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ASSESSING LIVELIHOOD VULNERABILITY IN GHORAMARA ISLAND, SOUTH 24 PARGANAS: INTERSECTIONS OF AGRICULTURE, FISHING, WATER RESOURCES AND CLIMATE CHANGE

PREPARED BY

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(BASELINE STUDY PARTNER)



PREPARED FOR

PROJECT- INTEGRATED WATER & LIVELIHOOD
SOLUTIONS FOR GHORAMARA

AZIM PREMJI FOUNDATION (FUNDING PARTNER)



SEED (SOCIETY FOR SOCIO ECONOMIC &
ECOLOGICAL DEVELOPMENT)
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Institute of Development Studies Kolkata (IDSK)
(A Centre for Excellence in Social Sciences funded by the Government of West Bengal)

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This study was conducted by a multidisciplinary team from the Institute of Development Studies Kolkata (IDSK), combining academic expertise and field research experience.

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Photo: Dr. Bidhan (centre) with PGDDS students



Photo: IDSK team with SEED filed team at Raypara

BASELINE AT A GLANCE

126 households surveyed	499 household members represented	52.38% households with migration history
72.2% households using government deep tubewells	37.3% households with agriculture as primary income source	66.67% households with one earning member
43.65% households reporting water- borne disease	100% households reporting cyclone exposure	21 bighas baseline irrigated command area
15.08% households in poor wealth tercile	7.14% households in rich wealth tercile	47.62% households owning agricultural land

Interpretation: The baseline is not a story of one isolated problem. Water insecurity, low-return livelihoods, migration, gendered labour burdens and repeated climate shocks reinforce one another. The APF programme is therefore strongest as it treats water and livelihoods as one system.



EXECUTIVE SUMMARY

This study aims to examine the intersection of climate change, environmental degradation, and livelihood insecurity in Ghoramara Island, one of the most vulnerable regions of the Indian Sundarbans. It demonstrates how recurrent cyclones, saline water intrusion, sea-level rise, and severe coastal erosion have progressively transformed Ghoramara Island from a relatively stable agrarian settlement into a shrinking and fragile ecological space. The island has reduced from nearly 30 sq. km to about 5.5 sq. km over the decades, causing large-scale land loss, displacement, and declining livelihood opportunities, and rendering the residents as “climate refugees”.

Adopting a mixed-method research design, the study combines quantitative household surveys of 126 selected households by adopting multi-stage stratified sampling with qualitative methods such as interviews, field observations and gender-specific Focus Group Discussions. Descriptive statistics are basically used for data analysis. Principal Component Analysis (PCA) were also used to assess socio-economic inequality, and household wealth distribution.

The findings reveal that livelihood systems in Ghoramara remain overwhelmingly dependent on climate-sensitive sectors such as agriculture, fisheries, agricultural labour, and informal manual work. Agriculture continues to be the principal source of income, yet salinity intrusion and repeated flooding have significantly reduced productivity and increased uncertainty in cultivation cycles. Fisheries, traditionally an important livelihood, have also declined because of ecological stress, deteriorating water quality and rising sea level.

A major analytical contribution of this study lies in demonstrating how environmental vulnerability translates into socio-economic precarity. Most households depend on a single earning member, have low per-capita incomes, and possess limited savings, making them highly susceptible to climate shocks. Occupational diversification exists, but secondary occupations are largely low-paying and seasonal, indicating that diversification functions more as a survival strategy than as sustainable economic mobility. The PCA-based wealth analysis further reveals pronounced inequality, with a small, relatively-affluent category possessing disproportionately higher assets while the majority remain clustered within economically insecure middle categories. The study also highlights the gendered dimensions of climate vulnerability. Women show lower educational attainment, minimal participation in paid labour, and greater dependence on welfare schemes like 'Lakshmir Bhandar' despite widespread bank account ownership. Migration emerges as both an adaptive response and a symptom of distress, disrupting social networks and increasing dependence on insecure urban employment. Overall, this study effectively links ecological degradation with structural inequality, climate-induced displacement, and livelihood transformation, being an independent empirical attempt at understanding the human consequences of environmental change in the Sundarbans.

The findings on the intersection of agriculture, water resources, fishing, and climate change in the study areas highlight urgent needs for livelihood generation that can be strategically addressed through the project "Integrated Water & Livelihood Solutions in Ghoramara" comprehensive intervention model supported by the Azim Premji Foundation. Such intervention must include desilting ponds so that the pond water can be used for Rabi crops, and also for fisheries, if required; establishing tubewells at the elevated level so that supply of drinking water remains uninterrupted even during flood or any other climatic events; distribute livestock such as poultry, goats etc. for alternative livelihood generation; and establishing handloom for income generation, particularly among women. For the future sustainability of these activities and physical resources Common Interest Groups (CIGs) may be created. Such initiative may serve as means of community participation and create a sense of community ownership during and after the end of the project.

Addressing these interconnected recommendations is essential for improving the well-being and resilience of climate-affected and economically vulnerable coastal communities. Additionally, such multi-pronged strategies would prevent male or family migration in the long run.

KEYWORDS: Climate Change; Ghoramara Island; Livelihood Vulnerability; Coastal Erosion; Sundarbans; Migration; Salinity Intrusion; Fisheries; Agriculture; Climate Adaptation; Environmental Degradation; Rural Livelihoods.

CHAPTER 1-INTRODUCTION

The Universal Declaration of Human Rights of 1948 recognises the right to livelihood through its guarantees relating to work, adequate standards of living, and social security. In particular, Article 23(1) recognises the right of every individual to work, to freely choose employment, to enjoy just and favourable conditions of work, and to receive protection against unemployment. Further, Article 25(1) affirms the right of every person to an adequate standard of living necessary for health and well-being, including access to food, clothing, housing, medical care, and essential social services. Collectively, these provisions provide the normative basis for the contemporary understanding of the right to livelihood by acknowledging that access to employment, income, shelter, food security, and social protection are indispensable to human dignity, survival, and overall well-being. In the Indian context, the Supreme Court, through its landmark judgment in *Olga Tellis & Others v. Bombay Municipal Corporation & Others* (AIR 1986 SC 180), held that the right to livelihood forms an essential component of the Right to Life guaranteed under Article 21 of the Constitution of India.

This right to livelihood, recognised as an essential component of human dignity and survival, remains severely compromised in coastal and island regions of West Bengal due to the combined effects of climate change, environmental degradation, economic inequality, and inadequate institutional support. Livelihood accessibility forms the foundation of socio-economic security, particularly in rural and coastal regions where communities remain heavily dependent upon natural-resource-based occupations. However, the occupations are highly vulnerable to climatic disturbances such as cyclones, saline water intrusion, tidal flooding, and coastal erosion, all of which directly threaten the survival of local communities.



The eroding Ghoramara Island (previously called Mud Point) in South 24 Parganas district of West Bengal within the Indian Sundarbans delta exemplifies this from climate-induced livelihood collapse. The erosion-accretion dynamics of the Hooghly and Muriganga river systems, coupled with rising sea levels and repeated cyclonic events such as Aila, Amphan & Yaas, have rendered significant areas of the island agriculturally unproductive through salinity intrusion and flooding. Ghoramara has also experienced continuous land erosion over several decades, resulting in the loss of cultivable land, residential settlements, freshwater sources, and ecological stability. Consequently, traditional occupations such as paddy cultivation, betel leaf farming, and fisheries have become increasingly unsustainable. Large portions of agricultural land and inhabited areas have already been submerged, forcing many islanders into landlessness and displacement, creating a vulnerable demography of displaced climate refugees.

The practical denial of the right to livelihood in Ghoramara is reflected not only in environmental destruction but also in the absence of adequate infrastructure and institutional protection. In the absence of sustainable livelihood alternatives, seasonal migration has emerged as an economic necessity, particularly among male workers seeking informal labour opportunities outside the island. Moreover, economically weaker households are disproportionately exposed to environmental risks because they are often compelled to reside near embankments and erosion-prone areas where land values remain comparatively lower. This deepens existing inequalities and reinforces cycles of poverty, displacement, and vulnerability.

Thus, in Ghoramara, the constitutional and human rights-based conception of the right to livelihood remains largely theoretical, as environmental uncertainty and institutional inadequacies have progressively eroded the material conditions necessary for dignified and secure living. This makes the island an indispensable area to identify and study the effects of climate change on the livelihood patterns of vulnerable populations.

CHAPTER 2- BACKGROUND AND MOTIVATION

The Indian Sundarbans delta region is widely identified as one of the world's most fragile coastal ecosystems due to unstable geomorphology; adverse climatic conditions- rising sea levels, frequent extreme weather events; and significant socioeconomic vulnerability. Remote inhabited islands in the Sundarbans face higher socioeconomic vulnerability due to poor accessibility, underdeveloped mobility and connectivity networks, systemic barriers to education, and recurrent disaster-induced setbacks (Biswas and Nautiyal, 2020).

Changing climate patterns have reduced the availability of fresh water, which in turn has lowered food production, weakened traditional livelihoods, and escalated food crisis in the Indian Sundarbans (Datta et al., 2024). Shortage of freshwater severely threaten the health and livelihoods of coastal populations reliant upon natural resources.

To cope with relentless environmental hazards, coastal population in the Indian Sundarbans increasingly resort to migration, informal credit, reduced food consumption, and occupational diversification (Mondal et al., 2022).



Located within the Indian Sundarbans, Ghoramara Island is one of the most climate-sensitive, inhabited sinking islands in India. The island experiences severe environmental degradation and compounding livelihood challenges owing to continuous coastal erosion, saline water intrusion, tidal flooding, embankment breaches, and repeated cyclonic disturbances over several decades. These have severely affected agriculture, fisheries, water availability for domestic use, and food security. Repeated environmental hazards have caused widespread anxiety, social exclusion, and outmigration among island residents (Chakraborty and Satpati, 2019). Constant coastal erosion, broken embankments, cyclones, and saltwater flooding contribute significantly to livelihood loss and forced migration in deltaic islands (Samanta et al., 2017). Ghoramara's climate-induced displacement crisis mirrors the broader reality of forced migration across the Sundarbans (Das and Hazra, 2020).

Worldwide, comparable patterns of economic and existential vulnerability manifest across inhabited, subsiding islands and low-lying littoral zones jeopardized by rising sea levels. Maldives, Kiribati, Tuvalu, and Papua New Guinea's Carteret Islands are encountering escalating threats from involuntary population displacement, acute freshwater depletion, and widespread disruptions to local economies. Structural precarity in Bangladesh's riverine islands is acutely intensified by an intersection of inadequate housing infrastructure, systemic poverty, low educational capital, forced migration, and high exposure to climate-variable employment sectors (Hossain et al., 2023). These global instances confirm that climate-related threats to livelihoods and human mobility now constitute primary humanitarian and developmental obstacles for low-lying island communities worldwide. Sustainable adaptation measures and resilience is imperative for livelihood planning in vulnerable coastal regions. To help the Sundarbans survive, there is a need to get the locals involved in creating new jobs, restoring mangroves, and designing safety plans (Chowdhury et al., 2016). There is an urgent need for long-term institutional planning and rehabilitation support in the Sundarbans and "Managed retreat" can be used as an adaptive strategy (Danda et al., 2019). Climate resilience in South Asia requires strong local adaptive capacities, sustainable resource management, and community participation (Haque et al., 2022).

Within this context, this present study is designed to evaluate the multi-faceted nature of economic and social fragility on Ghoramara Island. The primary impetus for this study is to discern the mechanisms through which escalating environmental degradation intersects with deep-seated socioeconomic stratifications. Understanding these dynamics is vital to determining the factors that restrict or enhance survival opportunities, long-term adaptive strategies, involuntary human mobility, and socio-ecological resilience among exposed populations. Ultimately, it seeks to contribute to policy discussions surrounding transformative climate change adaptation, sustainable alternative livelihood strategies, and environmental justice within Ghoramara Island.



CHAPTER 3-OBJECTIVES

- To examine how climate variability and hazards affect agricultural activities (productivity, cropping patterns, and livelihood systems).
- To assess the effects of climate variability and hazards on fisheries (fish availability, fishing practices, and livelihood systems).
- To analyze the effects of climate variability and hazards on non-farm activities (occupational shifts).
- To investigate patterns, drivers, and outcomes of migration in response to livelihood stress and environmental risks.
- To assess the availability, accessibility, and quality of water for drinking and livelihood purposes.
- To examine household-level experiences of climate risks, coping strategies and the role of government initiatives in addressing climate-related vulnerabilities.

CHAPTER 4- DATA AND METHODS

4.1: Study Area

Ghoramara island is a low-lying, permanently inhabited riverine island in the Sundarbans deltaic region of West Bengal. Administratively, it falls under Sagar Block of Kakdwip sub-division in the South 24 Parganas district of West Bengal. As per local residents, the name ‘Ghora (horse) mara (killed)’ comes from the legend of a horse of a British official being eaten by a Sundarbans tiger. Severely impacted by coastal erosion and sea-level rise, the island currently has only one Gram Panchayat “Ghoramara” though it earlier comprised three major mouzas—Lohachara, Khasimara, and Ghoramara. This coastal erosion and land submergence have resulted in reduction in the total area of the island to a current 5.5 sq. km from a historical 30 sq. km. As per Census 2011 data, the island had a total population of 5,193 with 2,644 males and 2,549 females spread across 1,095 households. The average literacy rate stood at 81.95% with a high 90.40% for males and a moderate 73.25% female literacy rate. More recent data is available with Ghoramara Gram Panchayat and is tabulated below on next page:

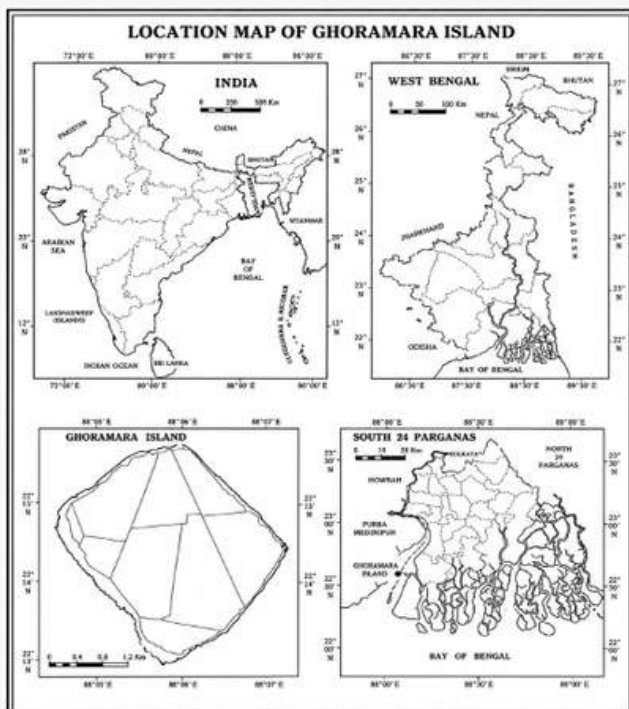


Figure 1: Location of Ghoramara Island in the South 24 Parganas district of West Bengal



Figure 2: Representational image of Ghoramara showing the major hamlets (not to scale)

CATEGORY	DETAILS
Name	Ghoramara Island, South 24 Parganas
Co-ordinates	21.914°N, 88.129°E
Subdivision	Kakdwip Subdivision
Community Development (CD) Block	Sagar Block
Mouza/Gram Panchayat	Ghoramara
Police Station Jurisdiction	Sagar Police Station
Parliamentary Constituency	Mathurapur (SC) Lok Sabha Constituency
Assembly Constituency	Sagar Assembly Constituency
Area	5.5 sq. km (current), 30 sq. km (historical)
Total number of Households	1,076 (Brick-walled: 824, Kachcha: 252)
Total Population	4,766 (Males: 2446, Female: 2320) persons
Scheduled Caste (SC) population	871 persons
Minority population	1,280 persons
Other Backward Classes (OBC)	185 persons
Literacy rate	84%
BPL population	384 persons
NSAP beneficiaries	88 persons
Active job cards (MGNREGA)	946 persons
Functional tube wells	63
Markets	2
Paved roads	Brick: 0.5 km, PCC: 7.8 km
RCC drain	1.2 km
Irrigation canal	2.5 km

Table 1: Tabulated information about Ghoramara Island & its demography

CATEGORY	DETAILS
Available agricultural land	527 acres
Agricultural labourers	918 (including 36 landless agricultural labourers)
Community toilets	2
Self-Help Groups (SHG)	71
Clusters/Sub-clusters	1 Cluster, 3 Sub-clusters
Health Sub-center	1
Suswasthya Kendra	1 (with telemedicine facility)
Cyclone shelters	2
Public library	1
ICDS centers	10
Free primary schools	4
Sishu Siksha Kendra (SSK)	1
Secondary school	1
Post office	1 (Mudpoint)

Source: Ghoramara Gram Panchayat, Gram Panchayat at a Glance (Ghoramara Gram Panchayat, Ghoramara Island, South 24 Parganas, n.d.)

Motivations behind choosing Ghoramara as the study area:

The island is severely affected by climate change and resultant estuarine and coastal erosion caused by the Hooghly, Muriganga and Bartala rivers by which it is bound. Together with tropical cyclones, land mass shrinkage due to soil erosion and subsidence has led to the loss of 2 of the 3 moujas on the island – Lohachhara and Khasimara (Fig:3). With an increase in global temperatures, the sea/estuarine water levels around Ghoramara Island have risen by more than 3 millimetres per year in recent decades. This has led to the island's coast eroding away at an alarming rate, causing the loss of agricultural and residential land as well as coastal mangroves. Between 1960 and 2012, the island was estimated to have lost land at an average rate of 5 meters per year, and some areas have lost up to 150 meters of land [Source: Ghoramara Gram Panchayat, Gram Panchayat at a Glance (Ghoramara Gram Panchayat, Ghoramara Island, South 24 Parganas, n.d.)].

Figure 3: Google Maps satellite image of Ghoramara island, showing submerged Lohachara and Khasimara islands to the North West and South West respectively. To its south is the northern part of Sagar Island.

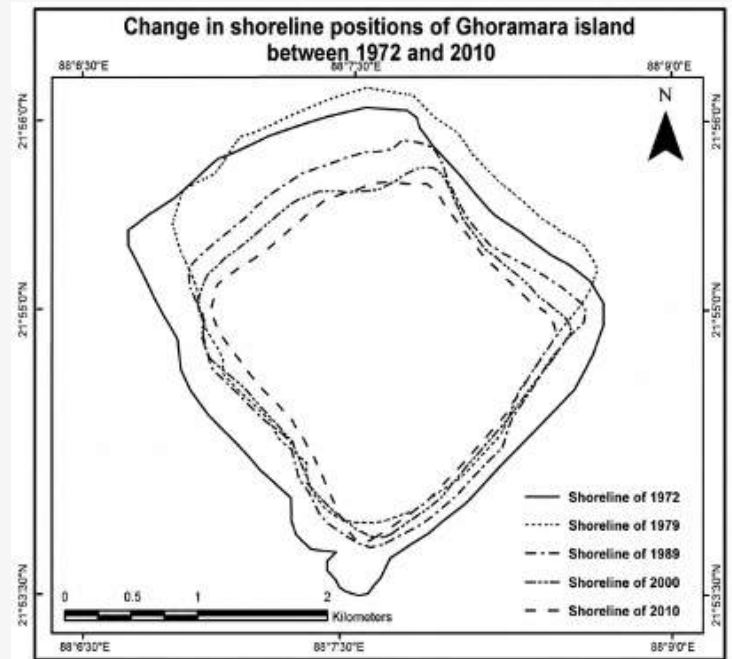


Figure 4: Shoreline Positions of Ghoramara Island between 1972 and 2010. T (Source: Jana et al., 2012)



In fact, a 2022 study on the impact on climate change on land degradation on the island using remote sensing (RS) and geographic information system (GIS) techniques found that the total insular area reduced from 608 hectares (in 1990) to 375 hectares (in 2020) due to extreme weather conditions and around 39% of the land area was found to have degraded due to shoreline changes. Additionally, the Land Use/Land Cover (LULC) classes of built-up area, agricultural land, water bodies, and vegetation were found to have lost around 62.345 hectares, 63.328 hectares, 0.836 hectares, and 113.241 hectares, respectively, from the year 1990 to 2020. It was observed that the shoreline shifted towards the north-east, north-west, and southern directions in the last thirty years. This LULC classification was carried out using thirty years of Landsat datasets with intervals of ten years (1990 and 2000) and intervals of five years (2005, 2010, 2015, and 2020). . Prior to this, Jana et al, 2012 recorded the change in LULC distribution of Ghoramara Island between 1972 and 2010, which is tabulated as follows:(Table 2)

Class Name	1972	1979	1989	2000	2010
Land Vegetation	157.68	99.35	102.96	108.5	116.37
Wetland	151.56	145.86	155.52	98.75	87.21
Uncultivated Land	272.52	170.05	201.33	208.76	129.33
Fisheries	4.68	3.72	1.89	1.22	1.71

Table 2:The change in LULC distribution of Ghoramara Island b/w 1972 and 2010

Thus, the wetlands on the island show a sharp decline post-1989, indicating ecological stress and salinity intrusion, while uncultivated land fluctuates but overall declines significantly by 2010, suggesting land loss or conversion. The fisheries area remains consistently minimal, reflecting limited aquaculture expansion. Interestingly, vegetation shows partial recovery after decline, possibly due to adaptive land use or natural regeneration. Extrapolating this data with the data from Halder et al (2023) clearly shows that the over-the-years decline in wetlands and water bodies is particularly significant, as salinity intrusion following extreme events such as Cyclone Amphan and Cyclone Yaas has rendered many ponds and low-lying areas unsuitable for both agriculture and fisheries. The following is a list of recent tropical cyclones that have impacted the erosion at coastal Ghoramara: (Table 3)

Cyclone	Date	Location of Landfall	Wind Speed (km/h)	High Tide Level at Sagar (m)	Nature of Cyclone
Aila	25 May 2009	Near Sagar Island	110–120 (gusting to 130)	4.2	Severe Cyclone
Bulbul	9 Nov 2019	Dhanchi Island	110–120 (gusting to 135)	4.77	Severe Cyclone
Amphan	20 May 2020	Lothian Island	155–165 (gusting to 185)	4.67	Very Severe Cyclone
Yaas	26 May 2021	Dhamra (Balasore)	130–140 (gusting to 155)	7.5	Very Severe Cyclone

Table 3: A list of tropical cyclones, impacting the erosion at coastal Ghoramara (Source: Report of the expert committee- July, 2021, Environment Department, Govt. of West Bengal)

Furthermore, the limited extent of fisheries-related land use by 2020 reflects both environmental constraints and the reduced viability of aquaculture under high salinity conditions. From an analytical standpoint, the 2023 data underscores a transition from a mixed subsistence landscape to a shrinking, risk-prone ecological system, where land loss rather than land-use conversion is the dominant process. This has direct implications for livelihood security, migration patterns, and long-term habitability of the island.

The residents of Ghoramara Island have experienced continuous loss of land, housing, and livelihoods due to coastal erosion, tropical cyclones and tidal inundation. As the island's area declines and flood risk increases, many households have been forced to relocate either internally or to nearby Sagar island or Kakdwip. This displacement has direct socio-economic consequences, including loss of agricultural land and income sources, disruption of community networks, and reduced access to basic services such as healthcare and education. This makes it a perfect area to study the livelihood vulnerability of the residents of the island caused due to climate change and land loss.

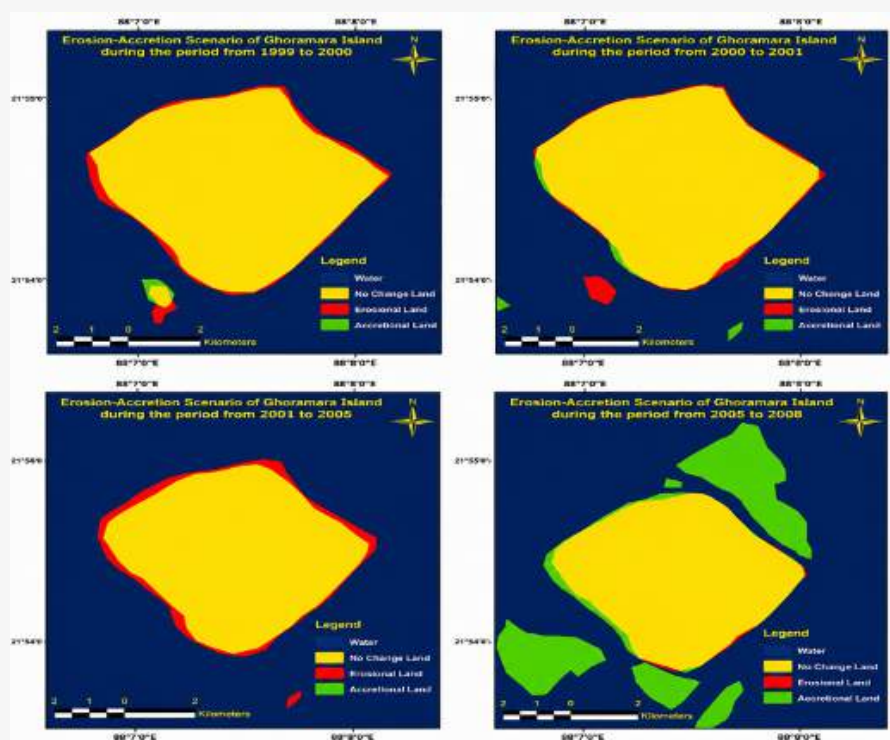


Figure 5: Erosion-Accretion scenario of Ghoramara Island during the different time-periods as extrapolated from satellite data. (Source: Guha et al., 2015)

4.2: Data and Sampling Techniques

The present study was undertaken to examine the livelihood choices, adaptive strategies, and socio-economic challenges experienced by rural households in Ghoramara Gram Panchayat. The study area comprised the hamlets of Raypara, Bagpara, Mandirtala, Hatkhola, Khasimara, and Chunpuri, representing the major inhabited settlements within the island region.

For the purpose of sampling, a comprehensive house listing was first prepared to establish the stratified sampling frame. The stratum was selected based on current landholding status, a representation of livelihood vulnerability. From this house listing, a sample of **126 households** was selected through a **stratified random sampling** technique to ensure representativeness and reduce the possibility of selection bias. The adoption of probability-based stratified sampling facilitated the inclusion of households from diverse socio-economic backgrounds, thereby enhancing the reliability and generalisability of the findings. Both quantitative and qualitative data were collected from the sampled households to develop a comprehensive understanding of livelihood patterns, vulnerabilities, and coping mechanisms within the study area.

4.3: Method used: Quantitative and Qualitative

The methodology of this study is a mixed-method process and incorporates three stages: **pre-field study, field study, and post-field study**. The pre-field study included a literature survey, a research presentation and collecting available materials on Ghoramara Island and its demography. The field study involved direct observation and interaction with the residents belonging to a randomly selected 126 households, along with a structured questionnaire survey. For the post-field study, the study includes the compilation and correlation of field observations and measurements, followed by the interpretation of the collected data was systematically arranged using **KoBoToolbox** to facilitate accurate and efficient digital data collection.

The quantitative data obtained from the household surveys were processed and statistically analyzed using Stata in order to identify significant socio-economic patterns and their correlation within the study area. To supplement the quantitative findings, qualitative data obtained through individual researchers' field notes were collated and contextualised. Furthermore, two separate Focus Group Discussions (FGDs), one with male participants and the other with female participants, were conducted to examine gender-specific perceptions, livelihood strategies, environmental vulnerabilities, and community-level challenges. The integration of quantitative and qualitative approaches enabled a comprehensive understanding of the livelihood dynamics and adaptive responses within the community.



Photo: Dr. Bidhan from IDSK interacting with women respondents during door to door survey

CHAPTER 5-FINDINGS

5.1: BACKGROUND CHARACTERISTICS OF SAMPLE HOUSEHOLD

The sample size of the study is **126 households** and **499 household members**. The mean number of household members are 3.96.

Table 4 shows that most households are small to medium-sized; four-member households are the most common (30.95%), followed by three-member households (21.43%) and five-member households (18.25%). Very large households are rare. The average household size is 3.96 members, with a range from 1 to 11.

Residing years in Ghoramara: The household members have been residing in Ghoramara Island for an average of 57.24 years, with durations of residence ranging from 10 to 100 years. This suggests deep local rootedness despite the island's environmental and livelihood pressures.



Number of Household Members	Frequency of the Number of Households	Percentage
1	2	1.59
2	20	15.87
3	27	21.43
4	39	30.95
5	23	18.25
above 5	15	11.9
Total	126	100

Table 4: Distribution of Household Size

RELIGION	Frequency	Percentage
Hindu	371	74.35
Muslim	128	25.65
Total	499	100

Table 5: Religion of Household Members

CASTE	Frequency	Percentage
General	392	78.56
SC/OBC	107	21.44
Total	499	100

Table 6: Caste Distribution of Household Members

MOTHER TONGUE	Frequency	Percentage
Bengali	498	99.8
Hindi	1	0.2
Total	499	100

Table 7: Mother Tongue of Household Members

SEX	Frequency	Percentage
Male	247	49.5
Female	252	50.5
Total	499	100

Table 8: Sex Distribution of Household Members

DISTRIBUTION OF AGE (In Years)	Frequency	Percentage
Young Children (<6)	33	6.61
Middle Childhood (6-12)	53	10.62
Teenagers (13-19)	59	11.82
Young adults (20-39)	186	37.27
Middle-aged (40-59)	113	22.65
Senior Citizens (60 and above)	55	11.02
Total	499	100

Table 9: Distribution of Age of Household Members

The mean age is 32.47 years. Table 9 shows that the sample is concentrated in the economically active ages, especially young adults aged 20-39 years (37.27%) and middle-aged members aged 40-59 years (22.65%). Children, teenagers and senior citizens together form a substantial dependent population, which increases care and expenditure responsibilities.

MARITAL STATUS	Frequency	Percentage
Married	185	37.07
Unmarried	283	56.71
Divorced/ Separated	31	6.21
Total	499	100

Table 10: Marital Status of Household Members

EDUCATIONAL STATUS	Frequency	Percentage
No Education	80	16.03
Primary	162	32.46
Upper Primary	115	23.05
Secondary	97	19.44
Higher Secondary and Above	45	9.02
Total	499	100

Table 11: Educational Status of Household Members

Table 11 shows that educational attainment is concentrated at the primary (32.46%) and upper-primary (23.05%) levels. Only 9.02% have reached higher secondary or above, suggesting a sharp decline at higher levels of schooling.

Focus Group Discussion similarly reports that many women studied only up to Class IV-VIII because early marriage and household responsibilities interrupted education.

Presence of local primary school highlights the availability of educational infrastructure within the village. However, despite institutional access, findings indicate that educational continuation beyond primary and upper-primary levels remains limited.

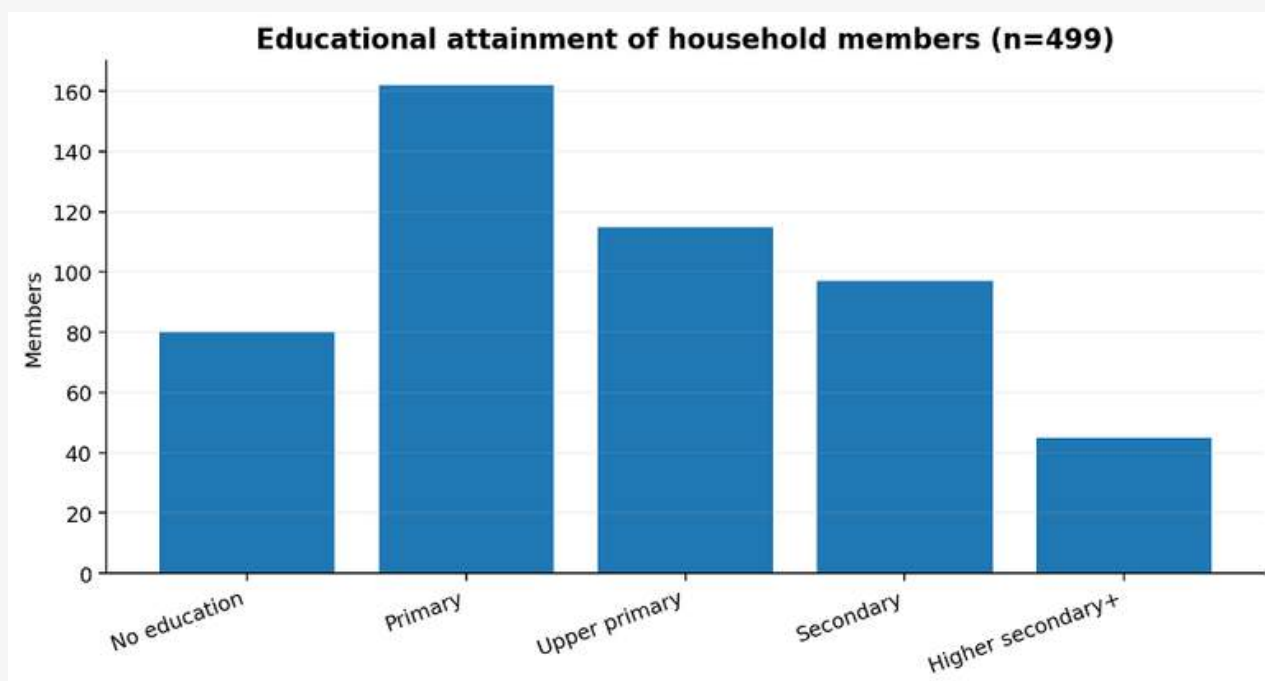


Figure: Educational attainment of household members (n=499).

Educational attainment is concentrated at primary and upper-primary levels. This matters for programme design because training, record keeping, financial literacy and institutional governance need to use accessible formats rather than assume high formal literacy.

Programme implication: Use this baseline signal to prioritise outcomes and targeting; do not treat activity counts alone as evidence of resilience or income improvement.

Source / note: Baseline household survey, n=499; Table 17 and related cross-tabulations.



Photo: Primary School at Raypara Village, Ghoramara Island

ACTIVITY STATUS	Frequency	Percentage
Currently Working	168	33.67
Not working currently but seeking and/or available for work	33	6.61
Neither working, nor seeking work	185	37.07
Attending educational institution	113	22.65
Total	499	100

Table 12: Activity Status of Household Members

Table 12 shows that only one-third of members are currently working (33.67%), while 37.07% are neither working nor seeking work and 22.65% are students. This points to a high dependency burden and limited labour-market participation, particularly relevant to women's work as described in the FGD. The programme's livelihood pathways therefore need to be targeted carefully rather than treating all residents as immediately employable.

Activity status of household members (n=499)

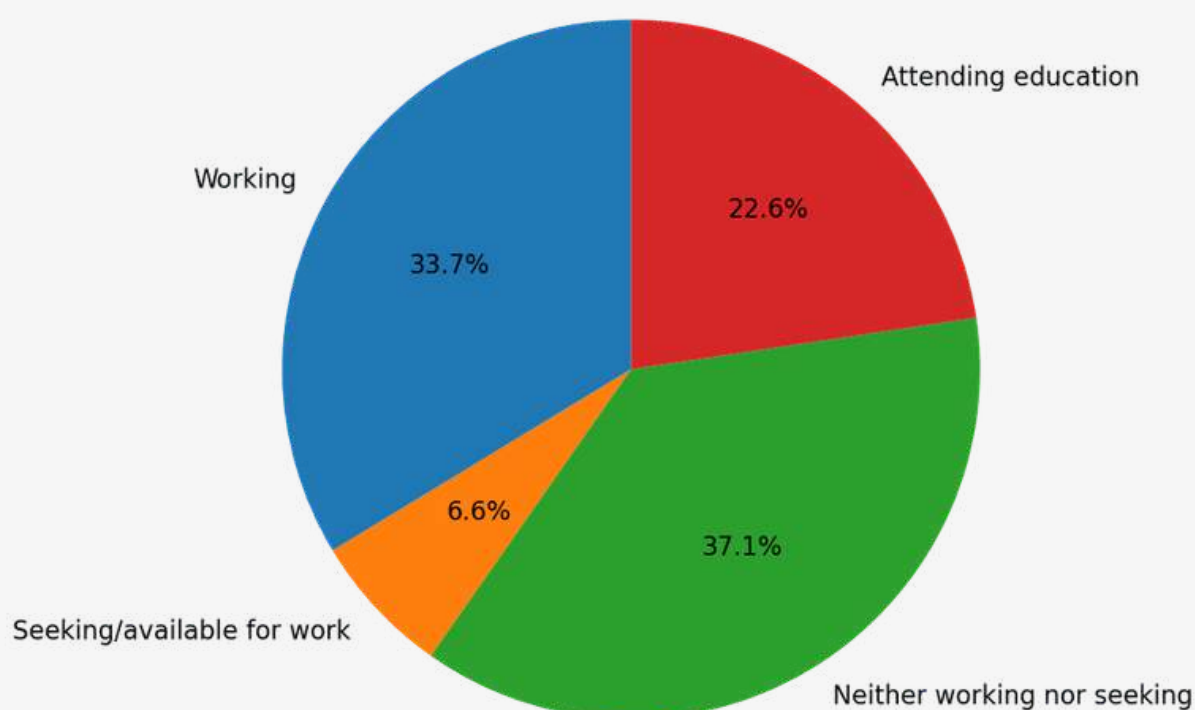


Figure: Activity status of household members (n=499).

BANK ACCOUNT STATUS	Frequency	Percentage
No	112	22.44
Yes	387	77.56
Total	499	100

Table 13: Bank Account Status of Household Members

5.1.1: SEX-WISE DISTRIBUTION

SEX	AGE GROUP					
	Young Children (<6)	Middle Childhood (6-12)	Teenagers (13-19)	Young adults (20-39)	Middle-aged (40-59)	Senior Citizens (60+)
Male	11	24	30	95	55	32
Female	22	29	29	91	58	23
TOTAL	33	53	59	186	113	55

Table 14: Sex and Age Group of Household Members

Table 14 shows that young adults (20–39 years) form the largest age category for both males (95) and females (91). Female representation is higher among young children and middle-aged groups, while males dominate among senior citizens.

SEX	No Education	Primary	Upper Primary	Secondary	Higher Secondary and Above	TOTAL
Male	25	82	61	53	26	247
	10.12%	33.20%	24.70%	21.46%	10.53%	100%
Female	55	80	54	44	19	254
	21.65%	31.50%	21.26%	17.32%	7.48%	100%
TOTAL	80	162	115	97	45	501
	15.97%	32.34%	22.95%	19.36%	8.98%	100%

Table 15: Sex and Educational Status of Household Members

Table 15 shows that female household members show higher rates of no education (22%) compared to males (10%). Males also show slightly better attainment at secondary and higher secondary levels.

The Focus Group Discussion (FGD) revealed that most women discontinued education between Class IV and VIII because of early marriage, domestic labour, and financial constraints. Mothers expressed a strong desire for their children, especially daughters, to continue higher education so that they do not face similar limitations.

SEX	Currently Working	Not working currently but seeking	Neither working, nor seeking work	Attending Educational Institution	TOTAL
Male	159	6	33	49	247
	64.37%	2.43%	13.36%	19.84%	100%
Female	9	27	152	64	252
	3.57%	10.71%	60.32%	25.40%	100%
TOTAL	168	33	185	113	499
	33.67%	6.61%	37.07%	22.65%	100%

Table 16: Sex and Activity Status of Household Members

As per Table 16, Labour participation is heavily gendered. A total of 159 males are currently working compared to only 9 females. In contrast, 152 females are outside the labour force. This reflects the persistence of unpaid domestic responsibilities among women.

FGD participants reported that women's paid employment opportunities are extremely limited in Ghoramara. Many women earlier depended on MGNREGA work such as road construction and plantation. The decline of these opportunities has increased women's dependence on male migrant income.

SEX	BANK ACCOUNT STATUS OF HOUSEHOLD MEMBERS	
	No	Yes
Male	54	193
Female	58	194
TOTAL	112	387

Table 17: Sex and Bank Account Status of Household Members

Table 17 shows that bank account ownership is almost equal between males (193) and females (194). However, numerical equality does not necessarily translate into financial autonomy for women.

FGD participants stated that although most women possess bank accounts and receive government benefits such as Lakshmir Bhandar and Kanyashree, financial autonomy remains limited because most of the money is spent on household expenses and children's education.

5.1.2: EARNING/EXPENDITURE, AND SAVINGS/DEBT

Number of Earning Members of the Households	Frequency of Households	Percentage
0	2	1.59
1	84	66.67
2	32	25.4
3	7	5.56
4	1	0.79
Total	126	100

Table 18: Number of Earning Members in Household

Two-thirds of households have only one earning member (66.67%), while 1.59% have no earner, as per Table 18. This reflects substantial dependence on a single income source and raises vulnerability to livelihood shocks. The mean number of earners per household is 1.37, confirming that most households rely on one principal earner. The concentration of households around one earning member creates a direct exposure to illness, migration, disaster or job loss. Livelihood diversification therefore needs to be judged by whether it adds a reliable second income stream, not merely whether households participate in a second activity.

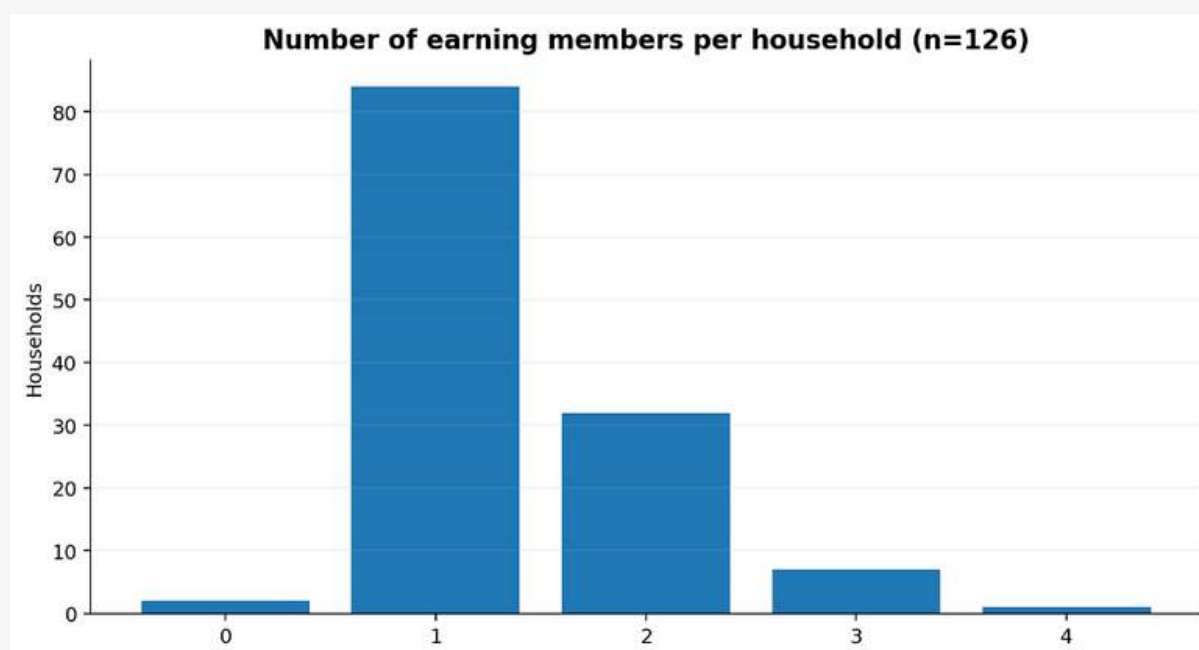


Figure: Number of earning members per household (n=126).

PER CAPITA MONTHLY INCOME (Approx.)	Number of Households	Percentage
Up to 1000	16	12.7
1001-5000	99	78.57
5001-10000	9	7.15
10001-20000	1	0.79
20000 and Above	1	0.79
Total	126	99.99

Table 19: Per Capita Monthly Income of Households.

As per Table 19, per capita monthly income is concentrated in the ₹ 1,001-5,000 range (78.57%), while only 1.58% of households exceed ₹ 10,000. The income profile indicates a generally low-income settlement with very few high-income households. The mean per capita monthly income (approx.) is ₹ 2957.52. This low-income structure limits the ability of households to self-finance productive assets after a climate shock and strengthens the case for livelihood interventions that generate repeatable household-level returns.

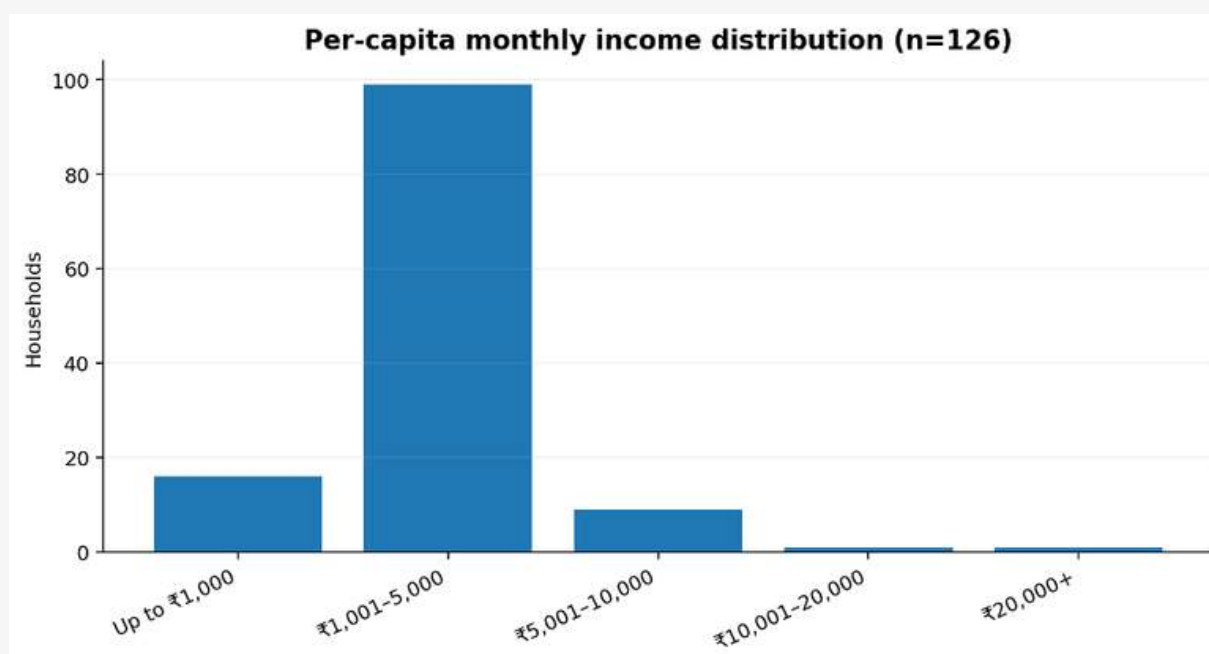


Figure: Per-capita monthly income distribution (n=126).

PER CAPITA MONTHLY EXPENDITURE(Approx.)	Number of Households	Percentage
Up to 1000	20	15.87
1001-5000	102	80.95
5001-10000	2	1.59
10001-20000	1	0.79
20000 and Above	1	0.79
Total	126	99.99

Table 20: Per Capita Monthly Expenditure of Households.

As per Table 20, per capita monthly expenditure is also concentrated in the ₹ 1,001-5,000 range (80.95%). The similarity between income and expenditure distributions suggests limited surplus capacity for savings. The mean per capita monthly expenditure is ₹ 2451.51.

PER CAPITA MONTHLY SAVINGS/DEBT (Approx.)		Number of Households	Percentage
Savings	1-1000	59	46.83
	1001- 2000	16	12.7
	2001 and Above	5	3.97
Debt	0 - 499	37	29.37
	500 -1000	9	7.14
	Total	126	100

Table 21:Per Capita Monthly Savings and Debt of Households

As per Table 21, about 63.50% of households report some savings, mostly within ₹ 1-1,000, while 36.51% are in zero/debt categories. This shows that even when savings exist, they are generally small and vulnerable to emergencies.

5.2: Occupational Structure

MAIN SOURCE OF INCOME OF HOUSEHOLDS	Number of Households	Percentage
Agriculture	47	37.3
Fisheries	14	11.11
Service	24	19.05
Others	41	32.54
Total	126	100

Table 22: Main Source of Income of Households

Table 22 shows that Agriculture is the leading income source (37.30%), followed by other sources (32.54%), service (19.05%) and fisheries (11.11%). Other sources include livestock, business, Mason/Carpenter/Potter/ Construction labourer, any other non-agricultural and non-pisciculture labourers, carton collector, almirah manufacturer, moulabi, tea seller, rickshaw puller, medical practitioner, mosque priest, vegetable seller, soil digger, restaurant worker, mill worker, beggar, etc. Livelihoods remain strongly linked to land and manual work, despite environmental stress.

The FGD highlights dependence on agriculture, casual labour and government work, while emerging skill-training and handloom work are viewed as possible alternative livelihoods.

MAIN SOURCE OF INCOME	WEALTH TERCILES					
	POOR		MIDDLE		RICH	
	No. of Households	%	No. of Households	%	No. of Households	%
Agriculture	3	6.38	39	82.98	5	10.64
Fisheries	1	7.14	13	92.86	0	0.00
Service	7	29.17	16	66.67	1	4.17
Others	8	19.51	30	73.17	3	7.32

Table 23: Main Source of Income and Wealth Terciles

Table 23 cross-tabulates wealth terciles with the main source of income of the households. The middle wealth group dominates most main source of income categories, while the poor and rich groups vary by source or social group, indicating differentiated but generally middle-clustered asset status.

NUMBER OF OCCUPATIONS OF HOUSEHOLD	Number of Households	Percentage
1	83	65.87
2	37	29.37
3	5	3.97
4	1	0.79
TOTAL	126	100

Table 24: Number of Occupations of Households

Most households depend on one occupation (65.87%), while 29.37% have two, as per Table 24. Households with limited occupational diversification face increased risk when agriculture, fisheries or casual labour are disrupted.

PRIMARY OCCUPATION	No. of Households	%	SECONDARY OCCUPATION	No. of Households	%
Agricultural cultivator	29	16.29	Agricultural cultivator	12	29.27
Fisheries cultivator	16	8.99	Fisheries cultivator	2	4.88
Mason/Carpenter/Potter/Construction labourer	43	24.16	Mason/Carpenter/Potter/Construction labourer	9	21.95
Agricultural Labourer	37	20.79	Agricultural Labourer	12	29.27
Others	53	29.78	Others	16	14.63
TOTAL	178	100	TOTAL	41	100

Table 25: Primary and Secondary Occupations of Households

As per Table 25, Primary work is spread across construction/manual work, agricultural labour, cultivation, fisheries and other jobs. Primary occupations are pursued for an average of 8.87 months a year, indicating seasonality rather than full-year stability. Secondary work is concentrated in agricultural cultivation and agricultural labour, indicating that backup employment remains tied to land-based and casual work. Secondary occupations last an average of 4.24 months, showing that supplementary work is mostly short-term or seasonal. This supports the need for alternative livelihoods and skill-based income opportunities.

ANY OTHER PRIMARY OCCUPATION	Number of Households	Percentage
Pisciculture Labourer	4	7.55
Other Labourer	13	24.53
Government scheme support	5	9.43
ICDS Worker	2	3.77
Tailor	2	3.77
Others	27	50.95
TOTAL	53	100

Table 26: Other Primary Occupations of Households

Among other primary occupations, more than half are grouped as 'Others' and 24.53% as other labourer, as per Table 26. This indicates a heterogeneous informal-work segment beyond the main occupational categories. Here, 'Others' include beggar, carton collector, almirah manufacturer, moulvi, tea seller, rickshaw puller, quacks, mosque priest, vegetable seller, soil digger, restaurant worker, mill worker, etc. Other secondary occupation responses are split between any work available and daily labourer.

PRIMARY INCOME CATEGORY	No. of Households	%	SECONDARY INCOME CATEGORY	No. of Households	%
0-5000	51	28.65	0-5000	27	65.85
5000-10000	67	37.64	5000-10000	11	26.83
10000-20000	53	29.78	10000-20000	2	4.88
20000 and Above	7	3.93	20000 and Above	1	2.44
TOTAL	178	100	TOTAL	41	100

Table 27: Primary and Secondary Income Categories of Households

Table 27 shows that primary income is concentrated between ₹ 5,000-10,000 (37.64%) and ₹ 10,000-20,000 (29.78%). Secondary income is much lower, with 65.85% in the ₹ 0-5,000 category, confirming its supplementary character.

	INCOME CATEGORY (in Rs)			
PRIMARY OCCUPATION	0-5000	5000-10000	10000-20000	20000 and above
Agricultural Cultivator	12	11	6	0
Fisheries cultivator	3	5	6	2
Mason/Carpenter/ Potter/Goldsmith/ Blacksmith/ Construction Labourer	0	15	25	3
Agricultural Labourer	14	17	6	0
Others	22	19	10	2
TOTAL	51	67	53	7

Table 28: Income Category by Primary Occupation

Table 28 shows that construction-related work has the strongest concentration in the ₹ 10,000-20,000 primary income category, while agricultural labour and cultivation are more concentrated in lower and middle-income bands. This suggests occupational stratification in income returns.

	INCOME CATEGORY (in Rs)			
SECONDARY OCCUPATION	0-5000	5000-10000	10000-20000	20000 and above
Agricultural Cultivator	10	1	0	1
Fisheries cultivator	1	1	0	0
Mason/Carpenter/ Potter/Goldsmith/ Blacksmith/ Construction Labourer	3	4	2	0
Agricultural Labourer	9	3	0	0
Others	4	2	0	0
TOTAL	27	11	2	1

Table 29: Income Category by Secondary Occupation

Table 29 shows that secondary occupations are mostly located in the lowest income band, especially agricultural cultivation and agricultural labour. Secondary work, therefore, provides modest support rather than a stable pathway to higher income.

5.2.1: Occupational Structure by Sex

SEX	TYPE OF PRIMARY OCCUPATION					TYPE OF SECONDARY OCCUPATION				
	AC	FC	M/C/P/ CL	AL	Others	AC	FC	M/C/P/ CL	AL	Others
Male	27	16	42	34	45	12	2	9	12	6
Female	2	0	1	3	8	0	0	0	0	0
TOTAL	29	16	43	37	53	12	2	9	12	6
AC: Agricultural Cultivator; FC: Fisheries Cultivator; M/C/P/CL: Mason/Carpenter/Potter/ Construction labourer; AL: Agricultural Labourer										

Table 30: Sex and Occupation Pattern of Household Members

As per Table 30, male workers dominate all forms of occupation, especially Mason/Carpenter/Potter/ Construction labourer (42 males). Female participation in income-generating occupations is extremely limited, reflecting the gendered division of labour in the local economy.

SEX	PRIMARY INCOME CATEGORY				SECONDARY INCOME CATEGORY			
	0-5000	5000-10000	10000-20000	20000 and above	0-5000	5000-10000	10000-20000	20000 and above
Male	41	65	51	7	27	11	2	1
Female	10	2	2	0	0	0	0	0
TOTAL	51	67	53	7	27	11	2	1

Table 31: Sex and Income Category of Household Members

Table 31 shows that most male earners fall within the ₹5,000–10,000 and ₹10,000–20,000 categories, while female income generation remains minimal. Only 10 females reported incomes within ₹0–5,000, reflecting limited economic participation by women.



Photo: A group of women from Ghoramara going to a nearby island for a casual labour work

5.3: Farm-based Livelihood Vulnerability

- Out of the 126 sampled households, 47 households were primarily engaged in agriculture, making it the highest share holder of primary income source (37.3%).
- In total, 61 households were engaged in agriculture-related activities either as primary or secondary occupation, 44 households had at least one member engaged as cultivators (either primary or secondary occupation) and 41 households had at least one member engaged in agricultural labour works (either primary or secondary occupation). While the cultivators had a duration ranging from 2 - 76 years of being involved in this activity, the agricultural labourers found work ranging from 2-30 days per month at the island.
- Out of the sampled households, 60 households had possession of some agricultural land.

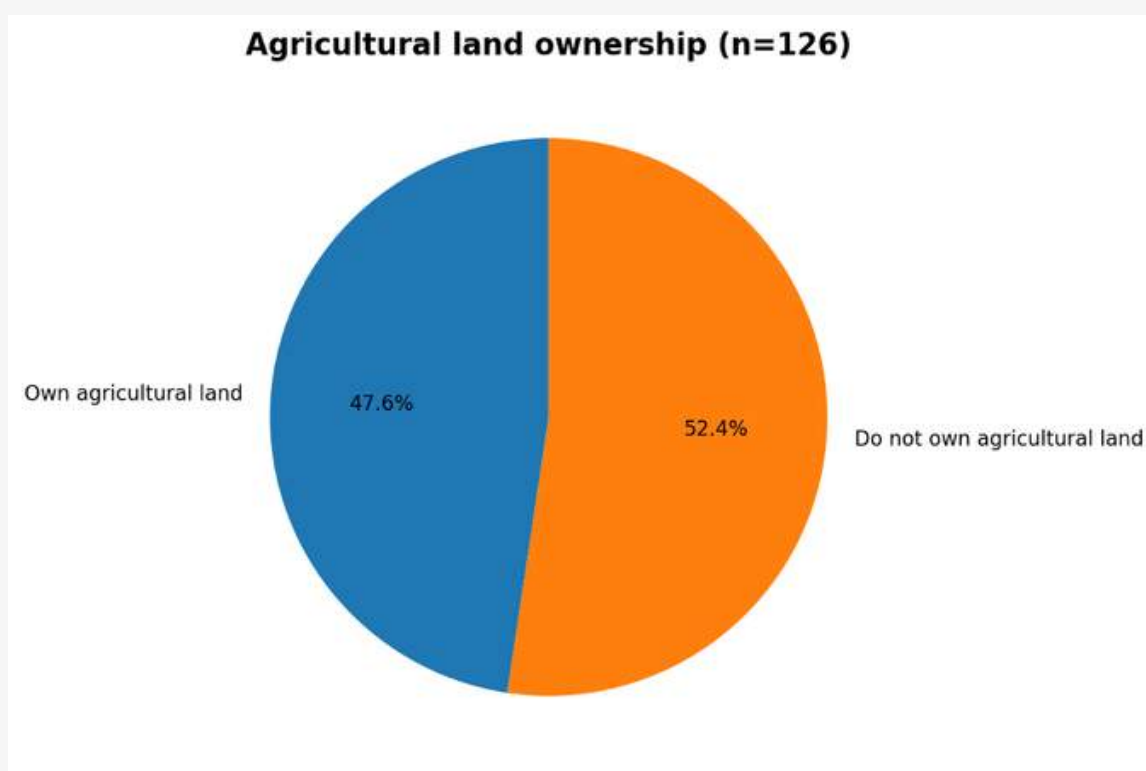
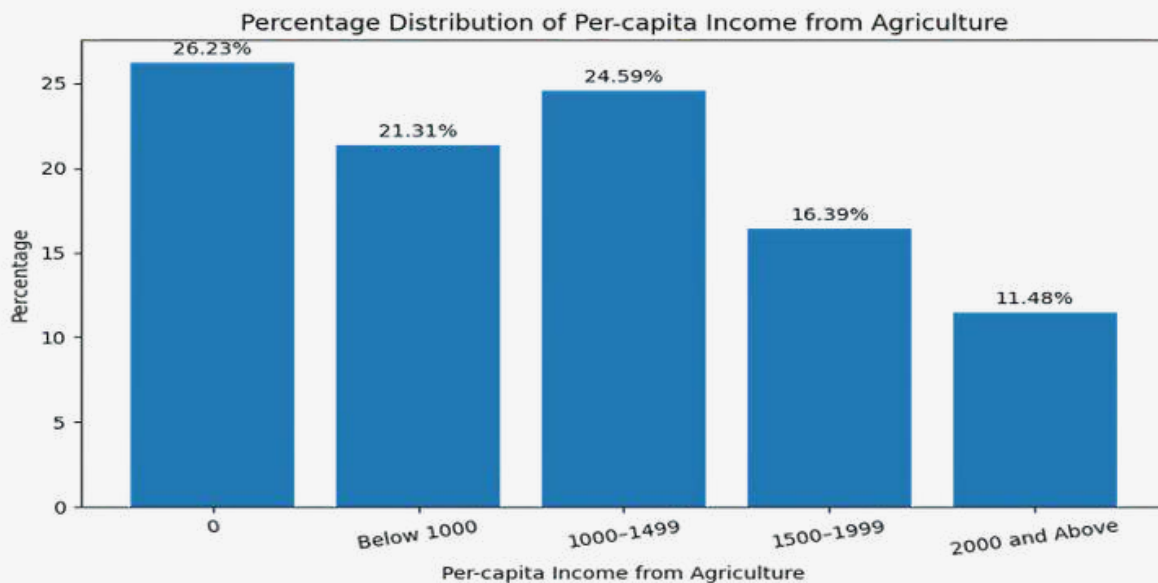


Figure: Agricultural land ownership (n=126).

- The mean agricultural land holding size emerged to be 22.5 kathas. However, this does not convey the full picture as it also takes into extreme outliers like 110 kathas and 0 Kathas (land less than 1 Katha) as reported by respondents.
- The mean monthly income for agriculture was found out to be ₹ 4331.96 while the median monthly income was ₹ 3000. For getting a clearer picture, the per-capita income was calculated. Refer Table 28, which shows that approx. 80% of the population have a per capita agricultural income of ₹ 1600 per month (highlighting how large population sizes have an impact). The mean per capita income was calculated to be ₹2957.5 per month while the mean per capita income specifically for agriculture was calculated to be Rs1092.4 per month.

Per-capita income from agriculture	Frequency	Percent	Cumulative Frequency
0	16	26.23	26.23
68.18182	1	1.64	27.87
200	1	1.64	29.51
285.7143	1	1.64	31.15
333.3333	2	3.28	34.43
600	4	6.56	40.98
750	4	6.56	47.54
1000	4	6.56	54.1
1200	2	3.28	57.38
1250	4	6.56	63.93
1333.333	3	4.92	68.85
1500	4	6.56	75.41
1600	2	3.28	78.69
1666.667	3	4.92	83.61
1750	1	1.64	85.25
2000	4	6.56	91.8
3333.333	2	3.28	95.08
4000	1	1.64	96.72
5000	2	3.28	100
Total	61	100	

Table 32: Calculation of Agricultural Per-capita income



- The daily wage rate of the agricultural labour ranged from ₹ 300-550. The mean daily wage was ₹ 380 while the median daily wage rate was calculated to be ₹ 400. Based on the Focused Group Discussion, it was brought to light that there existed a pay disparity among men and women for the same task or number of hours they spend on the field, and men clearly enjoyed a positive bias.
- To determine factors affecting the agricultural income, the agricultural land(X-variable) size was regressed with monthly agricultural income(Y- variable) Refer Figure below:

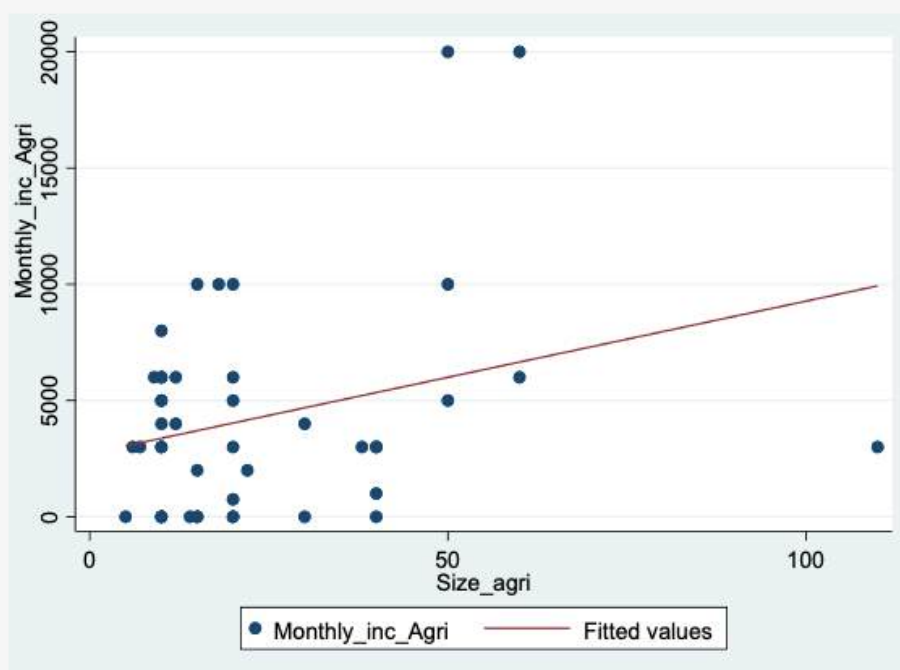


Figure: Positive relation between the size of Agricultural land and monthly agricultural income

- It was found that (R-squared = 0.0829) only 8.3 % of income was explained through agricultural land size. i.e., other factors like soil salinity, crop grown and its quality, crop season, market, calamity, etc., play a bigger role in the determination of the monthly agricultural income.
- Cultivators of Ghoramara basically grew Paddy, Betel leaves and vegetables. Refer below Figure:

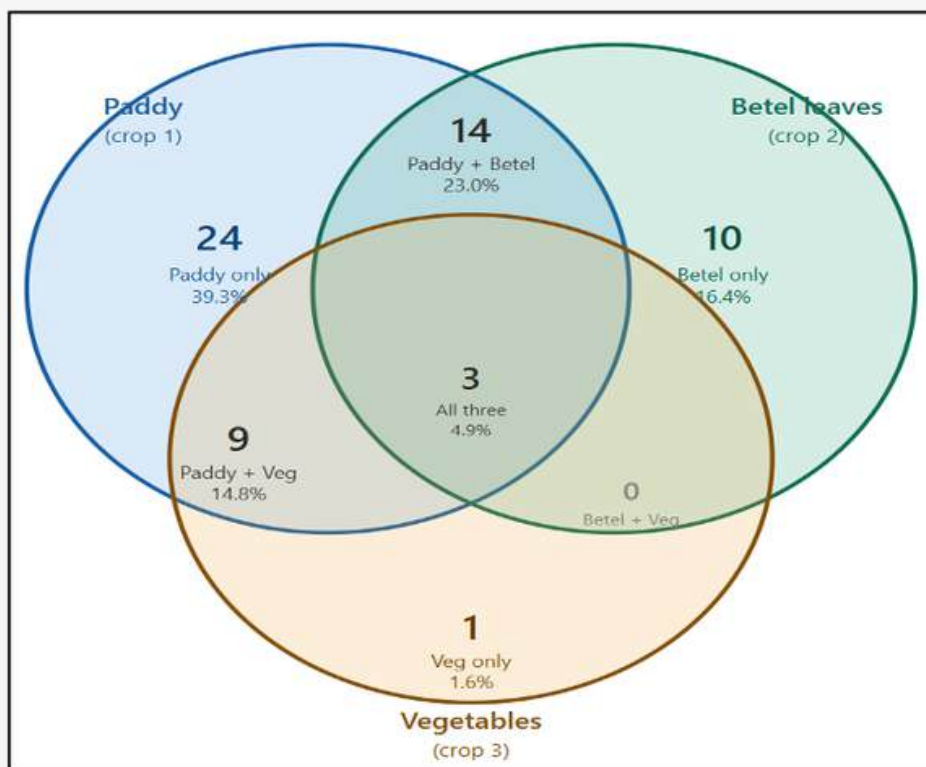


Figure: Share of Crops grown by Households

- Approx. 45% of the sampled cultivators shared a feeling that their economic status had deteriorated in the last 5 years(Figure below)
- Approx. 56% of the sampled agricultural labourers too shared the same sentiment that their economic status had deteriorated.

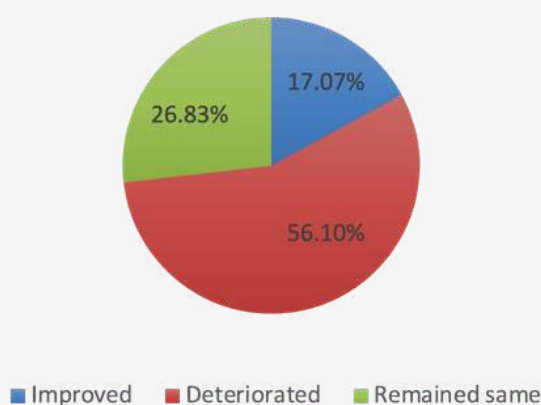


Figure: Responses of Agricultural labourers regarding economic status in last 5 years

- This can be attributed to multiple factors like the 2 high profile calamity which struck the island-Amphan and Yaas, the resulting soil salinity, bad quality produce, lesser yield, short betel leaves season (high income source but requires higher investment), decreased market price and low demand as almost everyone does subsistence farming in the island.
- What is interesting is that not a single agricultural household was a member of the Farmer-Producer Organisation (FPO). Also, to cope up with challenges, not a single agricultural household availed Government scheme. 22 households responded that they cope up through self (savings or other ways), 13 households took help of money lenders, 29 of them turned to SHG's while 14 households reported to have taken help from relatives and friend. 1 household resorted to taking up loan from the bank for coping up.



Photo: A subsistence farm in Raypara village



Photo: A paddy field in Mandirtala village



Photo: A women drying the paddy produce



Photo: A betel leaves farm in Ghoramara

5.4: Fishing-based Livelihood Vulnerability

Ghoramara Island, nestled within the ecologically intricate Indian Sundarban delta in West Bengal, represents one of the most climatically imperiled inhabited landscapes on the planet. Its residents have historically constructed their livelihoods around the natural rhythms of the delta — its rivers, tidal flats, fertile soils, and abundant aquatic resources. Yet decades of accelerating sea-level rise, compounding cyclonic events, relentless river-bank erosion, and the pervasive intrusion of salinity into freshwater systems have system-atically dismantled the traditional economic architecture of the island. Agriculture, which once served as the unchallenged anchor of household economies, has been progressively compromised, compelling communities to seek supplementary or substitute livelihood strategies.

Within this evolving landscape, fisheries have assumed a role of increasing significance, not merely as an economic activity but as a coping mechanism, a cultural inheritance, and, for a meaningful minority of households, the primary source of sustenance.

Understanding the precise contours of fisheries-based livelihoods in Ghoramara — their economic contribution, their asset requirements, their institutional entanglements, and their vulnerability to environmental and market shocks — constitutes an urgent scholarly and policy imperative. This dissertation addresses that imperative through a rigorous, data-driven examination of structured household survey data collected from across the island. The analysis draws on descriptive statistics, inter-sectoral income comparisons, asset ownership matrices, coping mechanism evaluations, and institutional landscape mapping to construct a holistic and internally coherent picture of fisheries as a livelihood system.

Rather than treating fisheries as an isolated occupational category, this work situates them within the broader matrix of livelihood diversification, examining how it interacts with agriculture, migration, social protection systems, and climate adaptation strategies to produce or undermine household resilience.

Households with Fisheries as Principal Income.	Mean Duration of Fisheries Engagement.	Mean Monthly Fisheries Income.	Households Exposed to Cyclones.
11%	26 years	₹15,150	100%

Table 33:Overview related to Fisheries

5.5: Migration and the Growth of the Non-Farm Sector: Exploring the Relationship

In Ghoramara, the transition from subsistence livelihoods rooted in a particular place to migrant labour marks a significant structural shift in the island's economy, reshaping household strategies, gender roles, and community ties. Migration from Ghoramara emerges not merely as an economic choice but as an adaptive response to environmental precarity, operating along a continuum between distress-driven compulsion and aspirational pursuit of better income and opportunity.

Understanding the socio-demographic contours of this migration – across caste, religion, and migration type – is therefore essential to any comprehensive analysis of livelihood transformation and vulnerability on the island.

Of the 126 households surveyed, 66 (52.38%) reported at least one member having migrated, while the remaining 60 households (47.62%) had no migration history, indicating that migration is a majority phenomenon among Ghoramara's households. The following sections analyses this phenomenon systematically, from who migrates, to how and where they move, to what outcomes result.

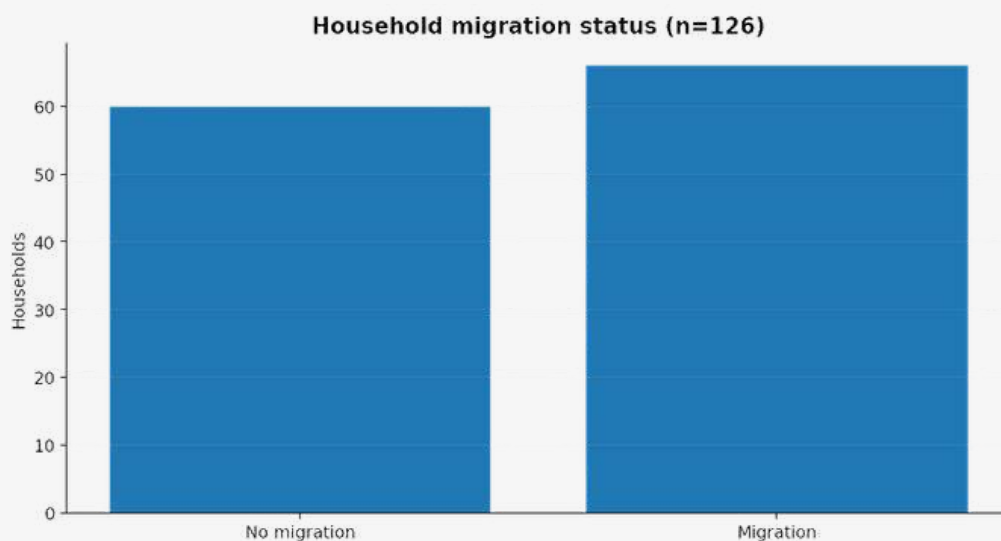


Figure: Household migration status (n=126).

Migration is a majority household phenomenon in the sample. This is central to the programme’s livelihood rationale: stronger local income opportunities can reduce the pressure for migration. The baseline itself identifies both aspiration-driven and distress-driven migration.

Programme implication: Use this baseline signal to prioritise outcomes and targeting; do not treat activity counts alone as evidence of resilience or income improvement.

Type of migration among migrant members (n=83)

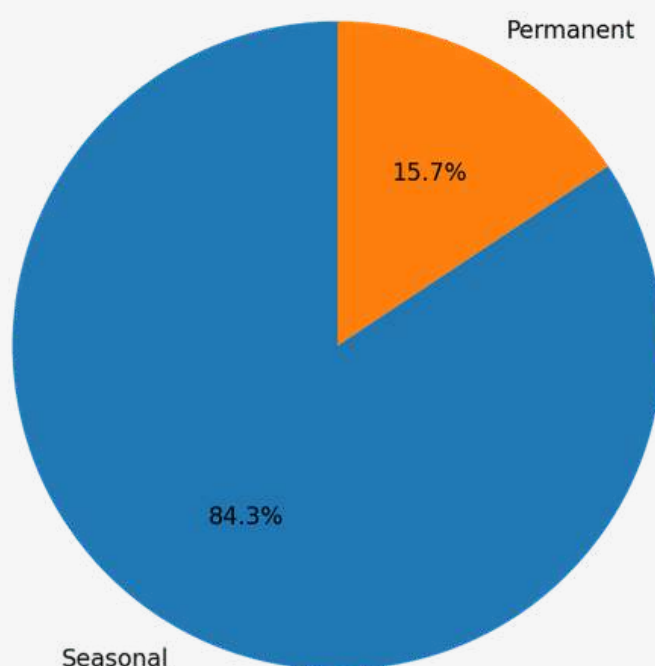


Figure: Type of migration among migrant members (n=83).

Seasonal migration dominates among migrant members. This pattern means that local livelihood interventions should be assessed not only by income but also by whether they reduce the need for repeated seasonal absence.

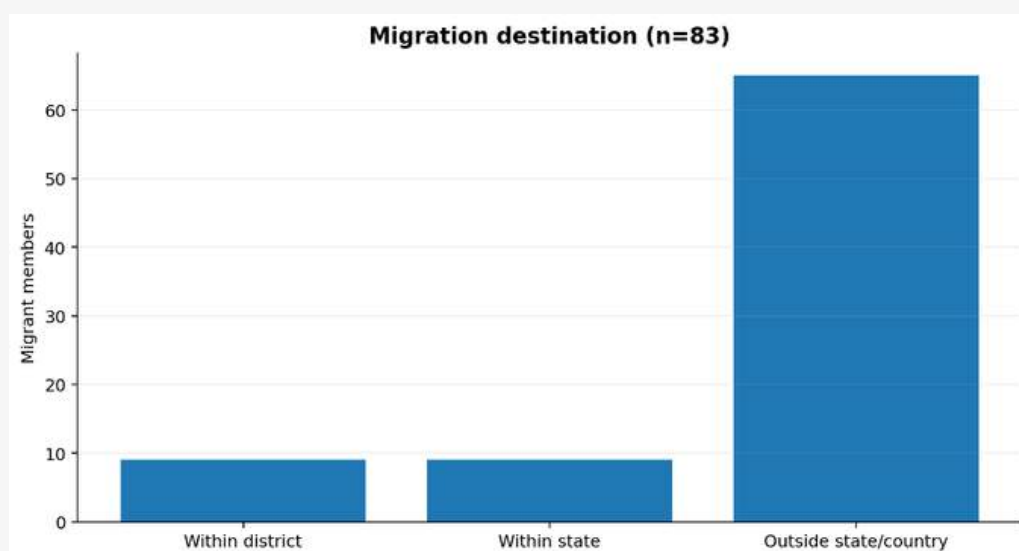


Figure: Migration destination (n=83).

Nearly four-fifths of migrant members move outside the state/country. Long-distance migration increases social separation and makes local livelihood resilience particularly valuable for households that prefer to remain connected to the island.

5.6: Water Resources: Access, Utilization, and Challenges

Access to safe and reliable water resources is one of the major challenges in climate-vulnerable places like Ghoramara Island. Rising sea levels, recurrent flooding, embankment breaching and saline water intrusion have adversely affected the availability and quality of freshwater resources in the island. Intrusion of saline water in ponds and agricultural land makes freshwater resources increasingly unsuitable for drinking and cultivation purposes. Therefore, people are gradually becoming more dependent on groundwater-based sources for drinking water, while traditional pond water continues to be used for agricultural and domestic activities.

The present section attempts to understand the pattern of drinking water sources, accessibility of water resources and utilization of pond water among the surveyed households. It also examines the extent to which households continue to depend on traditional water bodies despite increasing environmental degradation and climate-induced vulnerability in the island ecosystem.

5.6.1: Sources of Drinking Water

Main Source of Drinking Water	Number	Percentage
Personal Deep Tube Well	28	22.2
Government Deep Tube Well	91	72.2
Personal well & pond	7	5.6
Distance from source		
< 50 meters	63	50
50 meters -100 meters	50	39.7
100 meters - 500 meters	9	7.1
500 meters - 1 km	4	3.2

Table:34- Distribution of Drinking Water (Total N=126)

The survey findings in Table 34 reveal that groundwater-based sources constitute the major source of drinking water among the surveyed households in Ghoramara Island. A substantial majority of respondents (72.2%) reported Government Deep Tube Wells as their primary source of drinking water, while 22.2% depended on Personal Deep Tube Wells.

In contrast, only 5.6% respondents reported dependence on personal/community wells and ponds for drinking purposes. The findings indicate a clear dependence on deep tube-well-based water infrastructure for accessing drinkable water on the island.

The data further shows that accessibility to drinking water sources is comparatively favorable for most households. About 50.0% of respondents reported that the source of drinking water is located within 50 meters from their residence, while 39.7% accessed water sources situated within a distance of 50–100 meters. Only a relatively smaller proportion of households travelled longer distances, with 7.1% travelling between 100–500 meters and 3.2% travelling between 500 meters and 1 kilometer for collecting drinking water.

The findings suggest that Government Deep Tube Wells play the most significant role in meeting household drinking water requirements in the study area. Dependence on personal and community wells or ponds for drinking purposes remains very limited, reflecting the declining suitability of traditional water sources for potable use. Overall, the data indicate the increasing importance of Deep Tube-well based water supply systems within the climate-vulnerable island environment.

5.6.2: Utilization of Pond Water

Agricultural Usage	Numbers	Percentage
Yes	64	50.8
No	62	49.2
Non-Agricultural usage		
Yes	93	73.8
No	33	26.2

Table:35- Pond water Usage (Total N=126)

Table 35 indicates that pond water continues to play an important role in the livelihood practices of the surveyed households in Ghoramara Island. About 50.8% respondents reported using pond water for agricultural purposes, reflecting the continued dependence on traditional water resources for cultivation within the island region.

However, many respondents reported during the FGDs that the recurrent flooding, cyclones and saline water intrusion frequently reduce the suitability of pond water for irrigation and agricultural productivity, thereby limiting its reliability for farming activities.

5.6.3: Correlation between Income and Sources of Drinking Water

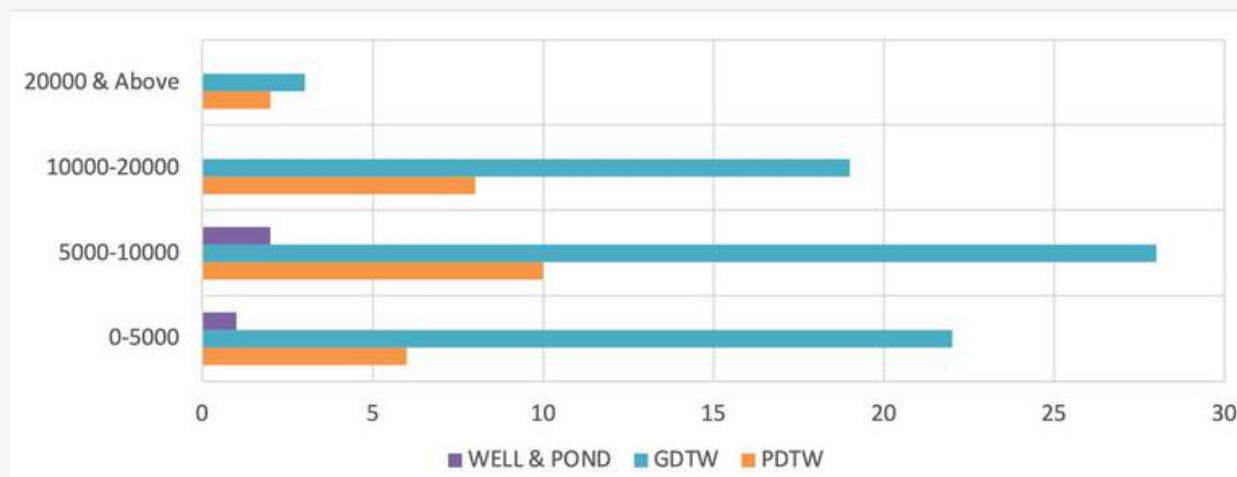


Figure : Income and Drinking Water Sources

The relationship between household income and sources of drinking water indicates a widespread dependence on Government Deep Tube Wells (GDTW) across all economic categories among the surveyed households (N=126) in Ghoramara Island. The findings suggest that access to safe drinking water within the island region is shaped more by the availability of public water infrastructure than by household economic capacity. Even among relatively higher income groups, dependence on Government Deep Tube Wells remained significant, indicating the limited availability of alternative safe water sources within the island environment.

In above Figure, the comparatively lower dependence on Personal Deep Tube Wells (PDTW) among lower-income households reflects economic constraints associated with establishing and maintaining private water infrastructure. In contrast, households belonging to middle and relatively higher income categories demonstrated somewhat greater access to personal tube wells, suggesting that economic capacity influences the ability to secure relatively independent water sources. However, the dominance of Government Deep Tube Wells across all income groups indicates that public water supply systems continue to function as the primary source of potable water, irrespective of household income levels.

The negligible dependence on wells and ponds for drinking purposes across all economic categories reflects the declining suitability of traditional freshwater sources within the island region. Recurrent flooding, saline water intrusion and contamination during cyclones and tidal inundation have increasingly reduced the reliability of ponds and shallow wells for potable use.

The findings, therefore, indicate that environmental vulnerability, combined with infrastructural limitations, has reinforced the central role of government-supported groundwater systems in ensuring drinking water accessibility among households in the climate-sensitive island ecosystem.

5.6.4: Major Water-Related Challenges during Natural Calamities

The surveyed households in Ghoramara Island reported several water-related challenges during floods, cyclones and other climatic disasters. One of the major problems identified was the severe shortage of safe drinking water during and after natural calamities.

Respondents reported that saline water frequently enters ponds and wells during tidal inundation and embankment breaching, making traditional water sources unsuitable for drinking and domestic use.

The findings further indicate that ponds, which are commonly used for bathing, washing and other household activities, often become polluted during disasters.

Contamination of water sources contributes to the increased occurrence of water-borne diseases and skin-related health problems among the affected population. The situation becomes more severe due to the lack of proper sanitation facilities, as toilets are often damaged or flooded during cyclones and heavy rainfall.

Respondents also reported shortages of freshwater for irrigation after disasters, adversely affecting agricultural activities and livelihood security within the island region.

Limited awareness regarding the health risks associated with contaminated water and inadequate access to emergency healthcare services further increases the vulnerability of households during periods of environmental crisis.

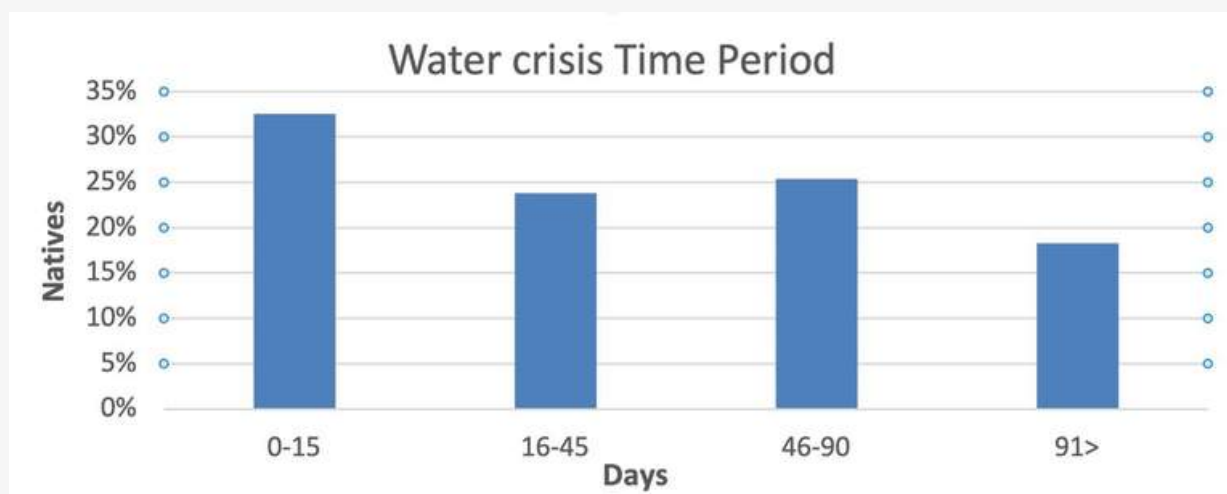


Figure: Crisis in the availability of Drinking Water during Climate Shocks

Figure on page 47 indicates considerable variation in the availability of drinking water among the surveyed households in Ghoramara Island during climatic shocks such as floods, cyclones and tidal inundation. About 33% households reported disruption in drinking water availability for a period of 0–15 days, while 24% households experienced disruption for 16–45 days. Another 25% households reported that the crisis continued for 46–90 days. A comparatively smaller proportion of households (18%) reported facing drinking water scarcity for more than 91 days during and after climatic events. The findings suggest that although some households were able to restore access to drinking water within a shorter period, a considerable section experienced prolonged disruption in water availability.

Overall, the data reflect the vulnerability of drinking water infrastructure within the island region during climatic shocks. Flooding, saline water intrusion and damage to water sources during cyclones often create prolonged drinking water crises, thereby affecting the daily lives and livelihood security of the surveyed households.



Photo: A submerged tubewell during cyclone Yaas in 2021

5.7. Climate Risk and Resilience: Lived Experiences, Challenges

Ghoramara Island, located in the Sundarbans region of West Bengal, represents one of the most climate-vulnerable inhabited landscapes in India. The island has become a living testimony to the intersecting realities of climate change, riverbank erosion, cyclonic disasters, forced migration, livelihood insecurity, gendered vulnerability, and community resilience. The people of Ghoramara continue to survive within a landscape marked by uncertainty, where every cyclone threatens homes, livelihoods, and social stability.

Climate risk in Ghoramara is not merely environmental; it is social, economic, psychological, and political. Residents face destruction of agricultural land, fisheries, transport systems, drinking water sources, houses, and public infrastructure. Yet despite repeated losses, the community continues to demonstrate remarkable forms of adaptation and resilience through collective support systems, migration strategies, women's labour, self-help groups, local ecological knowledge, and aspirations for education and alternative livelihoods.

5.7.1. Environmental Vulnerability and the Geography of Risk

Households on Ghoramara Island face a deeply intertwined set of environmental and economic hardships. In the survey, every single household reported that tropical cyclones (126 HH) and floods (95 HH) are the two most serious environmental threats, while riverbank erosion (98 HH) was cited by more than two-thirds of respondents as an equally destructive and constant menace.

These hazards are not isolated events but part of a cycle that continuously erodes the basis of life on the island. Cyclones such as Aila, Amphan, Yaas, and Phoni have repeatedly damaged houses, agricultural fields, fishing infrastructure, embankments, and roads.

Residents explained that land erosion is not restricted only to cyclones. Even low tides and recessive currents are capable of removing substantial sections of land overnight. The loss of soil affects not only settlements but also the emotional and cultural relationships people maintain with the island. All surveyed households reported experiencing multiple natural disasters in the last five years.

Cyclones were experienced by 100% of households, floods by almost 100%, and riverbank erosion by 68%. Drought and epidemics were negligible. When asked about the single most devastating event, almost all respondents named Cyclone Yaas (2021), with a few also recalling Cyclone Amphan.

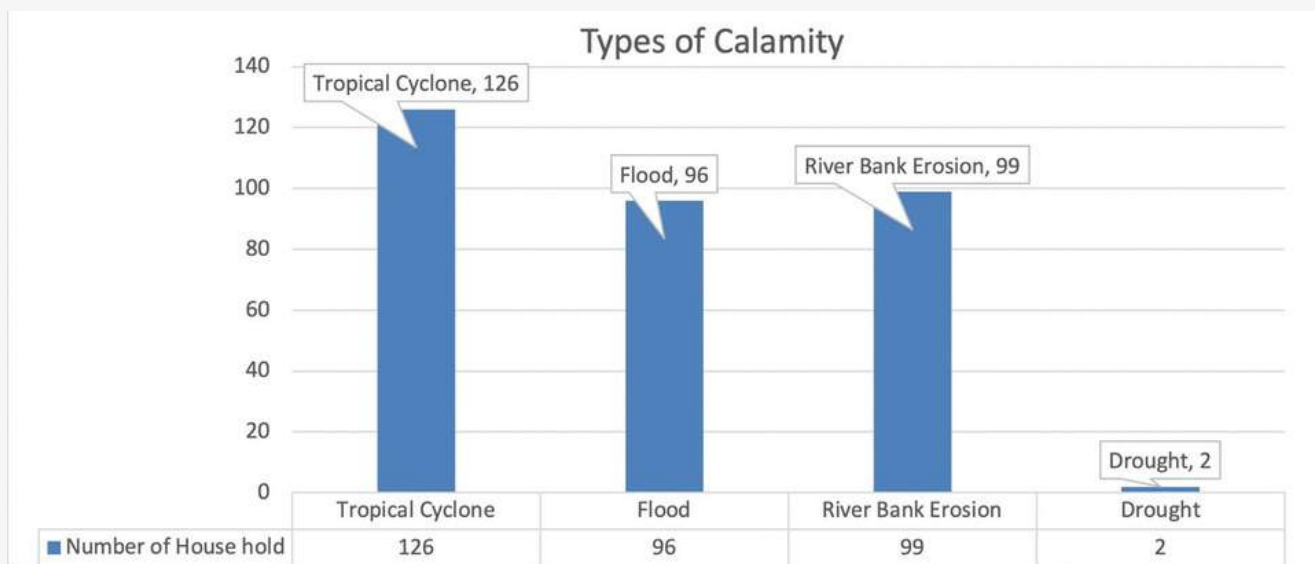


Figure: Types of calamity

Cyclones destroy homes, crops and household assets, while **floods bring saline water that makes soil and ponds unusable for years**. Riverbank erosion is swallowing up habitable and agricultural land metre by metre; several hamlets have already disappeared, and the remaining families live with the fear that their own land will be next. Alongside these physical losses, **people report severe shortages of drinking water, the collapse of farming and fishing incomes**, and a complete absence of reliable healthcare or education facilities. These interlocked problems make it practically impossible for families to plan for the future or break out of poverty.

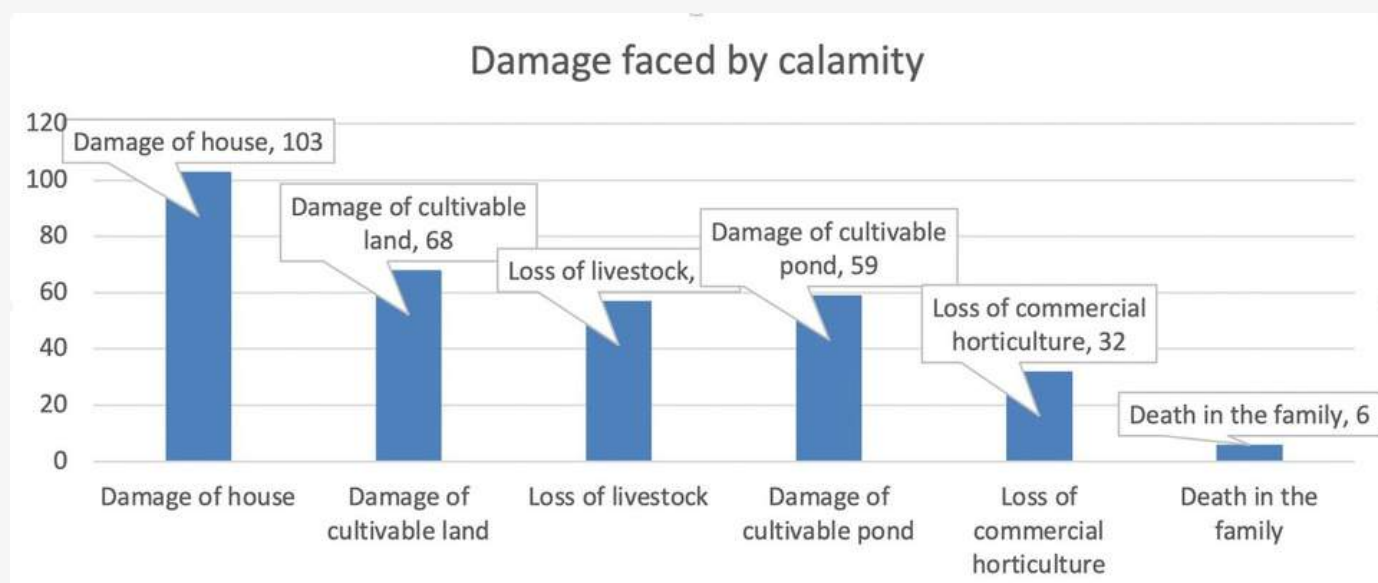


Figure: Damage caused by calamity

5.7.2. Experience of Natural Calamities in the Last Five Years

The household members share a harrowing picture of Yaas during the survey. The cyclone brought a massive tidal surge that breached embankments, flooded homes and fields, and deposited saltwater across agricultural land, ponds and wells. Families described seeing their houses collapse, their betel leaf farms vanish, and their stored grains rot. One widow recounted how her husband, the sole earner, was swept away by the strong water current and died. Another respondent said his father's body could not be recovered for five days, adding immense mental agony to the physical loss. Elderly residents, living alone, spent days on raised earthen mounds or climbed date-palm trees to survive the rising water.

In the survey, 82% of households reported damage to their houses, 53% lost crops or cultivable land, **47% suffered damage to ponds**, and 25% lost livestock or commercial horticulture. Tragically, 4% of households experienced a death in the family directly because of the cyclone. These figures confirm that every cyclone leaves behind a trail of asset destruction that takes years to recover from – and the next disaster often strikes before recovery is complete.

5.7.3. Drinking Water and Food Shortage During and After Calamities

Access to safe drinking water becomes a crisis during every disaster. In the survey, **94% of households said they faced an acute drinking water shortage after the most devastating calamity**. The primary coping strategy was to use submerged hand pumps or to rely on water supplied by NGOs and other organizations. Food shortages were reported by 96% of households, lasting, on average, two to three months, and families depended heavily on relief materials from NGOs and loans from relatives and self-help groups.

One of the major problems identified was the severe shortage of safe drinking water during and after natural calamities. Government deep tube wells are now the primary source of drinking water because ponds and freshwater sources have become saline after floods and cyclones. Ponds continue to function as an important supplementary resource for meeting everyday household and livelihood-related requirements within the island community.

Though ponds remain essential for washing, bathing, irrigation, and fishing, they are mostly unclean. Contamination of water sources contributes to the increased occurrence of water-borne diseases and skin-related health problems among the affected population. The pattern of pond water utilization reflects the continuing socio-economic importance of traditional water bodies despite increasing environmental stress within the island ecosystem. Hence, cleaning and renovation of pond seems to be useful for improving local people's health and hygiene. Climate-related disasters often create severe drinking water shortages, increasing dependence on NGOs, relief support, and community cooperation.

Environmental vulnerability, combined with infrastructural limitations, has reinforced the central role of government-supported groundwater systems in ensuring drinking water accessibility among households in the climate-sensitive island ecosystem.

CHAPTER 6- HYDROLOGICAL ASSESSMENT OF PONDS

6.1 INTRODUCTION

A hydrological assessment was undertaken of 24 ponds identified for rejuvenation across the project area. The assessment was undertaken to understand the existing physical condition of these water bodies and to establish a baseline against which future rejuvenation interventions can be monitored.

The ponds represent an important component of the local water landscape, with potential significance for water storage, irrigation, agriculture, fisheries and household-level livelihood activities.

The baseline assessment indicates that their existing physical condition limits their ability to function effectively as resilient freshwater storage structures.

Two common characteristics were identified across all 24 ponds:

- The average pond depth was approximately 1 metre, and none had a raised bund or embankment.
- All 24 ponds were essentially at ground level.



6.2 KEY FINDINGS

The hydrological assessment established a consistent physical condition across the 24 identified ponds.

Indicator	Baseline Finding
Ponds assessed	24
Average existing depth	~1 metre
Ponds with raised bunds	0
Ponds without raised bunds	24 (100%)
Ponds at ground level	24 (100%)

The most significant structural finding was the complete absence of raised bunds across the assessed pond system. All 24 ponds were found to be at ground level, with no raised bund or embankment structure identified around the ponds.

This condition is important from a water-retention and resilience perspective. A pond without a defined raised bund has limited structural separation between stored water and the surrounding land surface. During periods of heavy rainfall or high water levels, the absence of an adequately formed bund can reduce the ability of the pond to retain water within its intended storage area. The baseline therefore points to a clear physical requirement: rejuvenation needs to address not only pond depth but also the perimeter and water-retention structure

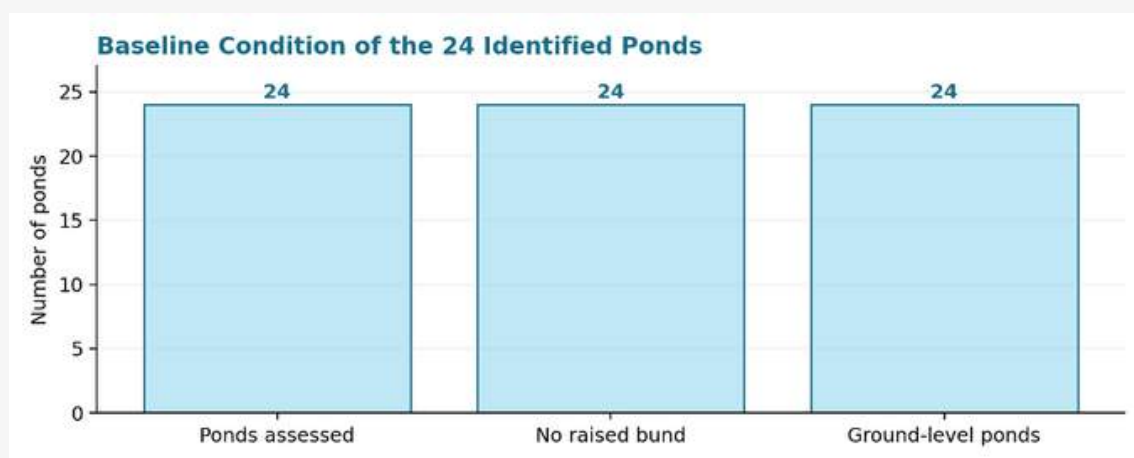


Figure: Baseline condition of the 24 identified ponds

The assessment found that the average depth of the 24 ponds was approximately 1 metre. This relatively shallow baseline condition is an important consideration for the project's water-storage objectives.

Pond depth influences the amount of water that can be retained within a given water-spread area. Where ponds are shallow, available storage can be limited, particularly when water levels decline during dry periods. A shallow water body can also have less capacity to retain water through seasonal fluctuations.

The baseline depth of approximately 1 metre provides an important reference point for subsequent rejuvenation work. Any increase in effective depth achieved through excavation or desilting can be measured against this baseline.

The baseline data provided do not establish total storage volume. Such a calculation would require pond-wise measurements of water-spread area and depth. Therefore, the 1-metre figure should be treated as the average observed baseline depth, not as an estimate of total water-storage capacity.

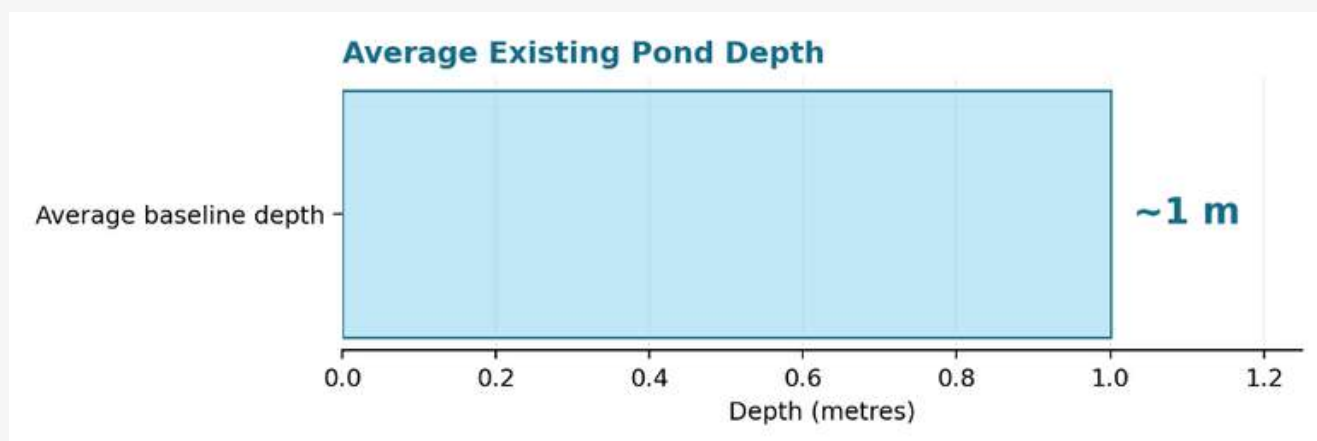


Figure: Average existing pond depth at baseline

6.3 HYDROLOGICAL IMPLICATIONS OF THE BASELINE FINDINGS

The baseline assessment suggests that the 24 ponds have significant potential for improvement as community water-storage assets. The combination of shallow average depth and the absence of raised bunds indicates that rejuvenation should be approached as a combination of water-storage enhancement and structural strengthening, rather than simply excavation.

1. Increasing effective water-storage depth- With an average existing depth of approximately 1 metre, rejuvenation can seek to improve effective depth through appropriate excavation and desilting, subject to site-specific technical assessment. The objective is to increase the amount of water that can be retained while ensuring that the intervention remains appropriate to local hydrological and physical conditions.

2. Strengthening pond boundaries- Since 100% of the assessed ponds lack raised bunds, bund formation and strengthening represents an important potential intervention. Properly formed bunds can help define the pond perimeter and improve its capacity to retain stored water. The design should give appropriate attention to stability, drainage and local site conditions.

3. Improving resilience of freshwater resources- The physical condition identified during the baseline assessment is particularly relevant to a climate-resilience approach. Strengthening ponds can improve their ability to function as local freshwater storage assets, supporting water availability during periods when rainfall and water access become less predictable. The rejuvenation strategy should therefore be viewed as an effort to strengthen the long-term functionality of community water resources.

The assessment of the 24 ponds identified for rejuvenation establishes a clear picture of their existing physical condition. With an average depth of approximately 1 metre, no raised bunds across any of the assessed ponds, and all ponds positioned at ground level, the water bodies have substantial scope for structural and functional improvement. The findings establish a simple and measurable baseline for the project. Future assessments can demonstrate whether rejuvenation has resulted in greater effective depth, improved water retention, strengthened pond boundaries and expanded utility for irrigation and livelihoods.

The central objective is therefore not simply to deepen 24 ponds, but to restore them as more reliable, resilient and community-managed freshwater assets that can support agriculture, fisheries and local livelihoods over the longer term.

CHAPTER 7-DISCUSSION

7.1 OVERVIEW

Ghoramara is a small, geographically vulnerable island in the Sundarbans delta of West Bengal, India. Classified as a sinking island, it has lost significant landmass to riverbank erosion and tidal flooding over the decades. Its population, primarily Hindu and Muslim households, subsists on agriculture, fisheries, petty trade, and remittances from seasonal male migrants.

The island has limited infrastructure: a panchayat office, four primary schools, a community health center, a cyclone shelter, solar lighting, and rudimentary road connectivity. Transport in and out of the island depends entirely on ferry services.

This report synthesizes field observations and community responses across three interlinked domains -livelihoods, environment, and social well-being. The tabular representation (Table 36) of occupational categories of island population suggests problems associated with each category of occupation and impacts on life and livelihoods of inhabitants, primarily due to climatic uncertainty, recurrent storm surge, flood disaster and soil erosion.

The residents of Ghoramara Island have experienced continuous loss of land, housing, and livelihoods due to coastal erosion, tropical cyclones and tidal inundation. As the island's area declines and flood risk increases, many households have been forced to relocate either internally or to nearby Sagar Island or Kakdwip.



7.2 A FRAGILE AND MULTI-OCCUPATIONAL ECONOMY

Serial No.	Sector	Observed Issues	Impacts on Residents
1	Agriculture	Salinity, crop loss, and flooding	Declining productivity and income
2	Fisheries	Saline ponds and damaged fishing resources	Reduced livelihood opportunities
3	Migration	Seasonal male out-migration	Increased burden on women
4	Healthcare	Irregular medical services	Delayed treatment and health risks
5	Education	Limited secondary education access	School dropouts and migration
6	Infrastructure	Weak transport and embankments	Isolation during disasters
7	Water Access	Cyclone-related saline contamination	Drinking water shortages

Table 38: Major Livelihood and Societal Challenges

Shrinkage of Land mass

The size of the island has gradually shrunk up to 45 per cent due to severe erosion that poses a threat to the local human communities (Bhattacharjee et. al., 2011). In fact, shrinkage of land mass has led to the loss of 2 of the 3 moujas on the island – Lohachhara and Khasimara due to soil erosion and subsidence as well as recurrent tropical cyclones. Between 1960 and 2012, the island was estimated to have lost land at an average rate of 5 meters per year, and some areas have lost up to 150 meters of land. The study revealed that between 1990 to 2020, the Land Use/Land Cover (LULC) classes of built-up area, agricultural land, water bodies, and vegetation were found to have lost around 62.345 hectares, 63.328 hectares, 0.836 hectares, and 113.241 hectares, respectively.

The shoreline shifted towards the north-east, north-west, and southern directions in the last thirty years. The Landset datasets suggest that the wetlands on the island show a sharp decline post-1989, indicating ecological stress and salinity intrusion, while uncultivated land fluctuates but overall declines significantly by 2010, suggesting land loss or conversion.

The fisheries area remains consistently minimal, reflecting limited aquaculture expansion. Interestingly, vegetation shows partial recovery after decline, possibly due to adaptive land use or natural regeneration.

It is clearly evident that over-the-years decline in wetlands and water bodies is particularly significant, as salinity intrusion following extreme events such as Cyclone Amphan and Cyclone Yaas has rendered many ponds and low-lying areas unsuitable for both agriculture and fisheries. Thus, the limited extent of fisheries-related land use by 2020 reflects both environmental constraints and the reduced viability of aquaculture under high salinity conditions.

A transition from a mixed subsistence landscape to a shrinking, risk-prone ecological system is emerging, where land loss rather than land-use conversion is the dominant process. This has direct implications for livelihood security, migration patterns, and long-term habitability of the island.



Photo: An inundated pond in Raypara Village, Ghoramara Island

Impact on Agricultural activities:

Although, agriculture remains a source of livelihood for the islanders, the brackishness of rivers makes agriculture unsuitable and uncertain (Mukhopadhyay, 2009). Agriculture- primarily paddy and betel leaves, remains the backbone of livelihoods, but is under severe stress. The shrinkage of landmass leads to the loss of agricultural land. Large tracts of cultivable lands have been either physically eroded or has become unsuitable for cultivation for saline water ingress resulted by breaching of embankments and tidal erosion. The cultivated paddy field area has suffered major loss ranging from 2.93 km² in 1972 to 1.13 km² in 2010. The uncultivated land area also decreases from 2.73 km² to 1.29 km² during the same period (Jana et al., 2012).

Soil salinity caused by tidal flooding and cyclone Yaas (2021) has sharply reduced both the productivity and marketability of produces. An increased level of salinity reduces crop productivity as well as future scope of cultivation. Intrusion of saline water through flooding combined with stagnation problem for a prolonged period turn a fertile land into an uncultivable sterile land making those lands cultivable for three to five years. Betel leaf cultivation, once a relatively stable income source, has been devastated by fungal disease during monsoons and saltwater intrusion. Farmers report that the same quantity of betel leaves now fetches the same price as before, but requires 20% more volume due to diminished quality – a hidden but severe income loss. There is no Farmer Producer Organization (FPO) on the island, no access to improved seeds, and minimal government scheme penetration for agriculture-related support. There is limited awareness of government schemes such as PM Kisan and Krishak Bandhu further weaken farmers' economic security.

Freshwater for irrigation is increasingly scarce: ponds take six to nine months post-cyclone before they are usable again.



Photo: A field of betel crop destroyed by saline water post Yaas in Kashimara, Ghoramara

7.3 ENVIRONMENT & CLIMATE RISK: A SLOW AND RECURRING CATASTROPHE

Cyclone Amphan, Yaas and continued vulnerability

Cyclone Yaas (2021) is described uniformly as the most devastating calamity in living memory. It caused flooding, embankment failure, saltwater intrusion into homes, ponds, and fields, destruction of betel vines, paddy crops, livestock, and household assets, and disrupted electricity, mobile connectivity, and ferry services for extended periods. Two deaths were reported—one person swept away by a current, another whose body could not be returned to the family for five days. Some households spent days on raised earthen platforms or climbed trees to survive. Post-Yaas, livelihoods took months to resume, and communities are still recovering. Cyclone Amphan (2020) preceded Yaas and compounded vulnerabilities without full recovery in between.

Chronic Environmental Stress

Beyond discrete cyclone events, the island faces slow-onset environmental degradation: continuous riverbank erosion shrinks the island steadily, saline intrusion degrades soil and groundwater, and rising water levels increase flood risk year on year. Respondents report a visible increase in the frequency and severity of storms over their lifetimes. Land value is declining, and 'Bhag Jomi' (sharecropped land) remains largely uncultivated because climate risk makes investment in it irrational. The loss of mangrove cover further weakens natural coastal protection. Soil subsidence under houses caused by erosion and salinity poses a physical risk to shelter.

Disaster Response Gaps

While cyclone centers provided shelter with food and basic amenities, several gaps were observed: no mock drills or evacuation training have ever been conducted; information about incoming cyclones was disseminated via announcements but without preparedness support; food in cyclone centers was not appropriate for elderly residents with dietary restrictions; and some residents took weather warnings lightly because announcements began days in advance. Critically, SEED (an NGO) was consistently cited as the primary and often sole provider of immediate relief - food, water, and medicines, while government support was described as delayed, inequitable, or non-existent. Relief funds of ₹ 20,000 per household were distributed after Amphan and Yaas were reported as unevenly distributed, raising concerns about corruption or administrative failure.

Coping mechanisms during climatic crisis:

The study showed that people of Ghoramara Island adopted multiple coping mechanisms to manage water-related difficulties during floods, cyclones and tidal inundation. A major strategy identified among respondents was reliance on NGOs and relief agencies for the supply of drinking water, food and emergency assistance during disaster periods.

Respondents indicated that external relief support became essential for meeting basic needs when local water sources and infrastructure were severely affected after major cyclonic events.

Community-level cooperation also played a significant role in helping households cope with crises. Respondents reported practices such as sharing food, providing temporary shelter and extending mutual assistance to affected families during periods of environmental distress. These forms of collective support highlight the importance of local social networks in areas where access to institutional support systems and healthcare facilities remains limited. Recurrent flooding, saline intrusion and disruption of freshwater availability further increase the vulnerability of households during climatic shocks.

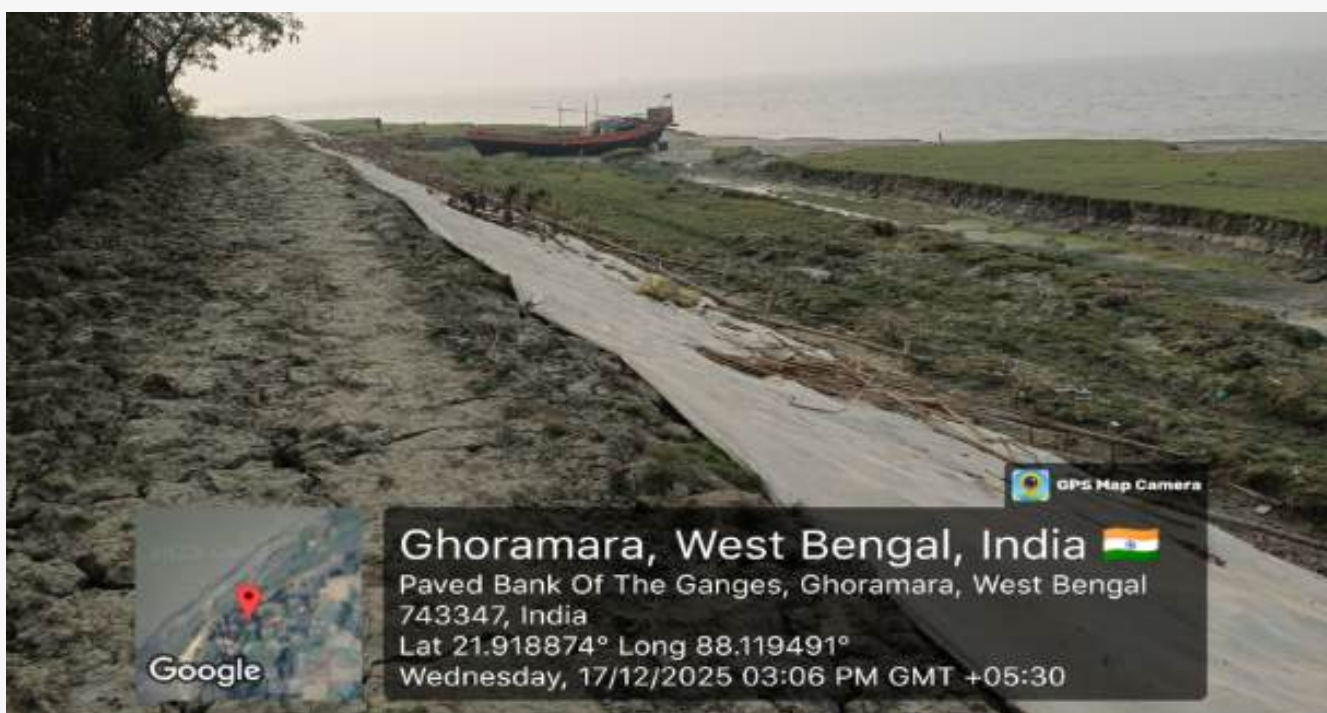


Photo: Bouldering and embankment structures are viewed by local communities as critical defences against erosion and flooding.



Photo: The shrinking shoreline demonstrates ongoing land loss caused by tidal currents and climate-related erosion.



Photo: Riverbank erosion continuously destroys the island's edges, threatening settlements and agricultural land.



Photo: Boat connectivity in Ghoramara Island remains essential for mobility, transport, and survival during environmental isolation.



Photo: People crossing unstable muddy terrain illustrate the infrastructural vulnerability created by erosion and flooding.

CHAPTER 8-SUMMARY AND CONCLUSION

The baseline establishes a clear programme logic for Ghoramara: unreliable freshwater access and inadequate pond capacity constrain household well-being and productive livelihoods, while limited income opportunities increase dependence on seasonal and informal work. Agriculture remains a major livelihood source but is highly sensitive to salinity, flooding and water availability. The survey also shows that most households depend on a small number of earners and that women have limited participation in paid economic activity.

These findings directly support the programme focus on climate-resilient drinking-water infrastructure, pond rejuvenation for irrigation and productive use, and small-scale livelihood opportunities for landless households.

The baseline should therefore serve as the starting point for measuring changes in safe-water access, irrigated area and farm productivity, household livelihood income, women's economic participation, and community-institution effectiveness.

Issues such as embankment protection, healthcare, education, disaster preparedness and longer-term relocation remain important contextual concerns, but they are treated here as convergence or advocacy issues rather than direct programme outputs unless separately approved.

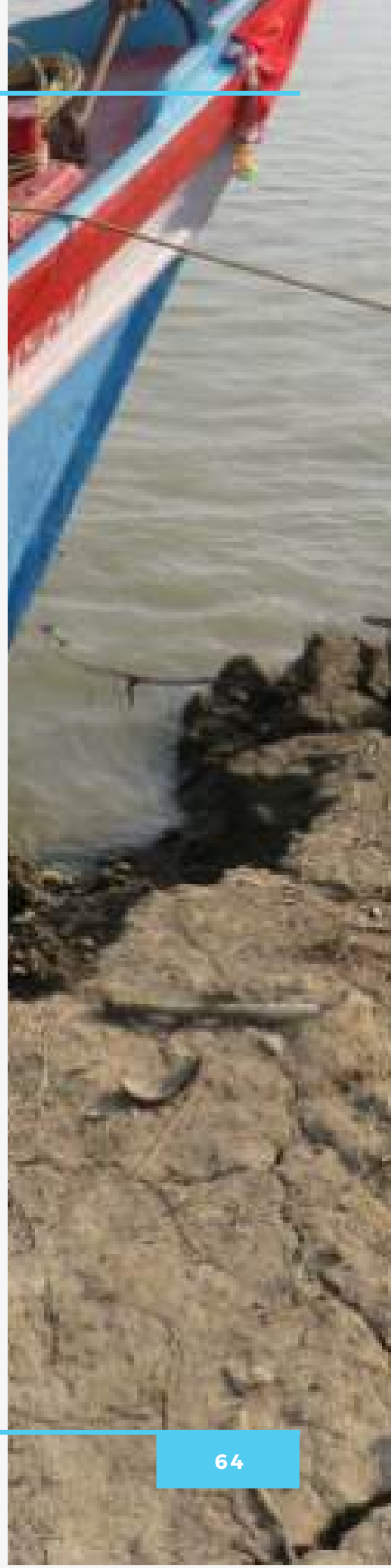


CHAPTER 9- RECOMMENDATIONS

9.1 PROGRAMME DIRECTION: FROM BASIC INFRASTRUCTURE TO CLIMATE-RESILIENT COMMUNITY ASSETS

The baseline assessment demonstrates that water insecurity and livelihood insecurity on last-mile isolated Ghoramara Island are closely interconnected. The household survey covered 126 households and 499 household members, with 72.2% of households dependent on government deep tubewells for drinking water. **The vulnerability becomes particularly severe during and after major climatic events: 94% of households reported acute drinking-water shortages following major calamities. The baseline also recorded 100% household exposure to cyclones, demonstrating the extent to which climate shocks influence everyday access to basic resources.**

At the same time, livelihood vulnerability remains high. Agriculture is an important source of household income but is constrained by salinity, flooding, water availability and limited productive capacity. **The baseline recorded an initial irrigated command area of 21 bighas, while 66.67% of households had only one earning member and 52.38% reported a history of migration.** Women face an additional layer of vulnerability because their participation in paid employment remains limited despite their substantial contribution to household and care responsibilities.



The next phase of the APF-supported programme should therefore focus not simply on creating infrastructure, but on building assets that remain functional during climatic stress, generate productive value during normal periods and are governed by the community over the long term.

Three interconnected areas should remain at the centre of programme implementation:

1. Climate-resilient pond rejuvenation and productive water management
2. Raised and disaster-resilient drinking-water infrastructure
3. Inclusive livelihood diversification for landless and women-headed households

The programme should measure success through the outcomes generated by these assets rather than through construction or training numbers alone.

9.2 CLIMATE-RESILIENT POND REJUVENATION AND WATER STORAGE

The baseline hydrological assessment of the 24 ponds identified for rejuvenation indicates a significant gap in their existing water-storage capacity. The ponds were found to have an average depth of approximately 1 metre, with no effective raised bunds, as the pond edges were largely at ground level. This physical condition limits their ability to retain adequate freshwater and increases their vulnerability to flooding, saline-water intrusion and rapid loss of stored water.

The rejuvenation of these ponds should therefore move beyond simple desilting. Each selected pond should be developed as a climate-resilient freshwater storage and productive livelihood asset, with interventions designed according to the physical characteristics and local use of each site.

Recommended Pond Design

The rejuvenation plan should aim, where technically and site-condition appropriate, to increase pond depth up to approximately 3 metres, compared with the baseline average of about 1 metre. The deeper water profile would increase freshwater storage capacity and create a more reliable source for irrigation and freshwater fish culture. The pond edges should also be strengthened through the development of bunds of approximately 1.5 metres, subject to site-specific technical assessment. Raised and strengthened bunds would provide a physical separation between the stored freshwater and surrounding ground-level floodwater and would improve the ability of ponds to retain water during periods of heavy rainfall and tidal or flood-related pressure.

The proposed design should not be implemented as a uniform engineering specification across all 24 ponds. Pre-work technical verification should determine the appropriate final depth, bund geometry, slope, soil stability and water-retention requirements for each pond. This will help avoid over-excavation or inappropriate bund construction in locations where local soil, ownership, drainage or hydrological conditions require modification.

Pond bunds as productive ecological assets- The proposed bunds should not remain bare earth structures. Where technically feasible, the bunds should be strengthened through plantation of suitable fruit-bearing species and Casuarina. Fruit trees can provide an additional productive use of the pond perimeter and potentially contribute to household nutrition and supplementary income. Casuarina plantation can provide vegetation cover and help strengthen the bund structure through root development, while also creating a vegetated buffer around the restored water body. Planting should, however, be based on site suitability, soil conditions, salinity tolerance and community preference. Species selection should avoid compromising pond access, water withdrawal points, sunlight requirements for fish culture or future maintenance activities. The bund plantation should therefore be treated as part of the pond-rejuvenation design rather than as a separate plantation activity.

From pond excavation to productive water use- The programme should explicitly link pond rejuvenation to measurable improvements in productive water use. The baseline identified 21 bighas as the initial irrigation command area, and the programme should use this as the starting point for tracking changes in actual irrigation. The key question should not be how much soil was excavated, but: How much additional freshwater is retained, how much land is actually irrigated, what crops are produced, and what additional income is generated?

Accordingly, each rejuvenated pond should have a simple monitoring record covering:

- baseline and post-rejuvenation pond depth;
- bund height and condition;
- seasonal water availability;
- number of water users;
- actual irrigated area;
- crops cultivated;
- cropping intensity;
- crop yield;
- freshwater fish production where applicable;
- income generated from irrigation and fisheries; and
- maintenance requirements.

The baseline report already recommends that actual Rabi-season irrigation, rather than projected pond capacity, should be used to assess whether restored freshwater storage is producing productive resilience.

9.3 STRENGTHENING COMMUNITY WATER GOVERNANCE AROUND REJUVENATED PONDS

Physical rejuvenation alone will not ensure sustainable use of the 24 ponds. The programme should continue strengthening Water User Groups (WUGs) as the principal community mechanism for managing access to water.

The baseline recommendations similarly emphasise transparent allocation rules, written agreements and community-level governance.

Each rejuvenated pond should therefore have:

- clearly identified users;
- a documented water-sharing arrangement;
- agreed rules for irrigation access;
- defined responsibilities for routine maintenance;
- a mechanism for resolving minor water-use disputes;
- records of actual water use; and
- a simple maintenance and repair mechanism.

Water User Groups should also receive continued practical training in water assessment, water testing, allocation planning, record keeping and basic operation and maintenance. Particular attention should be given to increasing women's participation in water governance. The baseline recommends measurable women's participation rather than simply counting women as beneficiaries. Women from water-using households, including those without formal land ownership, should be encouraged to participate in WUG decision-making where their households depend on the restored water resources.

9.4 RAISED HANDPUMPS FOR RELIABLE DRINKING WATER DURING CLIMATE EMERGENCIES

Safe drinking water represents a critical resilience gap for last-mile isolated Ghoramara Island. The baseline found that 72.2% of households use government deep tubewells, while 94% reported acute drinking-water shortages following major calamities. The assessment also records that flooding and saline-water intrusion can affect water sources and that households often depend on cyclone shelters, relief supplies and external support when normal water access is disrupted.

The programme should therefore continue developing raised handpumps/tubewells specifically designed for climate-disrupted conditions.

For future installations, the handpump platform and water-access point should be positioned at a minimum height of approximately 2.5 metres above the surrounding ground level, subject to site-specific technical and hydrogeological assessment.

The objective is not simply to make the handpump physically higher. The entire installation should be designed as a climate-resilient drinking-water asset that remains accessible when surrounding areas are affected by flooding, tidal inundation or cyclone-related waterlogging.

Each raised drinking-water point should include, as appropriate:

- raised reinforced platform;
- safe steps and handrails;
- secure drainage around the platform;
- protection from standing floodwater;
- technically appropriate bore depth;
- water-quality testing before commissioning;
- periodic bacteriological and chemical testing;
- clearly assigned operation and maintenance responsibility;
- community-level repair arrangements; and
- an emergency-use protocol during and after cyclones or floods.

The baseline recommendations already identify the need to complete the remaining raised tubewells and to combine each asset with operation and maintenance arrangements, community contributions and periodic water-quality testing.

This should remain a central design principle: a drinking-water asset should be considered resilient only when it remains functional, safe and accessible during climatic disruption.

9.5 WATER QUALITY MONITORING AND COMMUNITY CAPACITY

Infrastructure alone cannot guarantee safe drinking water. The programme should institutionalise periodic water-quality testing for project-supported drinking-water sources. Water User Groups and Village Water Management Committees can be trained to understand basic indicators and recognise potential risks, while laboratory testing can be undertaken periodically through appropriate technical partners.

The monitoring system should record:

- date of testing;
- source/location;
- basic water-quality parameters;
- bacteriological safety;
- identified risks;
- corrective action required; and
- date of subsequent verification.

Community training should also explain the relationship between flooding, salinity, contamination and drinking-water safety. This would strengthen the programme's shift from infrastructure provision toward community-managed water security.

9.6 PRIORITISING LANDLESS AND WOMEN-HEADED HOUSEHOLDS IN LIVELIHOOD SUPPORT

The livelihood component should place deliberate emphasis on households that have limited or no productive land, particularly women-headed households.

The baseline shows that livelihood insecurity is closely connected with limited assets, low and concentrated household income, migration and low participation of women in paid work. 66.67% of households have only one earning member, while 52.38% report migration history. These conditions increase the vulnerability of households when climate shocks interrupt agriculture, fishing or wage employment.

For such households, livelihood interventions should not depend on ownership of agricultural land. Instead, the programme should prioritise low-land or land-independent income opportunities that can be operated close to the household and continue during periods when outdoor work becomes difficult.

Two activities already aligned with the APF programme are particularly relevant:

Backyard Poultry

Backyard poultry provides a relatively accessible livelihood pathway for landless households because it requires limited space and can be managed close to the home. Future support should move beyond initial distribution and basic training toward:

- improved poultry management;
- vaccination and disease prevention;
- feed planning;
- mortality tracking;
- production-cycle planning;
- household-level cost and income recording;
- collective procurement where beneficial;
- market linkage;
- reinvestment from household earnings; and
- gradual reduction of dependence on grant-supported inputs.

Loom-Based Livelihoods for Women

Loom-based livelihood activities should receive particular emphasis among women who have limited access to paid employment or cannot regularly undertake physically demanding or climate-exposed work outside the home. The baseline indicate that loom-based production has the potential to provide home-based income, making it relevant for women managing household responsibilities and for periods when weather conditions restrict mobility. Support should focus on:

- skill strengthening;
- product diversification;
- quality control;
- production planning;
- costing;
- individual income tracking;
- repeat orders;
- buyer linkages;
- collective marketing; and
- reinvestment.

The programme should measure success through income generated per woman, repeat orders and sustained production, rather than simply the number of women trained. This is consistent with the existing baseline recommendation to prioritise income and repeat market engagement over participant numbers.

9.7 TARGETING WOMEN-HEADED HOUSEHOLDS THROUGH A STRUCTURED LIVELIHOOD SELECTION PROCESS

The next phase should establish transparent criteria for identifying and prioritising vulnerable landless households. Priority may be given to households that combine several vulnerability characteristics, such as:

- women-headed households;
- landless households;
- households with a single earning member;
- households experiencing seasonal migration;
- households with irregular income;
- households with limited productive assets; and
- households affected by recent climate-related livelihood loss.

9.8 LINKING WATER SECURITY AND LIVELIHOOD SECURITY

One of the strongest findings emerging from the baseline is that water and livelihood insecurity should not be treated as separate programme issues. Rejuvenated ponds can provide freshwater for irrigation and fish culture. Improved irrigation can support crop production. Crop and fish production can strengthen household income and food availability. Livelihood diversification can reduce dependence on a single climate-sensitive occupation. At the same time, reliable drinking water can reduce the burden of securing water following disasters.

The programme should therefore develop a clear water-to-income pathway:

Pond rejuvenation → freshwater storage → irrigation/fish production → food and income → household resilience

alongside:

Raised handpump → reliable drinking water during floods/cyclones → reduced disruption → improved household health and recovery capacity

and:

Landless household inclusion → poultry/loom income → diversified earnings → reduced livelihood dependence and migration pressure

This integrated approach is consistent with the baseline's conclusion that water insecurity, low-return livelihoods, migration, gendered labour burdens and climate shocks reinforce one another.

9.9 MONITORING FRAMEWORK FOR THE NEXT PHASE

Water and pond indicators

- Number of ponds rejuvenated
- Post-rejuvenation pond depth
- Bund height and condition
- Seasonal water retention
- Number of households/farmers using each pond
- Actual Rabi irrigated area
- Cropping intensity
- Crop yield
- Freshwater fish production
- Fish sales and net return

Drinking-water indicators

- Number of raised handpumps completed
- Platform height
- Households served
- Water-quality test results
- Number of functional days
- Downtime following floods/cyclones
- Repairs completed
- Community maintenance contribution

Livelihood indicators

- Number of landless households supported
- Number and proportion of women-headed households supported
- Poultry production cycles
- Poultry mortality
- Household poultry costs and net returns
- Loom production per woman
- Monthly individual earnings
- Repeat orders
- Sales value
- Savings and reinvestment

Gender and governance indicators

- Women's membership in WUGs
- Women attending WUG meetings
- Women participating in decisions
- Women holding leadership responsibilities
- Number of women-headed households receiving livelihood support
- Community contributions toward asset maintenance

9.10 SUSTAINABILITY AND COMMUNITY OWNERSHIP

The sustainability of the APF intervention should be measured by the ability of community institutions to manage assets increasingly independently of external facilitation. Village Water Management Committees and Water User Groups should progressively take responsibility for:

- maintaining registers;
- monitoring water assets;
- organising routine maintenance;
- reporting damage;
- collecting agreed maintenance contributions;
- resolving minor water-use conflicts;
- managing water-sharing arrangements; and
- maintaining transparent records.

Similarly, livelihood groups should gradually develop the capacity to manage procurement, production, sales, savings and reinvestment. The objective should therefore be to create community-managed systems rather than project-dependent assets. The baseline already identifies institutional independence, transparent records, maintenance funds, procurement and marketing as important measures of sustainability.

9.11 OVERALL RECOMMENDATION

The next phase of the Integrated Water and Livelihood Solutions programme should deepen the shift from infrastructure delivery to climate-resilient community systems. For water resources, this means rejuvenating the identified ponds to provide greater freshwater storage, with pond depths targeted up to approximately 3 metres and strengthened bunds of approximately 1.5 metres, subject to technical site assessment. Fruit-bearing trees and suitable Casuarina plantation along the bunds can further strengthen the productive and ecological value of the restored assets.

For drinking water, the programme should continue developing raised handpumps/tubewells with the water-access platform positioned at least approximately 2.5 metres above ground level, where technically appropriate, so that drinking-water access is better protected from flooding and cyclone-related inundation. Water-quality testing and community-led maintenance should remain integral to every installation.

For livelihoods, the programme should deliberately prioritise landless households, particularly women-headed households, through accessible income-generation pathways such as backyard poultry and loom-based production. The emphasis should progressively shift from training and asset distribution toward sustained income, market access, reinvestment, women's economic agency and reduced dependence on a single income source.

Ultimately, the programme's success should be demonstrated not by the number of ponds excavated, handpumps installed or people trained alone, but by whether these interventions enable families to retain access to freshwater, sustain productive activities, diversify income and recover more effectively from climate-related disruptions.

This provides a coherent pathway for the next phase:

Restore water. Protect access. Create income. Strengthen women's economic participation. Build community ownership.

That is the pathway through which water infrastructure and livelihood diversification can work together to strengthen resilience among vulnerable families on last-mile isolated Ghoramara Island.



CHAPTER 10-

DATA QUALITY AND ATTRIBUTION NOTES

- Baseline sample- 126 households and 499 household members. Percentages are reported as presented in the baseline dataset and should not be recalculated from rounded narrative values unless necessary.
- The baseline includes both quantitative household survey data and qualitative evidence from interviews, field observations and gender-specific focus group discussions.
- Some source tables use different denominators (126 households, 499 household members, 83 migrant members, etc.).
- Respondent quotations are retained from the source report and presented in quotation marks.
- Issues such as embankment strengthening, healthcare, education and potential relocation are recognised as wider system needs.



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Closing Synthesis

The baseline establishes a clear programme case: Ghoramara's water insecurity and livelihood insecurity are mutually reinforcing. The survey found heavy dependence on tubewell drinking water, low and concentrated household incomes, a high prevalence of single-earner households, widespread migration and repeated exposure to cyclones, floods and riverbank erosion. Women carry a disproportionate share of the resulting household and care burden while remaining weakly represented in paid employment and water governance.

The first phase of APF-supported implementation should focus on raised tubewells, pond rejuvenation, poultry and loom-based livelihoods, and community institutions. The next phase should resist the temptation to equate more infrastructure or more training with greater resilience. The sharper question is whether the assets and institutions are producing durable, measurable improvements in water reliability, productive water use, household net income, women's economic agency and community-led maintenance.

Management priority for Years 2–3: Complete the remaining water assets, verify actual irrigation outcomes, deepen poultry and loom profitability, increase women's influence in Water User Groups, strengthen maintenance and financial systems, and document outcome-level evidence that can be independently checked.

