THIRST, THREAT, AND TENACITY: A BASELINE OF STRUGGLE AND SURVIVAL IN GABURA AND PADMAPUKUR UNIONS OF SATKHIRA

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ABSTRACT

Bangladesh's coastal belt, particularly the Satkhira district, stands at the frontline of escalating socio-environmental distress fueled by the relentless march of climate change, salinity intrusion, and recurrent natural calamities. This study delivers a rigorous and multidimensional baseline assessment of two of the most climate-impacted unions Gabura and Padmapukur, situated in Shyamnagar Upazila. The methodology integrated household surveys (n=200), Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), and ecological and environmental assessments, supported by geospatial data, primary physico-chemical data and literature review. Findings reveal that salinity intrusion, waterlogging, frequent cyclones and widespread practices of Gher farming have significantly disrupted freshwater availability, agriculture and local livelihoods. Vulnerabilities are amplified for women and children, who bear the burden of water collection and are disproportionately affected by health and education challenges. The socioeconomic survey identified a lack of employment opportunities, inadequate road infrastructure, alarming early marriage rate, acute internal migration and severe deficiencies in educational and healthcare services. The ecological survey documented biodiversity loss across floral, faunal, and aquatic systems, identifying threatened species and degraded habitats. Physicochemical analysis highlighted poor water and soil quality, high salinity, and limited access to safe drinking water- conditions detrimental to public health and sustainable agriculture. By documenting the interlinked vulnerabilities and opportunities in Gabura and Padmapukur, this baseline study lays the groundwork for evidence-based policy and targeted interventions. It strongly advocates for the integration of Corporate Social Responsibility (CSR) frameworks and decentralized planning to bolster national adaptation strategies and foster resilience in Bangladesh's increasingly precarious coastal margins.

Keywords: *Baselines Assessment, Socio-economic Resilience, Drinking Water Crisis, Corporate Social Responsibility, Coastal Bangladesh.*

1. INTRODUCTION

Bangladesh, ranked 7th in the last Global Climate Risk Index among the countries hardest hit by climate change, is on the frontline of the climate emergency (Kreft et al., 2016). Its southwest coastal areas are particularly prone to the effects of a changing and increasingly unpredictable climate. In Bangladesh, there are approximately 29% people lives in the coastal areas which is affected by several man-made and natural disasters (Rezoyana et al., 2023). However, one of its most vulnerable districts is Satkhira, where salinity intrusion makes crops hard to grow, especially in the dry months of March and April when the problem is most acute. Waterlogging, flooding, cyclones and storm surges also wreak havoc on the local economy, food security and livelihoods. In 2009 cyclone Aila destroyed farmers' fields, vegetable gardens and fishponds in Satkhira. The powerful storm also made sources of fresh water scarcer than ever, leaving local people struggling to produce enough food. Recent cyclone Remal on 26 May 2024 for 40 hours also severely affected Satkhira. In a web publication of FRIENDSHIP (2024), it is mentioned that the Sundarbans is the Bangladesh's silent protector, took the brunt of Cyclone Remal, being the first line of defense for the flora, fauna and human populations in Bangladesh's south. It is reported that forest officials have confirmed at least 39 deer perished, with 17 others rescued. The entire Sundarbans were flooded in high tide for about 30 hours, resulting in flowing saline water into the ponds dug to contain fresh water for wild animals and forest-dwelling communities. Gabura and Padmapukur are the unions of Shyamnagar upazila under Satkhira district which are the most vulnerable areas due to climate change and disaster (SEDSO, 2023). The present study focuses on these two locations as case studies. The aim of this study is to identify the baseline situation of socio-economic, environmental and ecological status of the Gabura and Padmapukur, the two unions of Shyamnagar upazila under Satkhira district which is one of most vulnerable coastal areas. The overall objective of this study is to investigate/ find out/ assess the socio-economic, environmental and ecological status of the selected unions Gabura and Padmapukur of Satkhira District. And the specific objectives of the study are:

- To assess the present socio-economic conditions
- To assess the baseline situation of ecology
    - ✓ to gather information on the existing ecological aspects that present within and surrounding the Gabura and Padmapukur Unions,
    - ✓ to identify the potential causes of degradation of eco-species and eco-habitats, and
    - ✓ to suggest future conservation, management & monitoring of important eco-habitats & eco-species at in-situ.
- To assess the baseline situation of the environment
- To assess the water management practices
- To recommend mitigation & adaptation strategies

2. METHODOLOGY

2.1 Study Area

The study area focuses on the disaster prone Gabura and Padmapukur union of Shyamnagar upazila under Satkhira district as shown in Figure 1. BWDB constructed coastal polders 7/1 and 15 in the early sixties to protect the Padmapukur and Gabura respectively from coastal cyclone and storm surges. Kholpetua and Kobadak river pass in the west and east side of these two unions. Mangrove forest Sundarbans is located at the south of the Gabura union. Gabura Union is entirely separated from the mainland and the adjacent Padmapukur Union by the Kholpetua and Kobadak Rivers. Meanwhile, Padmapukur Union is bordered on three sides by the same rivers. The northern part of Padmapukur is connected to Pratapnagar Union by land, while the southern part is linked to Gabura Union via the Choddoroshi Bridge.

Figure 1: Study area (Padmapukur on the left, Gabura on the right)

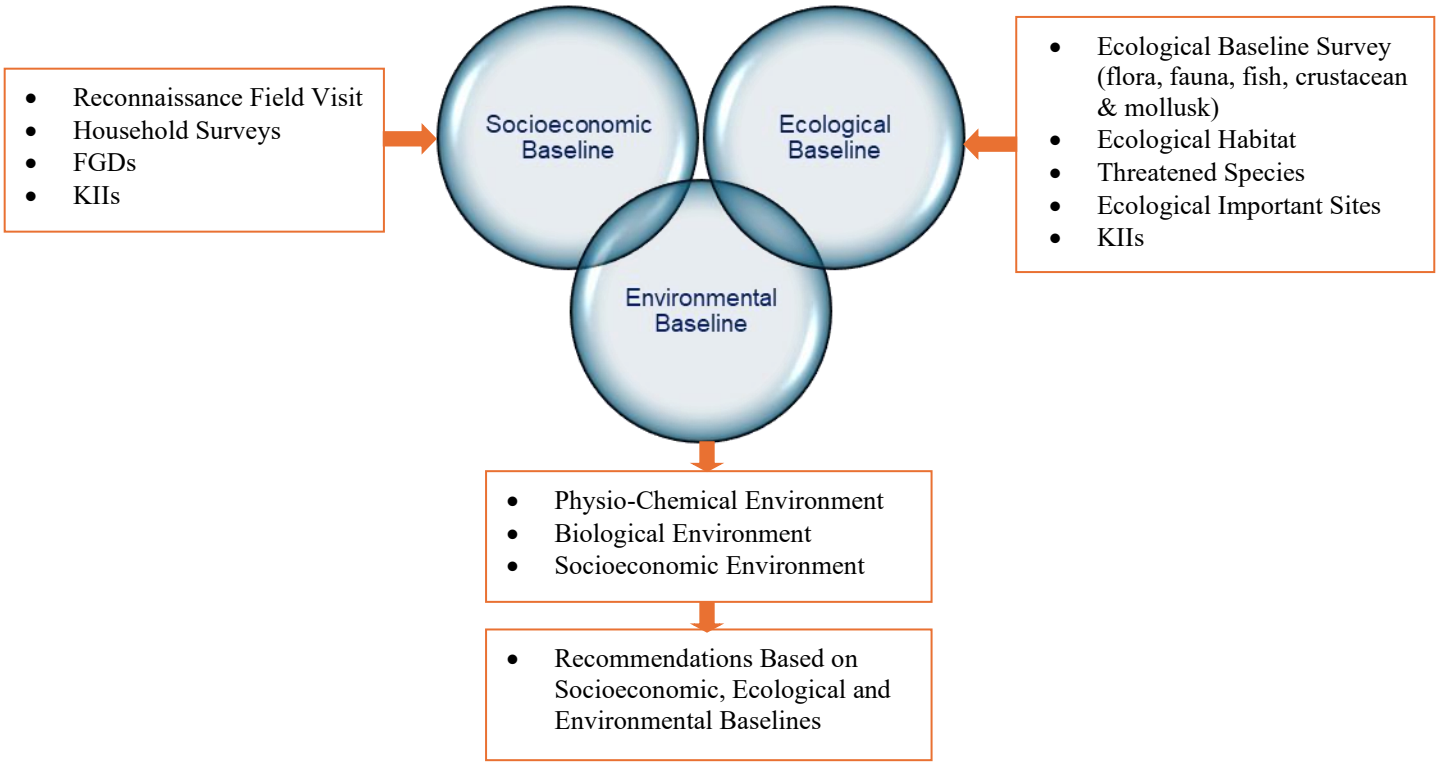


Figure 2: Methodological workflow

2.2 Methods of Socioeconomic Survey

This study was designed to assess the baseline status of the population of Gabura and Padmapukur unions in terms of socio-economic indicators. The study used both quantitative and qualitative data and information from both primary and secondary sources. At the design phase, a wide range of efforts, such as extensive literature review, two reconnaissance field visits – spending many days with the indigenous peoples had been made aiming at sharpening the methodology and understanding the contextual issues pertaining to the study. The sample population for the quantitative survey has been selected using an appropriate sampling procedure. A random sampling strategy has been adopted where the villages have been chosen as the administrative units at lower tier. A total of 200 household surveys, distributed based on the ratio of households among the villages of two unions, with 100 surveys in each union following random sampling method. In addition, qualitative exercises such as focus group discussions, stakeholder's analyses, and consultation meetings with the knowledgeable of the study areas (KII) have been conducted to get deeper insights into the relevant issues.

Figure 3: Training of the enumerators on the left, Household survey on the right

Figure 4: FGD on the left, KII on the right

2.3 Methods of Ecological Survey

A holistic approach was adopted to achieve the objectives of the ecological assessment through a combination of literature review, field investigations, interviews, and stakeholder consultations. A systematic desktop review was conducted to gather existing information on the ecological aspects of Gabura and Padmapukur Unions. Key Informant Interviews (KIIs) were held with local experts using structured questionnaires, while Focus Group Discussions (FGDs) were organized with community stakeholders to identify specific ecological issues. Field eco-assessments were carried out mainly during the day and partly at night using various methods such as line-transect (walk and boat), random and quadrate sampling, and vantage point observations. Herpeto-faunal and mammalian species were assessed through direct sightings, signs (tracks, scat, nests), and use of a bat detector, complemented by local knowledge and literature review. Ornithological surveys relied on aural and visual searches, while fish and fishery assessments involved visual observations, market and fishing area surveys, and discussions with local fishermen. Similarly, flora, crustacean, and mollusk assessments were

conducted through visual observation, sampling, and consultations with local communities. Informal discussions were also held to document the seasonal variations in ecological conditions across the study area.

2.4 Methods of Environmental Survey

The Environmental Baseline Survey encompasses three main areas: physico-chemical, biological, and socioeconomic environments. For the physico-chemical environment, all components were calculated using secondary data sources. The biological environment was described based on the Ecological Baseline Survey Report, while the socioeconomic environment was described based on the Socioeconomic Baseline Survey Report.

3. BASELINE CONDITION

3.1 Socioeconomic Baseline

The Socio-Economic Baseline Study of Gabura and Padmapukur Unions in coastal Satkhira reveals communities struggling with poverty, climate vulnerability, and limited infrastructure. Padmapukur has 6,574 households (26,136 people) and Gabura 8,090 households (33,814 people), with average family sizes of 4.6 - 4.9 and a predominantly Muslim population. Livelihoods are shifting from agriculture to shrimp farming, reducing local employment and forcing seasonal migration to other regions. Daily wages are low (BDT 400 for men, BDT 270-310 for women), and most families depend on microcredit for housing, medical care, and small-scale farming. Agriculture suffers from salinity and flooding, with significant food deficits 6,450 MT in Gabura and 4,837 MT in Padmapukur.

Health services are inadequate over 70% rely on village doctors and education suffers from poor access and high dropout rates, especially for girls, leading to 95% early marriage and around 15% divorce. Infrastructure remains poor, with mostly unpaved roads, katcha houses (78-91%), erratic electricity, and scarce internet access. Access to safe water is critical: most households depend on rainwater harvesting or tube wells, and women and children spend 1–2 hours daily collecting water due to salinity intrusion. Disaster preparedness is weak, with limited cyclone shelters and fragile embankments. NGOs such as Shushilan, Nowabenki Gonomukhi Foundation, SEDA, and Parittran play vital roles in relief, water supply, and livelihood support. Migration is widespread 59% of households have at least one migrant, mostly internal short-term laborers (OKUP, 2023). Environmental degradation, frequent cyclones, and waterlogging continue to undermine agriculture, health, and livelihoods. Despite these hardships, the communities remain resilient, showing potential for improvement through climate-resilient infrastructure, improved water management, education, women's empowerment, and livelihood diversification.

Figure 5: Scarcity of drinking water in both unions

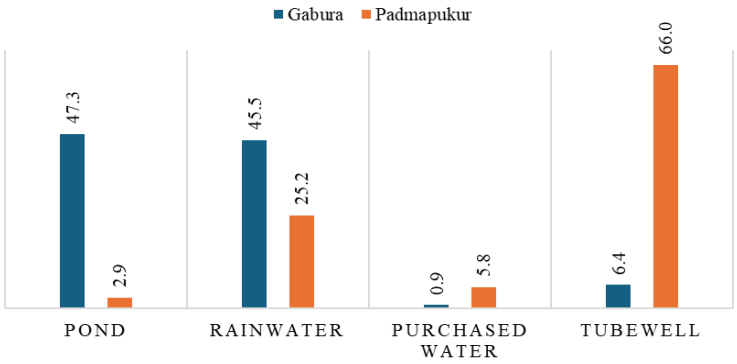


Figure 6: Comparison of major sources of drinking water

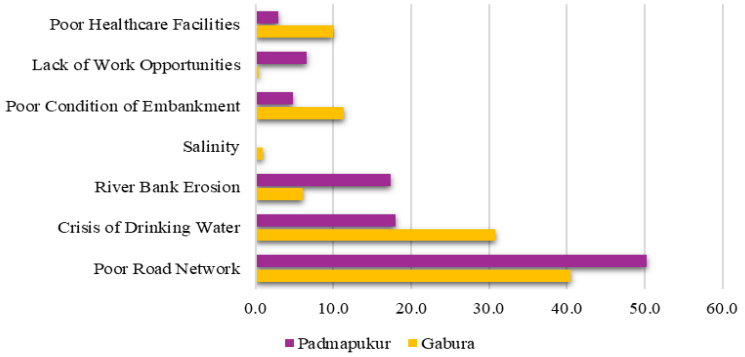


Figure 7: Comparison of major problems of both unions (Source: HH Survey)

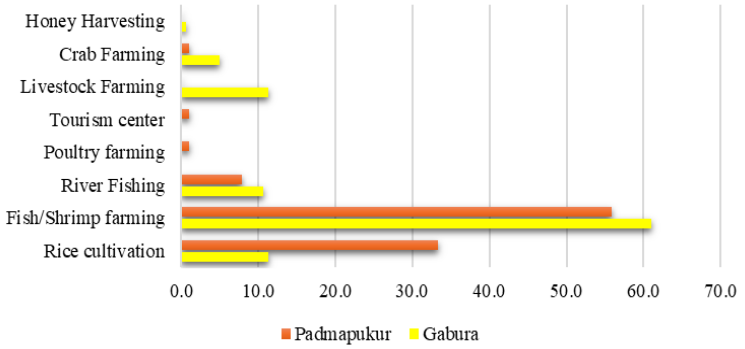


Figure 8: Comparison of major prospects of both unions (Source: HH Survey)

3.2 Ecological Baseline

The Ecological Baseline Study of Gabura and Padmapukur Unions in Shyamnagar Upazila, Satkhira District, provides an in-depth overview of the region's coastal ecosystems, biodiversity, and ecological challenges. Gabura (33 km²) and Padmapukur (37 km²) are situated between the Kholpetua and Kopotakkho Rivers, characterized by saline tidal floodplain soils and exposure to cyclones, floods, salinity intrusion, and habitat degradation. The study assessed both terrestrial and aquatic ecosystems, including flora, fauna, fish, crustaceans, and mollusks.

Both unions belong to Bio-ecological Zones 10 (Saline Tidal Floodplain) and 12 (Coastal and Marine Water), supporting diverse species due to varied soil and hydrological conditions. Eco-consultations included 4 FGDs and 4 KIIs with local stakeholders across villages, identifying community insights on ecological changes and pressures.

Floral Diversity

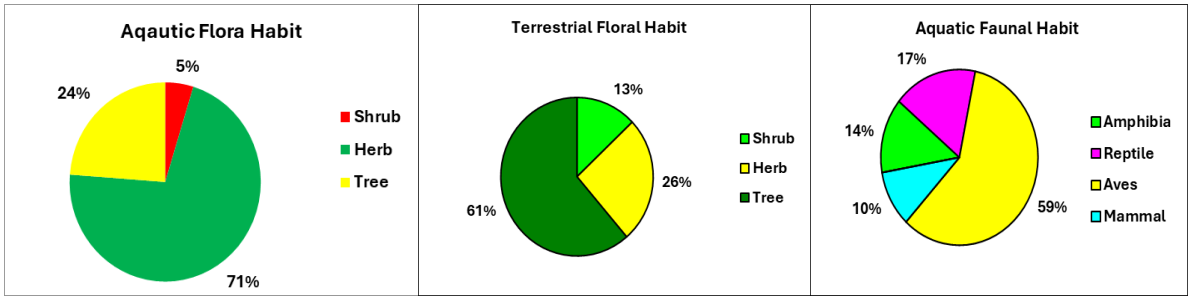
A total of 21 aquatic and 31 terrestrial floral species were recorded. Aquatic flora included Nipa Palm, Keora, Gewa, and Water Lily, found in shrimp farms and ponds, while terrestrial flora such as Acacia,

Peepul, Tamarind, and Coconut dominate homestead areas. Two-thirds of terrestrial flora are tree species, indicating moderate plant diversity shaped by both natural and planted species. Faunal Diversity The area hosts rich but declining fauna. A total of 29 aquatic and 58 terrestrial faunal species were identified. Aquatic fauna include the Ganges River Dolphin, Common Kingfisher, and Skipper Frog, while terrestrial fauna include Asian Common Toad, Scarlet Minivet, Spotted Dove, and Booted Eagle. Avian species form about 50% of the total fauna, emphasizing the ecological importance of bird habitats. A total of 31 fish species were identified in the study area, with over two-thirds belonging to brackish-water habitats, including Flathead Mullet, Barramundi, and Bengal Yellowfin Seabream. Local fishing practices primarily use cast nets, seine nets, and traditional drying methods. Additionally, 17 species of crustaceans were recorded, such as the Giant Tiger Shrimp, Yellow Shrimp, and Fiddler Crab, along with several mollusk species including Apple Snail, Brown Mussel, and Clams. These aquatic species hold both ecological and economic importance, serving as vital food sources and contributing significantly to export income.

The study area comprises three main habitat types: natural, modified, and critical habitats. Critical habitats support several endangered and vulnerable species, such as the Asian Giant Softshell Turtle, Ganges River Dolphin, Fishing Cat, Small-clawed Otter, Rhesus Macaque, and Swimming Crab. The Sundarbans Reserve Forest, situated near Gabura, represents the nearest major ecological site, with no other protected areas such as Ecologically Critical Areas (ECA), National Parks (NP), or Important Bird Areas (IBA) located nearby.

Key ecological concerns identified include severe habitat degradation resulting from shrimp farming expansion, salinity intrusion, and recurrent natural disasters. The widespread conversion of terrestrial lands into aquaculture ponds has displaced native flora and fauna, leading to the local extinction of certain species and rapid population declines in others.
To address these challenges, the report highlights the urgent need for habitat restoration and the conservation of critical species. It recommends the regulation of shrimp and mollusk farming to safeguard natural lands, the establishment of community-based biodiversity monitoring programs, and the promotion of eco-friendly aquaculture integrated with sustainable water management practices.

Overall, the Gabura and Padmapukur ecosystems are biologically rich yet increasingly fragile. With 21 aquatic flora, 31 terrestrial flora, 29 aquatic fauna, 58 terrestrial fauna, 31 fish, and 17 crustacean species, the region retains high biodiversity despite heavy human and climatic pressures. However, continued salinity intrusion, land conversion, and weak management threaten the ecological balance. Strengthening eco-conservation, habitat protection, and sustainable livelihood initiatives is vital to preserving biodiversity and ecosystem services in these vulnerable coastal areas.



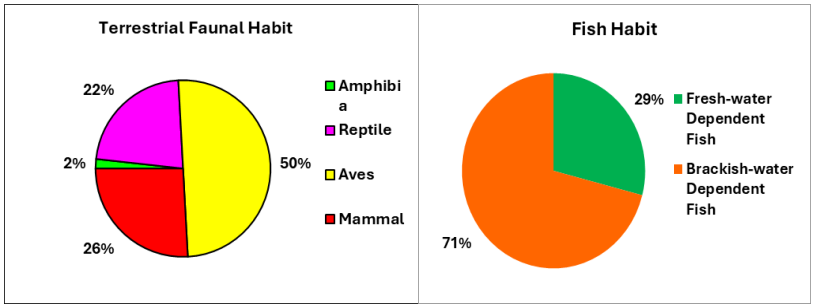


Figure 9: Distribution of Flora, Fauna and Fish in both unions

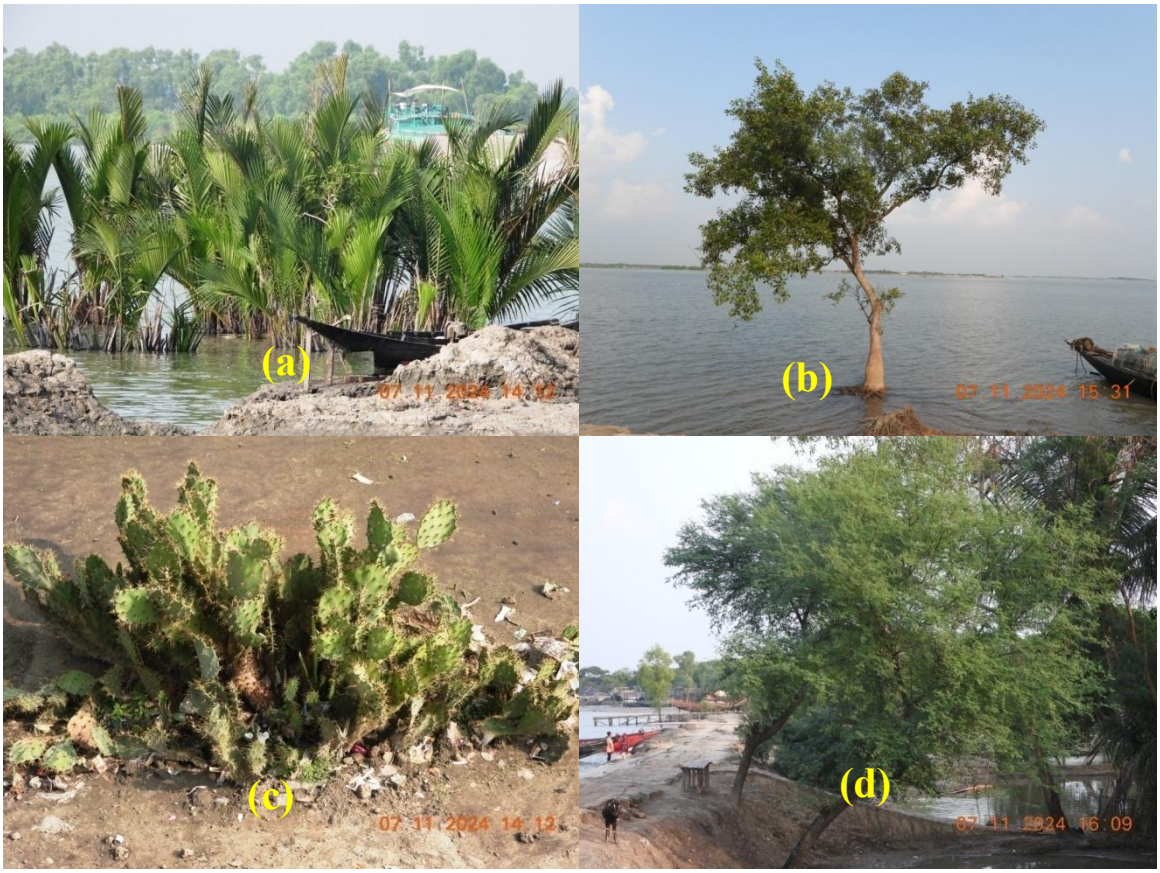


Figure 10: Some of the floras of the study areas: (a) Nipa Palm - Nypa fruticans, (b) Gewa - Excoecaria agallocha, (c) Cactus - Opuntia dilleniid, (d) Babla - Acacia nilotica

Figure 11: Some of the faunas and fishes of the study areas: (a) Checkered Keelback - Xenochrophis piscator, (b) Grey Heron - Ardea cinerea, (c) *Pacific Golden Plover* - Pluvialis fulva, (d) Asian Common Toad - Duttaphrynus melanostictus, (e) S*potted Scat* - Scatophagus argus, (f) Bengal Yellowfin Seabream - Acanthopagrus datnia

3.3 Environmental Baseline

The study area (Satkhira region) lies within the "Aw" tropical savanna climate zone per the Köppen-Geiger classification.

Maximum temperature rises from 25.5°C in January to 35.3°C (April–May) and drops to 26.5°C in December. Minimum temperature varies between 12.3°C (January) and 26.5°C (June). Rainfall is below 50 mm from January–April, peaks at >450 mm in July, and declines after September, showing a strong monsoon pattern (June–September). The 80% dependable rainfall is well below the average, indicating variability. Maximum humidity remains >90% year-round, while minimum humidity varies from 45% (Jan–Dec) to 75% (July–Aug), with higher values during the monsoon. Average wind speed peaks at 4.5 knots in April, remains above 3.5 knots (May–Aug), and drops to 2.3–2.6 knots (Oct–Dec). The prevailing wind direction is southerly to southwesterly. Sunshine Hours are highest in April (8.5 hr/day), lowest in July (3.7 hr/day). Sunshine increases again to 7.5 hr/day in November, aligning with pre- and post-monsoon clear periods. Using TROPOMI satellite data validated with DoE CAMS, R^2 values were 0.72 (CO), 0.62 (NO_2), 0.73 (O_3), 0.81 (SO_2). All pollutants were below national limits (NAAQS), indicating excellent air quality due to absence of industrial activity. Field measurements of noise data ranged 38.6–46 dB, far below the national limits (50–75 dB depending on zone), showing a quiet environment. The soils of Gabura are characterized as silty clay loam with a pH ranging from 6.5 to 7.2, electrical conductivity between 7.97 and 12.8 mS/cm, and salinity levels of 4.21–6.98%, indicating moderately saline conditions. Organic carbon content varies from 0.87% to 1.41%, reflecting low to medium fertility, while total nitrogen remains low at 0.03–0.08%. Sodium and magnesium concentrations range from 7.5–13.5 meq/100g and 5.11–6.01 meq/100g, respectively, and calcium levels are comparatively low, between 15.55 and 25.08 meq/100g (Shaibur et al., 2017).

These soil characteristics limit crop productivity, making saline-tolerant crops the most suitable for cultivation in the area. Cloud cover is highest from June to August, averaging around six oktas, while the clearest skies occur between November and February with only one to two oktas. Evaporation rates peak above 5 mm/day in April, remain steady from July to November, and drop to about 2.5 mm/day during January and December.

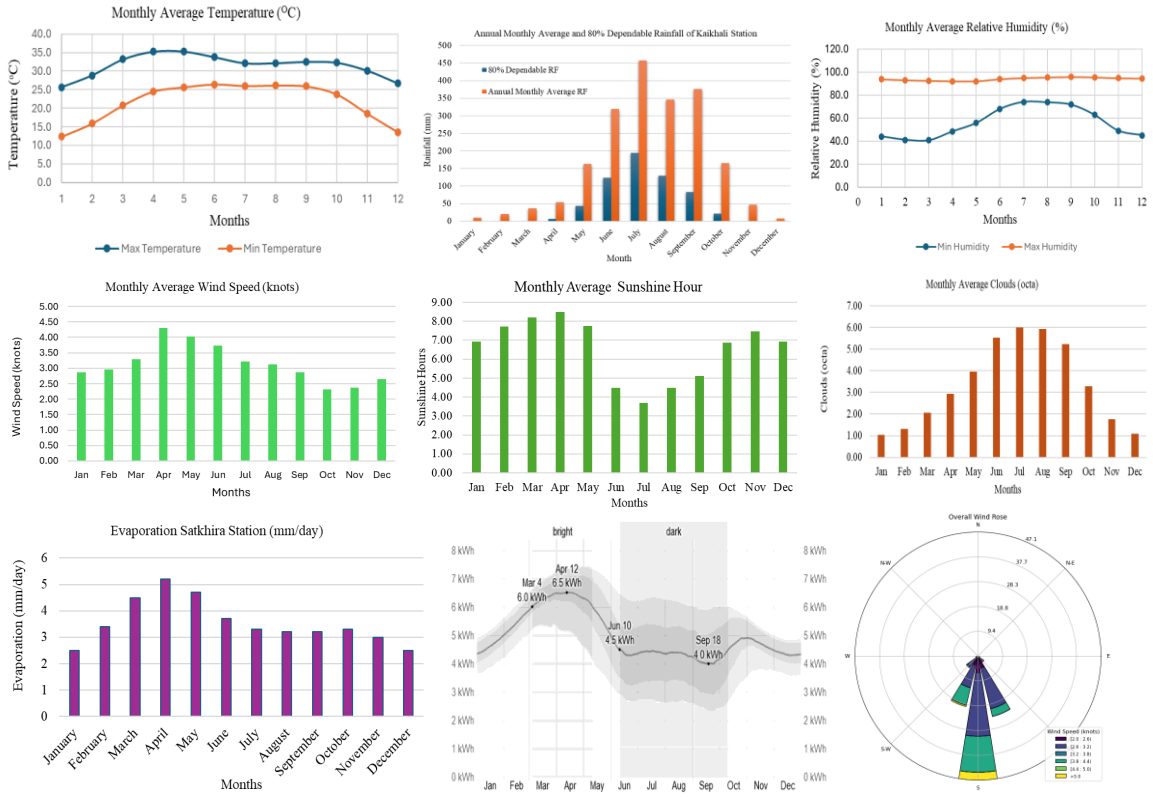


Figure 12: Some of the parameters of environment of the study area

According to the WARPO–KUET (2022) study, water quality analysis based on 91 samples collected during dry and wet seasons of 2022 shows that groundwater exhibits high salinity, with electrical conductivity reaching up to 15.02 mS/cm and chloride concentrations as high as 1382 mg/L. Total and faecal coliform counts were also significant, reaching 45,530 and 2,304 cfu/100ml, respectively. Surface water showed similar contamination, with EC values up to 11.83 mS/cm, chloride concentrations of 510 mg/L, and total coliform levels up to 57,000 cfu/100ml. Arsenic concentrations remained within acceptable limits (0–0.1 mg/L). Overall, the water in the study area is affected by salinity and microbial contamination, though arsenic is not a concern. Seasonal variation in daily shortwave solar radiation shows the brightest period between March and May, when radiation exceeds 6.0 kWh/m²/day and peaks in April at 6.5 kWh/m²/day. The lowest radiation occurs in September, averaging 4.1 kWh/m²/day. The most favorable period for tourism is from early November to early March, with peak comfort in December due to clear skies and mild temperatures.

4. CONCLUSIONS

The socio-economic, environmental and ecological assessment of Gabura and Padmapukur Unions in Satkhira District highlights the severe vulnerabilities these regions face due to climate change, environmental degradation, and socio-economic challenges. The study identifies key issues such as declining agricultural productivity, inadequate healthcare and education services, gender-based vulnerabilities, and migration driven by environmental stressors. The region also suffers from

environmental threats, including soil salinity, biodiversity loss, and habitat destruction due to unsustainable shrimp farming and deforestation. Additionally, climate-induced disasters such as cyclones and floods have exacerbated the vulnerabilities of the local population. Despite these challenges, there is potential for resilience and sustainable development if appropriate interventions are implemented. The study underscores the necessity of an integrated approach that combines ecological conservation, sustainable livelihood strategies, improved infrastructure, and policy support to enhance resilience and adaptation capacities in these communities.

5. RECOMMENDATIONS

5.1 Socioeconomic and Environmental Recommendations

Education

- Provide financial support to families (e.g., food for education, scholarships, cash transfers) to reduce dropout rates.
- Establish colleges within the study areas to improve access to higher education for both boys and girls.

Health

- Improve access to healthcare through well-equipped hospitals, community clinics, and mobile health units.
- Ensure availability of registered doctors for maternal and child healthcare.

Transportation

- Construct metalled roads connecting clinics, cyclone shelters, and schools for better accessibility.
- Build bridges to connect polderized areas with the mainland.

Livelihood

- Reintroduce agriculture through soil reclamation, salt-tolerant crops, soil amendments, irrigation management, and farmer training.
- Discourage environmentally harmful gher farming due to its negative socio-economic and ecological impacts.
- Promote eco-friendly tourism focusing on the Sundarbans and community participation.

Migration

- Create local employment and better wage opportunities to reduce forced migration.
- Improve infrastructure—education, health, transportation, and electricity—to enhance living conditions.
- Construct and upgrade embankments to protect communities from cyclonic surges.
- Encourage legal migration through training and awareness programs.

Safe Drinking Water

- Identify and protect potential drinking water sources with community management.
- Promote rainwater harvesting systems, especially for poor families.
- Develop pipe-based water supply systems from safe sources to community outlets.
- Explore new water reservoirs and modern technologies such as MAR, RO, and other desalination methods.

Gender-Based Vulnerabilities (Early Marriage & Divorce)

- Ensure girls' access to quality education and empowerment through life skills and mentorship programs.
- Raise awareness about the negative impacts of early marriage and engage community and religious leaders to prevent it.
- Provide economic support and vocational training for young women to enhance independence.
- Enforce legal frameworks that uphold the minimum marriage age of 18.
- Promote education on conflict resolution, communication, and financial management to prevent divorce.

- Offer financial and livelihood support to reduce economic stress in families.

5.2 Eco-Conservation and Management

- Implement habitat restoration and species conservation programs involving communities and experts.
- Conduct eco-social awareness programs highlighting the value of biodiversity and habitats.
- Introduce eco-land use initiatives to limit shrimp farming and restore agro-land.
- Launch eco-conservation measures to prevent hunting and killing of wildlife, coupled with alternative livelihood programs.
- Regulate brackish water intrusion for aquaculture control.
- Create eco-ponds with freshwater for habitat restoration.
- Provide eco-awareness training and prepare GIS-based eco-maps for conservation planning.
- Establish long-term eco-monitoring programs (2025–2060) for flora, fauna, fish, crustaceans, mollusks, and related habitats.

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