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Vulnerability and Resilience in Coastal Bangladesh

An assessment of flood Risk in the polder systems of Khulna Division

Key Messages

- Predictive risk assessments should not rely on a myopic viewpoint, relying simply on flood exposure, but should consider the complex mix of tangible assets, as well as the community's adaptive capacity
- Continued negligence of the polders could result in a catastrophic disaster for the region, rather than locally manageable issues.
- Repairing the polders' infrastructure should be joined by fortifying the surrounding communities' capacity to practice adaptation strategies, otherwise lasting resilience will be difficult to achieve.
- A complex relationship exists between economic needs and collective safety, where shrimp farming poses a conflict at the intersection of economic necessity and climate resilience.

Executive Summary

This policy brief focuses on the climate change vulnerability and resilience in four polder areas of Khulna, Bangladesh, and the adaptive capacity of each respective locality. The brief also explores the impact of various factors that have historically impacted the conditions of the polders, such as extreme weather events and lack of maintenance and upkeep.

The brief further explores the usage of a fuzzy model logic to predict future damages in the study areas, compounded by the effects of cyclonic events and rising sea levels. In order to address these issues, the brief recommends policies addressing the urgent repairment of polder infrastructure, regulated land zoning for shrimp farming, formalising LLA efforts, and constructing elevated housing.

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Introduction

Bangladesh is considered to be one of the world's most climate-vulnerable countries, with the coastal regions in particular scoring around 5.7-6.5 across three dimensions of hazard exposure, vulnerability, and coping capacity as per the Index for Risk Management (INFORM), reflecting very high risk coupled with limited resilience (Bomer et al., 2020; United Nations Resident Coordinator's Office & Ministry of Disaster Management and Relief, 2022).

The coastal zone of the country is home to around 45 million people (BBS, 2022; Ahsan et al., 2024), who frequently experience the impacts of climate change-induced disasters through cyclones, floods, saline water intrusion, storm surges, etc. This results in devastating losses of life, property damage, and severe environmental degradation.

The situation is further exacerbated by the socio-economic conditions of the region, especially for those living below the poverty line (Ashrafuzzaman, 2022).

In an effort to mitigate the damages and safeguard the coastal region, the Coastal Embankment Improvement Project (CEIP) was enacted in the 1960s in Bangladesh. The project involved the construction of "polders", which are low-lying tracts of land surrounded by walls of earth (embankments). The polders serve two primary functions: as a defense mechanism against tidal flooding and saltwater intrusion, and as a drainage system for excess rainwater.

This aims to create a controlled environment for promoting agriculture, and the economic well-being of the inhabitants of the coastal regions (Segeren, 1983).

reduced soil fertility and increased salinity in the surrounding land, owing to congestion in the internal drainage systems and sedimentary accumulation.

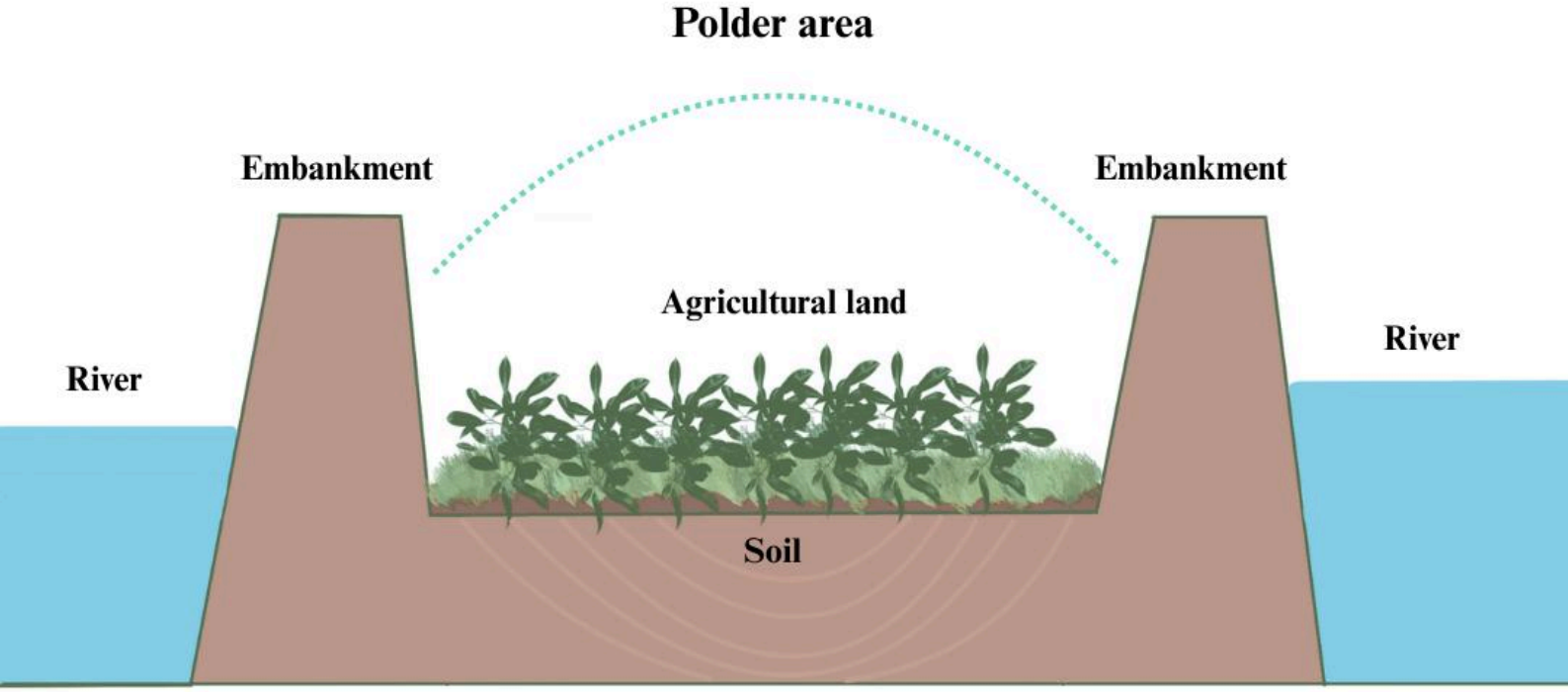

Figure 1: Diagram of a polder adapted from Mainuddin et al. (2019)

The 139 polders built throughout the region were initially significantly helpful, but over the years, their efficacy has compromised severely, owing largely to the severe cyclones, such as Sidr in 2007, Aila in 2009, and Amphan in 2020 (Dasgupta et al., 2010; Islam et al., 2019; Hossain, 2022). Coupled with poor maintenance and insufficient management efforts, the polders have now brought forth a new set of challenges, such as

The study, which provides the foundation for this brief, is based on the conditions of four polders, emphasises the urgent need to rehabilitate their damaged infrastructure in an effort to enhance resilience to the threats of climate change.

Background

The thesis focuses on four specific polders (7/1, 7/2, 10/2, and 13-14/2) within the Khulna and Satkhira districts, as part of the CEIP Phase 2 project.

In order to assess and analyse the impacts of environmental damages, the study used a mix of both qualitative and quantitative methods. Household surveys were conducted to collect quantitative data, in an effort to assess the financial damages from past cyclones and to illustrate flood damages. This was complemented by qualitative insights from focus group discussions (FGDs) and interviews with members of the locale to understand their lived experiences and adaptive strategies. Current and future inundation rates were also measured using ArcGIS, and a fuzzy logic model was developed to predict damages under the high-emissions Representative Concentration Pathways (RCP) 8.5 scenario, which is a model where greenhouse gasses keep rising, resulting in about 4 degrees celsius warming by the year 2100. Lastly, the socio-economic impacts inflicted by the COVID-19 pandemic on these vulnerable populations were also included to complement the thesis findings.

Polder 7/1

- Located in Pratapnagar and Paddapokur Unions (Satkhira District)
- Surrounded by the Kobadak and Kholpetua rivers
- Covers 3887 hectares (2700 hectares cultivable)

Polder 7/2

- Located in Pratabnagar, Anulia, Baradal, and Khaira Unions (Satkhira District)
- Surrounded by the Kobadak and Kholpetua rivers
- Covers 10953 hectares (3375 hectares cultivable)

Polder 10/2

- Located in Laskar, Chandkhali, Garuikhali, Amadi, and Moheshwaripur Union Parishads (Khulna District)
- Surrounded by Koyra, Kapatakshi, Shibsha, and Karulia rivers
- Features 15 drainage sluices

Polder 13-14/2

- Located in in Bagli, Maheshwaripur, Maharajpur, Koyra, and Uttar Bedkashi Union Parishads (Khulna District)
- Surrounded by by Kapataksho, Koyra, and Shagbaria rivers, near the Sundarbans
- Features 15 drainage sluices (13 are damaged)

Key Findings

- ***Historical vulnerability may not predict future risk:*** The predictive fuzzy logic method used in the thesis revealed that areas that faced the brunt of climate disasters in the past may not face the greatest risk in the future. Despite historical evidence stating that Polder 7/1 has faced the most damage, predictions for the year 2100 show that Polder 7/2 currently poses the most risk, as it holds more tangible assets (croplands, aquaculture, settlements, etc.). This finding highlights how predictive risk assessments should not rely on a myopic viewpoint, relying simply on flood exposure, but should consider the complex mix of tangible assets, as well as the community's adaptive capacity.

- ***Deteriorating infrastructure is a primary component of vulnerability:*** Based on the thesis's projections, a drastic increase in flooding is imminent, where major flood events could submerge more than half the area covered in the study. Therefore, continued negligence of the polders could result in a catastrophic disaster for the region, rather than locally manageable issues.

- ***Structural solutions cannot be effective without the communities' adaptive capacity:*** Urgent repair and rehabilitation of the polders is of utmost importance. However, repairing the infrastructure should be joined by fortifying the surrounding communities' capacity to practice adaptation strategies, otherwise lasting resilience will be difficult to achieve.

- ***A complex relationship exists between economic needs and collective safety:*** In the study areas mentioned (Satkhira and Khulna districts), shrimp farming poses a conflict at the intersection of economic necessity and climate resilience. Shrimp farming, a key livelihood practice, creates a destructive cycle which requires farmers to cut into the embankments, thus worsening the flood risks and making it even harder for vulnerable communities to cope and adapt.

Policy Recommendations

- ***Prioritse polder rehabilitation with updated designs:*** Given how many of the polders are in a state of disrepair, temporary fixes will not suffice. The Bangladesh Water Development Board (BWDB) should focus on fast-tracking the rehabilitation of the polders, with specific attention given to Polder 7/1 (the most historically damaged) and Polder 7/2 (predicted to have the highest future damage rates). Additionally, new designs should incorporate projections for future sea-level rise, as well as account for the growing intensity of recent storm surges, to increase the strength and durability of the embankments.

- ***Regulate land-use zoning around embankments and provide livelihood support:*** Given how the practice of cutting into the embankments significantly weakens the structures, clear land-use regulations should be enacted by the local governments to designate specific zones for aquaculture that do not compromise the integrity of the polders. However, since shrimp farming is a highly significant livelihood practice, land-use regulation alone will only add to the economic burdens of the communities. Therefore, these regulations should be paired with alternative livelihood support for members of the community.

- ***Formalise and directly fund locally led adaptation (LLA) efforts:*** Ad-hoc consultations with local community members should be transitioned into a formal LLA framework for the coastal region, particularly for those residing near the polders. An official, Community-Based Organisation could be established who are entrusted with the decision-making and fund allocation for the upkeep and maintenance of their local polders, ensuring that adaptation efforts are context-specific and sustainably managed by the people they are designed to protect.

- ***Establish programmes to support construction of elevated resilient housing:*** A government-supported programme could be launched to incentivise and support the construction of elevated housing in high-risk coastal areas. The programme could also offer financial assistance, such as low-interest loans, to members of the locale and launch initiatives to provide technical guidance on constructing flood-resilient homes.

NOTE:

*This policy brief is based on CCD 2022-23 COLOCAL Fellow Md. Shahadat Hossain's thesis titled, ***"Climate Change Vulnerability and Resilience of People Living in the Polders Area of Khulna Division and Assessment of Effectiveness of Locally Led Adaptation (LLA)".*** The master's thesis was part of the COLOCAL project's initiative to develop a greater evidence base on locally-led adaptation in Least Developed Countries. Funded by the NORHED II programme, the project's overall objective is to foster collaborative learning and capacity building in the Global South, with Independent University, Bangladesh (IUB) as a partner in Bangladesh.

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