loss of livelihoods among marginalised communities, loss of access for women over resources and burden on women and they should be compensated appropriately.
- Climate change mitigation processes need to be further decentralised by giving a more defined role to PRI members, women, youth and other community members in rebuilding and resettlement plans, especially in managing local resources like land, water and forests.

Promoting best practices found effective across districts in mitigating the impacts of sea intrusions and adapting to it

Early action strategies, the state level climate change action plan and non-governmental networks working towards climate change have created the following spaces for adaptation to sea intrusions, disasters and socioeconomic losses. These practices need further expansion and more resources and stakeholder engagement to cope with intense environmental impacts.

Mangrove plantations

The Forest, Environment and Climate Change Department's plantations of open mangrove forests have been successful in Puri, Bhadrak and

Kendrapara districts. These plantations can be developed further into more expansive shelter belts across the state's coastline that can mitigate the impacts of seashore erosions and loss of land.

In Bhadrak, the mud flat formed adjacent to the coastline due to the deposition of fine sediments by tidal action supports the growth of varieties of mangroves in the 2 to 5 km coastline. While Chandabali block's coastline has several mangrove varieties in close proximity to the Bhitarkanika forests, Basudevpur block saw extensive plantations after the 1999 Super Cyclone. Villages like Kantipur have become habitable only due to the mangrove plantation, which acts as a buffer against tidal flows along the flatland into habitation, supports the local fishing economy and reduces the impact of cyclones. In other parts of the block's coastline, there is potential for expanding the current width of forests or plantations to form 2-3 km wide belts or buffer zones.

›› Rejuvenation of Buffer Zone

It is very much evident from the study findings that there has been a gradual shrinking of the buffer zone alongside the sea cost in Puri, Jagatsinghpur, Bhadrak and Ganjam districts due to the rise in sea level, coastal erosion and loss of forest coverage. The decline of the buffer zone has further led to the salination of agricultural land. However, by learning from the existing best practices, we can further the rejuvenation measures for recovery and resilience building. Divisional Forest Office, Puri and Wildlife Division, Puri, the Forest, Environment & Climate Change Department, Government of Odisha, under the project Enhancing Climate Resilience of India's Coastal Communities (ECRICC), has done bio fencing on the boundary line of the sea shore of Kanharapur under Nadiamath beat Balidokan section of the Konark range in Puri district. The bio fencing was done using the kewda or kia plant, also known as the fragrant screw pine and whose latin name is pandanus odorifer. The kewda plant is native to the Odisha coast and its flower is used to flavour food, in perfume and in ayurvedic medicines.

However, considering the extent of damage in terms of erosion and salination that is continuously happening along the coast of the Konark range, the

effort of bio fencing needs to be done on a large scale with increased investment and ensuring participation of the coastal communities. Also, these measures need to be followed up with an effective community-based watch and ward and repair system. The action of bio-fencing needs to be done for a large extended area alongside the coast. And, as viewed by the communities, the buffer zone alongside the sea coast should be covered by layers of local varieties of plants like casuarina that can prevent erosion.

Also, there have been specific measures like trenching alongside the buffer zone of the sea coast to prevent saline intrusion by utilising provisions of the MGNREGA to design work projects according to need. These measures need to be replicated and scaled up using the MGNREGA, ensuring livelihood to the affected communities while ensuring buffer zone maintenance and rejuvenation occur. Thus, the trench could be repaired and maintained periodically. In undertaking preventive measures, the participation and leadership of the local communities need to be ensured.

›› Alternative livelihoods

In the process of rehabilitation, people are shifted to new place like Bagapatia. And, due to this shifting the people lose access to many resources which were available to them free for years. At the original location, people had access to common property resources and other natural resources like land, water and forest. Dependency on natural resources and their conservation was an integral part of the people's social and cultural lives. From the experience of the Super Cyclone, people realised that mangroves around the seacoast are very effective for protection from the impact of cyclones. So, the communities were consciously taking care of the growth of the mangroves around their habitats. Also, the mangroves are very useful for the communities in their day-to-day lives. The leaves, trunks of the trees and ropes are used for making shelters. Communities conserve the mangroves consciously considering their uses in their social life as well as their significance in protection form the impact of cyclones. However, due to rehabilitation and shifting to a new location, the culture of conservation has been affected. The communities need to be mobilised to

go back to the age-old practice of community conservation of mangroves. A long stretch of a river connected to the sea is available in the current location. So, there should be efforts to grow mangroves alongside the river and the communities need to be engaged in this effort.

Besides, the communities were leading a communitarian life sharing resources and many other intangible social, cultural and psychological support. There should be efforts for revival of their cultural lives in terms of promoting more community-based activities and festivals of cultural significance. Social cohesion needs to be strengthened with more capacity building engagement to face disasters and extended support to each other in emergency situations.

Hence, while planning rehabilitation, factors like provisions and access to agriculture land, common land, water resources and forest and forest produce need to be considered consciously. In case forest resources are not available at the place of rehabilitation, the people should be ensured with the right to access the forest and uncultivated forest products that exist in nearby villages.

While agriculture and wage labour (both local and migrant) remain the primary sources of livelihood generation for the people, some government schemes and alternative livelihoods with the support of local NGOs have helped Puri's coastal villages in resilience building measures. Betel vine plantations and prawn farming are the two most common alternatives. Betel vine plantations have contributed to incomes among Puri's villages and have received support from local development focused NGOs. Prawn farming is another alternative but comes with its own risks due to involvement of middlemen reducing profits for small farmers, financial risk due to crop failure, lack of insurance and environmental impact due to lack of regulations and proper technology.

People have been involved in government schemes like the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) that are targeted to build local infrastructure like drainage, roads and water

storage units. These efforts need more push, more work days being put into them and the involvement of forestry in the work. Compared to an ActionAid Association visit in the aftermath of Cyclone Phailin, the forest cover has almost disappeared today, especially in villages such as Udaykani, Tandahar and Katakana. People seek solutions in building stone and cement embankments to shield the village but afforestation of *jhaun* (casuarina) and other trees can mitigate constant erosions by the sea.

Generation of alternative livelihoods with support from local markets, non-governmental actors and state financial support are important areas of action. For agriculture dependent areas, these activities can be horticulture, integrated farms and fields, crop diversification and seasonal crop rotation mechanisms, which will need support in the initial stages and revaluation for disaster protection and insurances against failure. In fishing dependent communities also, integrated fish farm systems can be a useful adaptation, along with community fishing ponds, river conservation efforts and land development for preventing inundation. These need state support. Regulations of the environmental impact of shrimp cultivation is an important point to assess and take corrective steps to ensure an environment for better livelihoods. Strengthening traditional agriculture and fishing-based livelihoods with access to land, water, technical skills and capital for investment are important.

Improving and decentralising local resource management and development initiatives that both use and conserve the local ecosystem

Landless households must be given ownership of homestead land, access to disaster resilient housing and ensured access to safe drinking water and other basic amenities. Common land for community use like pastures, minor produce plantations, community forests and ponds is also crucial for ensuring sustained village economies.

Access to good quality and sufficient water resources for both domestic and commercial purposes like irrigation is crucial to address climate

change vulnerabilities. Community initiatives like water parliaments, construction of infrastructure like rain harvesting ponds, coast canals and smaller embankments need proper focus and funds. These measures can be integrated with natural resource conservation and create a symbiotic community and environment relationship.

Forest conservation can get a massive boost if used for the benefit communities and shielding them from climate change's impacts. Plantation of disaster resilient forests and constitution of panchayat level cooperatives for devising livelihood strategies from such plantations can be an important step.

Targeting youth development through nutrition, education and employment opportunities that address sea intrusion's present and future challenges

With changes in food security and exposure to disasters, children and youth are impacted in their crucial developmental periods and need special attention. The impacts of climate change induced dietary changes, changes in healthcare, education and opportunity access need to be included in state policies for child development and educational institutions. Infrastructural resources need more focused investment to reduce educational losses, create growth spaces and improve resilience in future communities. More effective strategies are needed for reducing dropout rates, ensuring completion of school education and development of employability skills. As a productive component of the demography, young people need to be provided with skill training, credit support and employment opportunities.

Environmental challenges also need youth involvement to advance technique and technology for traditional agricultural, plantation, fishing and forest based livelihoods and integrate the efforts with conservation. Establishment of local educational institutes on sustainable farming, fish-farm integration and management of prawn cultures for developing

youth expertise can be a crucial step alongside ensuring better local resources and opportunities for reducing distress migration among youth for employment.

Disaster management and relief measures need to be more effectively implemented to aid post disaster recovery and growth and to ensure sustained support from welfare policies

- Revisit the existing relief code and develop a rebuilding and resettlement plan to ensure appropriate compensation to the affected communities most specifically the landless, small and marginal farmers, women and Dalit communities.
- Re-evaluate compensation amounts given under SDRF norms to include damage to property, crops, livestock and other sources of sustenance along with better disaster education to prevent health and education losses.
- Protection of existing forest systems such as mangroves, jhaun and casuarina to strengthen natural barriers to disasters and engage community members in forest based conservation livelihoods. Afforestation in areas that have been damaged by disasters and sea ingress.
- Development of community forests, ponds and water management systems to ensure a better forest cover and maintenance and community livelihood integration with mitigation measures.
- Develop appropriate resettlement and rehabilitation packages for the people affected and displaced by sea erosions to ensure proper habitation to the people, crop land, common land and other compensatory measures of ensuring right to access the forests and uncultivated forest produce that exists around the settlement areas.

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Annexure

INDIVIDUAL STRUCTURED INTERVIEW SCHEDULE

Profile

1. Name:
2. Age:
3. Sex:
   - Male
   - Female
   - Other
4. Education:
   - Below high school level
   - High School
   - Graduate
   - Post graduate
5. Occupation:
   - Agriculture
   - Fishing
   - Self-employed
   - Other
6. Annual Income:
7. Religion:
8. Category: General/SC/ST/OBC
9. No. of family members

Adults -

Children -

Senior citizens -

PwDs -

10. Are there any terminally ill individuals in the household?
11. Type of house now:
    - Kutcha
    - Pucca
12. Type of house before displacement:
    - Kutcha
    - Pucca
13. Other assets (vehicles, livestock, household items):

Section I - Understanding vulnerabilities

Physical vulnerabilities

14. Were there any senior citizens/PwD/terminally ill individuals in your household at the time of displacement? How did they get affected?
15. How did women in your family get affected at the time of displacement?
16. How did the children get affected? Did any of your children drop out of school?

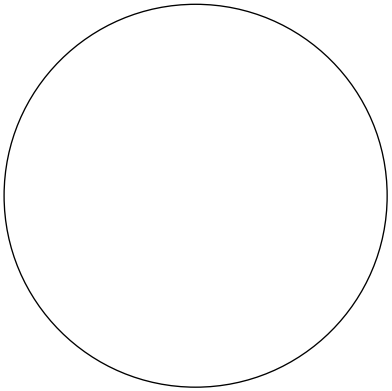
Economic vulnerabilities

17. In which year were you displaced?
18. What kind of losses did you incur?
    - Lost homestead land
    - Lost agricultural land
    - Lost livelihood source
    - Lost family member
    - Other losses

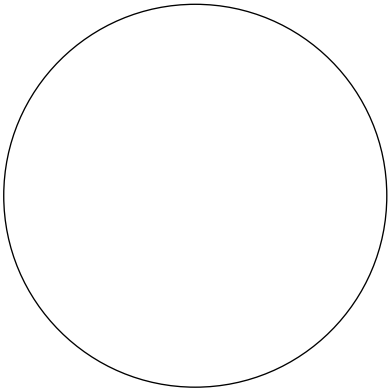
    Please specify:

19. How much land did you lose due to seawater intrusion?
20. How long had you all been living on this land before you got displaced?.....years
21. Did your parents live here? .....
22. What is your main source of livelihood? Did it get affected by your displacement? How?
23. Are other members of your family engaged in occupational work? What kind of income generating work do the women do?
24. What are the household earnings? Did they get affected after you moved?
25. Please specify changes in your household expenditure before and after you got displaced:

Categories: Food / Education/ Health/ Agriculture/ Fishing/ Others



Before



After

Ecological vulnerabilities

26. How far is the mangrove forest from your house?
27. How much do you depend on the mangrove forest for household requirements?
28. What are the food and other household items you get from the mangroves?

29. Has resources accessed (in terms of quality/ quantity) changed?
30. Any efforts made to improve the mangrove's conditions?

Disaster related vulnerabilities

31. How many times have you been affected by disasters like cyclones, floods including the COVID-19 pandemic in the last 10 years?
32. What was the impact of this?

Loss of house/ loss of livelihood source/ loss of education for children/ loss of health and other long term impacts

33. What kind of disaster relief have you received from the government/ NGOs/ other organisations?

Housing compensation/ land/ others

34. Is the relief amount timely/ adequate/ suited to your needs?

Section II - Coping mechanisms

35. How did you sustain your income after being displaced?
36. Did you buy more land? How did you cover the costs?
37. Did you seek any alternative source of earnings?
38. What were these alternatives?
39. What were your earnings?
40. Were there any infrastructural changes you had to make to your residential/ agricultural land?
41. Have there been any changes in your land's productivity/ fertility? What did you do to address these changes?
42. Were there any changes in your fishing practices?

Specify:

43. Have any members of your household migrated outside the village for work?

44. For how long are they gone?
45. What kind of work are they engaged in?
46. Are issues related to your village's displacement discussed in a common community forum?
47. Did you receive support from the community when you were displaced? What kind of support?

Section III - Government schemes

48. Did you receive any government compensation for your land (residential and agricultural)?
49. Do you receive any kind of housing support from the government? (funds for building house, toilets, etc.)
50. Do you or any other family member receive a government pension?
51. Do you have access to credit services if you need funds? What does the process look like?
52. Do you receive any health benefits from the government? What about other family members (women, children, senior citizens, PwD, terminally ill)?
53. Do you receive any benefits from agricultural/ fishermen support schemes?
54. Are you part of a SHG? What kind of support do you receive?

Focussed Group Discussion

Understanding Ecological Changes And Community Impacts Related To Seawater Intrusion

1. Has the frequency of disasters increased in the last few years? What have been the impacts at the village level/ community level/ district level? What are the reasons behind this?
2. What kind of changes have you seen in the mangrove forests over the years? How have these affected your village?
3. How has aquatic life changed over the years (focus on quantity, quality, diversity)? What are its impacts on fishing livelihoods?
4. What do you feel are the biggest changes that seawater intrusion has brought about in your community's life? (focus on economy, social life and cultural practices)
5. What do you think should be prioritised in dealing with the problem of seawater intrusion?
6. How are you as a community working towards protecting your ecological habitat? What are the biggest challenges that you face right now?
7. Do you think climate change has had an impact in your village/ region?

VILLAGE LEVEL INFORMATION SHEET

A. Identification

Name of the Village	
Name of the Hamlet	
Panchayat	
Block	
District	

B. Socioeconomic Information

1. No. of Household.....
2. Average household size.....
3. Population.....
4. Male.....
5. Female.....
6. Social group

Caste group		Religious group	
General		Hindu	
OBC		Muslim	
ST		Christian	
SC		Others	
Total		Total	

7. Demographic details

0 to 5		5-14		15-60		60 above		SC		ST		BPL	OBC	Total
M	F	M	F	M	F	M	F	M	F	M	F			

8. Type of household

Sl. No	Village/ hamlet	Type of House				
		Thatched	Tile	AC/ Tin sheets	Concrete	Total

9. Infrastructure facilities in the village

Sl. No.	Infrastructure	Status (strength, facilities, etc.)	Accessibility

10. Road and communication

Sl. No	From	To	Description	Present situation	Main or connective road	Regular/ seasonal	Main use	Remarks

11. Water source availability

Sl. No	Source	Number	Owner	Location	Quality	Quantity	Access	Remarks

12. Drinking water facility and its location

Sl. No	Source	Number	Owner	Location	Quality	Quantity	Access	Remarks

13. Sanitation facilities

Sl. No	HH Nos. (as per the social map)	Place for defecation	Location of toilet	Type of toilet	Remarks

14. Distance of village from nearest town.....

15. Distance of village from motorable road.....

16. Level of educational institutions in the village.....

17. Level of healthcare infrastructure.....

18. Major health problems.....

19. Is the village electrified.....

20. No. of households in which any of the members have migrated.....

21. Migrated to which place.....

22. Migrated for which work.....

23. Land particulars

Total area		Cultivable area	
Irrigated land		Unirrigated land	
Culturable waste		Common property resource	

24. Land ownership pattern (In acres)

< 0.5		6.0 – 8.0	
0.5 – 2.0		8.0 – 10.0	
2.0 – 4.0		10.0>	
4.0 – 6.0		Landless	

25. No. of households below the poverty line

Village/hamlet	Number of household as per the economic status		
	BPL	APL	Total

26. Main occupation of the villagers:

Livelihood profile

No. of HHs engaged (mention the HHs no. in the social map)	Primary Occupation	Secondary Occupation	Remark

27. Well Being Analysis (As per the perceptions of the local people)

WellBeing Ranking	Criteria as set by the community	Put specific indicators/no. of HHs as per the social map
Well Off		
Medium		
Poor		
Extremely Poor		

28. Major crops grown

Sl. No	Kharif		Rabi		Cultivable land in acres		Total land
	What are the crops	Duration	What are the crops	Duration	Kharif	Rabi	

29. Livestock varieties

Village/ Hamlet	Cow	Bull	Buffalo	Goat	Sheep	Hen, duck, swan	Others	Total

30. Types of fuel used bythe villagers.....

31. Major community festivals.....

32. Other occasions for community gatherings.....

33. What are the memorable incidents or major happenings in village that you can recall.....

34. What are the local common pool resources.....

35. List of village level institutions/resources and their role

Sl. No	Institution	Functions	Special role towards disaster risk reduction and water management	Mention whether village level or situated outside and working in the village	Remarks

36. What are the government programmes implemented in the village this year?

Name of the programme	Infrastructure built	Month of implementation	Man days created

37. Activity calendar of villagers

Month	Agriculture	Wage labour	Community festival	Water conservation	Health

38. Any other participatory programmes in the village?..... (SHG, Pani Panchayat, farmers' cooperative, etc.)

39. History of disaster

Sl. No	Event	Year	Month	Human casualties	Agricultural loss	Other losses	Most vulnerable area	Duration	Remarks

40. Impact on life and livelihood

Key areas of change	Causes	Intensity and occurrence of each cause factor	Impact of such changes
eg. More water logged area			
Duration of water logging is more			

41. Coping mechanism

Cause	Existing coping mechanism	Suggested adaptation measure

42. Vulnerability analysis (village level)

Vulnerable elements (who or what)	Natural (environmental factors)	Physical (location, number)	Financial (money, assets, belongings etc.)	Human (skills, knowledge, attitudes, motivations etc.)	Social (institutions, groups, culture, community dynamics etc.)	Political (networks, connections, influence etc.)

C. What are the areas of major changes

Particulars	1990s	2000s	2010s	2020	Last year
Land					
Pasture					
Mangrove					
Water availability					
Drinking water quality/quantity					

Water management					
Drainage system					
Forest cover					
Aquatic life					
Temperature					
More number of hot days or more temperature overall					
Rainfall					
More number of rainy days or more rainfall overall					
Natural Disasters					
Livestock rearing practices					
Cropping patterns					

Cultivation practices					
Agricultural marketing					
Food habits					
Food availability					
Employment opportunities					
Traditional village institutions					
Housing patterns					
Migration					
Village institutionalisa-tion					
Government assistance					

D. The trends and patterns of change?

E. What are the drivers of such changes?

F. Whether these changes are good?

G. How are people adapting to such changes?

Besides this general information should be collected from the village:

- Nearest UP school
- Nearest high school
- Nearest post office
- R I office
- ANM centre
- Name of ASHA
- Name of anganwadi worker
- Nearest PHC/ CHC
- Nearest veterinary hospital/doctor
- Nearest fire station
- Police outpost/ police station
- Electric sub-station/ electric office
- Telephone exchange
- Name of agricultural officer
- Name of panchayat executive officer
- Name of sarpanch
- Name of ward members
- Name of panchayat samiti member
- Tahsil office
- Name of BDO
- Contact details of the above person and institution.

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