ICWFM 2025

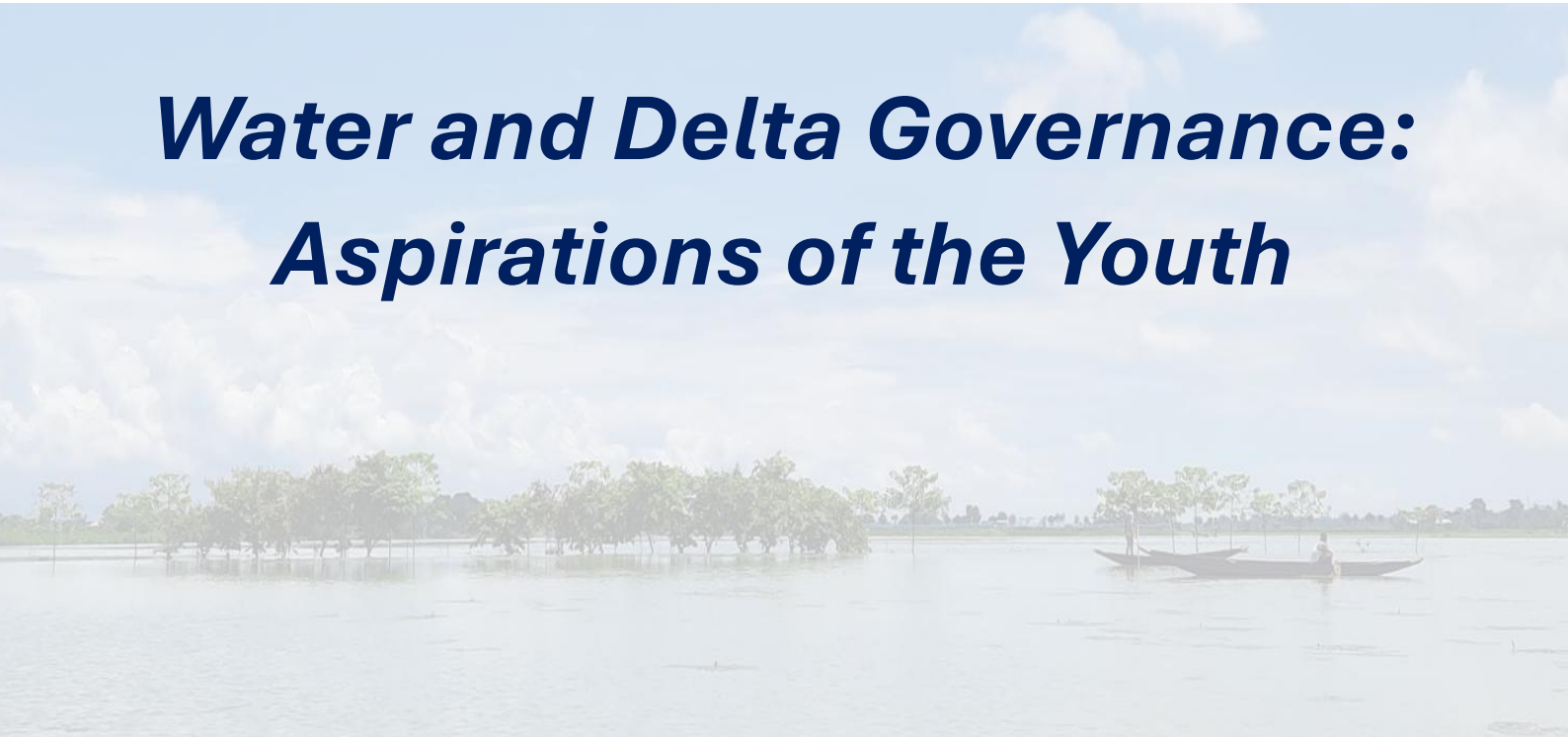
10th International Conference on Water and Flood Management

with special focus on

Water and Ecosystem Conservation for Climate Resilience

22-24 February 2025 Dhaka, Bangladesh

Water and Delta Governance: Aspirations of the Youth



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Aspiration Paper
Theme: Water and Delta Governance: Aspiration of the Youth

Title: Bridging the Water Governance Gap: Youth Engagement and Political Reforms in Bangladesh

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ABSTRACT

The degradation of the Mayur River in Khulna, Bangladesh, highlights significant deficiencies in water governance. These include weak enforcement of surface water property rights, lack of accountability among water sector officials, and insufficient decentralization within existing laws. Key governance gaps, such as the absence of integrated legal frameworks for water treatment, inadequate pricing policies, and weak linkages between water laws and policies, further aggravate the situation. Youth and local communities could play pivotal roles in improving the river's condition through awareness campaigns, monitoring river development projects, and advocating for sustainable practices. Proper waste collection systems, efficient waste treatment plants, and stricter enforcement of regulations are critical measures for cleaning and maintaining the river. This study explores the potential of youth engagement, public participation, and regional expert collaboration to bridge these governance gaps. By adopting the principles of good governance outlined by OECD (2015), a sustainable solution can be achieved.

1. Introduction

Bangladesh is a riverine country with approximately 700 rivers, relies heavily on water as a vital natural resource, supporting its ecosystem and the livelihoods of millions (Chowdhury, 2010). However, over the past three decades, pollution, encroachment, and reduced environmental flow have severely degraded many rivers. Unmanaged solid waste dumping, wastewater discharge, river sedimentation, unplanned embankments, and encroachments are common issues, threatening the ecosystem's health and the goods and services rivers provide.

In Khulna city, the Mayur River exemplifies this crisis. Spanning 11.69 km through urban and peri-urban areas, the river serves as a critical resource for irrigation and drainage. Mayur, once a storehouse of freshwater fish and a helping hand for agriculture, has now become a severely polluted, water-hyacinth riddled waterbody (Roy, 2022). Yet, numerous sewage outfalls, illegal encroachments, and waste dumping have rendered its water highly contaminated, unfit for irrigation, and significantly reduced its capacity to manage surface runoff, leading to severe waterlogging during rainfall (Akber et al., 2010; Hashan and Moniruzzaman, 2021; Haldar et al., 2022).

Addressing such challenges requires robust water governance. Defined by GWP and UN-Water WWAP, water governance encompasses the political, social, economic, and administrative systems managing water resources and services (UN, 2015). Although Bangladesh has enacted

various policies, including the National Water Policy (1999) and the Bangladesh Water Act (2013), gaps in implementation and governance persist (Ahmed et al., 2023).

This paper focuses on bridging the governance gap for the Mayur River's degradation, emphasizing public participation, youth involvement, and regional integration to ensure sustainable water management. This study also explores how recent political reforms in Bangladesh can foster improved water governance and highlights the critical role of youth in shaping inclusive and sustainable approaches, in the dimensions of OECD Principles on Water Governance intend to contribute to tangible and outcome-oriented public policies (OECD, 2015).

2. Materials and methods

To achieve a comprehensive understanding of the issue, a qualitative research design was adopted, using Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) as the primary methods of data collection. These methodologies were chosen to capture local communities' lived experiences as well as the opinions of key stakeholders in governance and environmental management. The data for this research was collected using two main qualitative techniques: Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs).

Focus Group Discussions (FGDs): Focus group discussions were held to engage local community members, including residents, fisherman, farmers, and other stakeholders who rely on the Moyur River. These discussions aimed to explore the community's perceptions of water contamination, its causes, and the consequences for their livelihoods and the environment. Another FGD was done with a youth group who are the students of different public universities of Khulna city. The focus group discussions also delved into participants' perspectives on the **effectiveness of local governance** in pollution management, as well as their recommendations for change.

Key Informant Interviews (KIIs): A total of 14 KIIs were conducted with individuals who were actively involved in the governance of the Moyur River or had expertise in water pollution management. In depth interviews were conducted with important stakeholders including local government officials, environmental activists, policymakers, and water resource management professionals. These interviews aimed to better understand the institutional and governance problems associated with river pollution, the role of political movements in policymaking, and the impact of recent political uprisings on environmental regulation.

3. Results and Discussions

The Bangladesh Water Act and related policies address issues such as water rights, equitable sharing, and gender participation, but they lack clear provisions for corruption control, accountability, and transparency (Rahman et al., 2022). The weak enforcement of environmental regulations and inadequate mechanisms for monitoring and implementation exacerbate pollution in rivers like the Mayur.

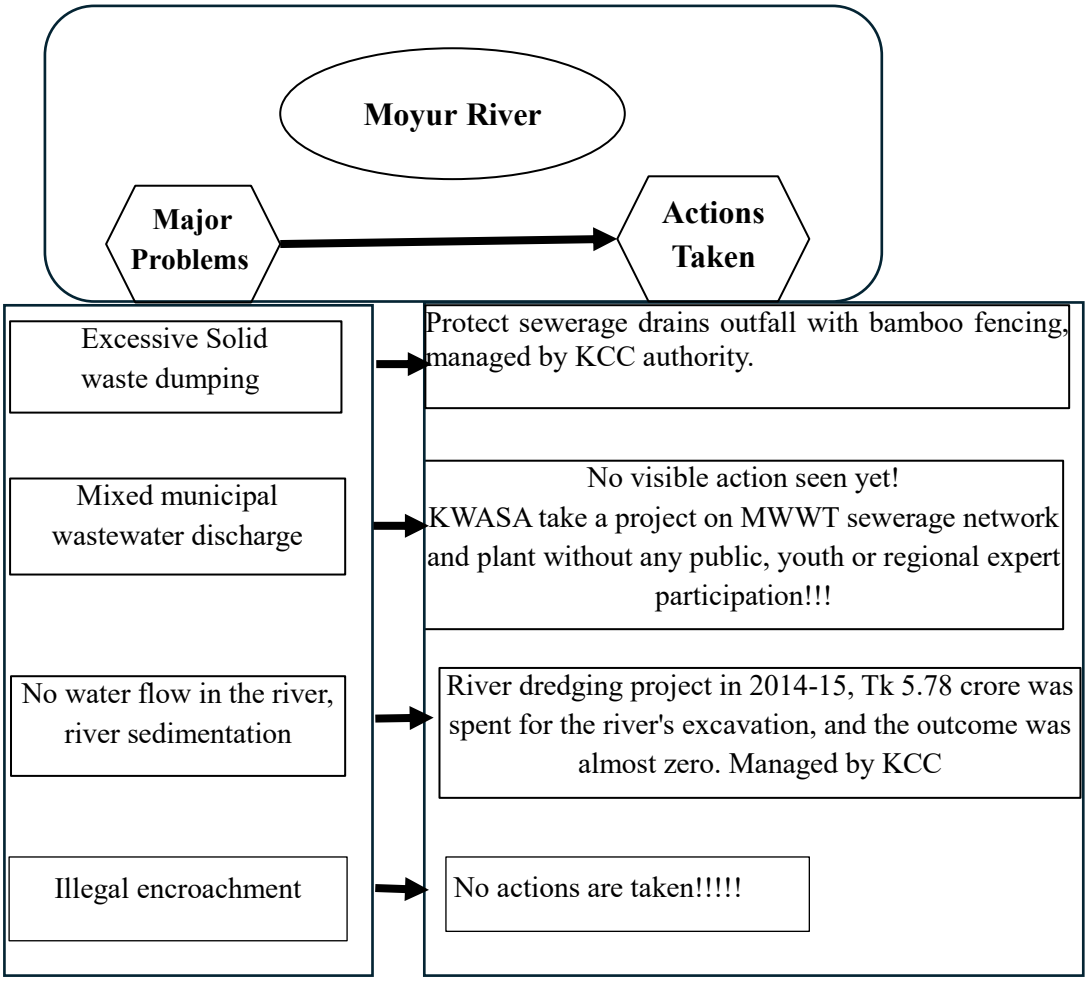

Figure 1: Flow chart of Moyur river existing management.

From the FGDs it has found that, the Mayur River in Khulna, Bangladesh, is facing significant challenges due to water pollution, primarily caused by untreated sewage, industrial discharge, and improper waste disposal (Figure 1). The river's declining water quality has been linked to increased contamination, reduced oxygen levels, and a drop in aquatic biodiversity. Human activities such as industrial waste discharge, agricultural runoff, and inadequate waste collection systems further exacerbate the issue. Weak enforcement of environmental regulations and insufficient infrastructure contribute to the persistence of these problems, while public awareness about pollution and its consequences remains minimal. Community impacts, such as degraded ecosystems and livelihoods, do not appear to have led to widespread health concerns or noticeable declines in fish populations.

However, the lack of proper waste management infrastructure, including waste treatment facilities, has intensified pollution, with waste often disposed of directly into the river. No actions taken for effective solid waste management before dumping into the drains. The absence of effective waste management policies highlights the urgency of developing comprehensive solutions to mitigate pollution. A policy needed for solid waste collection and treatment system development. For this integrated institutional effort is very crucial. Key institutions such as Khulna City Corporation (KCC), Khulna Development Authority (KDA), Bangladesh Water Development Board (BWDB), Khulna Water Supply and Sewerage Authority (KWASA), the Office of the Deputy Commissioner, the Department of Environment (DoE), and the Ministry of Water Resources should work together to implement sustainable

solutions. Public participation and youth involvement is also necessary to ensure a collective approach for managing waste and wastewater effectively.

Governance challenges, including poor coordination among local, regional, and national authorities, limited public involvement, and weak accountability, hinder effective river management. Local NGOs and civil society organizations have made efforts to raise awareness and promote sustainable practices, but their reach remains limited without stronger governmental support. GO-NGO combined effort is required for better management of the river. Although it is difficult in the present administrative situation, initiatives must be taken as the present sociopolitical situation will take a long time to recover. This can be enhanced by the joint approach of GO-NGOs to work together in this regard. NGOs, with their strong community connections, can mobilize local populations to actively participate in river waste management while Govt. can support NGOs by legitimizing their efforts and integrating them into national or regional plans. Addressing these issues requires enhanced enforcement of environmental regulations and investments in waste management infrastructure. For the investment, government should primarily invest in it. Sustaining waste management initiatives requires consistent financial support, which is often difficult for NGOs dependent on donor funding or grants. Many donors provide funding for short-term projects. Moreover, securing permits, approvals, and government cooperation can be time-consuming and hinder progress. Engagement of local communities in governance processes also very important. For the active participation of people, communities can be represented in the decision-making process by forming river committees comprising local residents, youth and women, ensuring diverse perspectives. Besides, livelihood opportunities such as eco-friendly riverbank planting, waste and water hyacinth removal initiatives can benefit communities economically while encouraging environmental stewardship.

Youth and local communities could play pivotal roles in improving the river's condition through awareness campaigns, monitoring river development projects, and advocating for sustainable practices. Proper waste collection systems, efficient waste treatment plants, and stricter enforcement of regulations are critical measures for cleaning and maintaining the river.

Recent political changes present both opportunities and challenges for governance reform, depending on their prioritization of environmental issues. To restore the health of the Mayur River and ensure its long-term viability, collaboration between administrative institutes and local communities is crucial. However, the current local governance is largely ineffective, and the administrative institutes are not functioning well. In this situation, the local community must step forward to take proactive action. Currently, there is no institutional venue for communities to participate in decision-making. One potential strategy could be to form "River Committees" consisting of local residents, NGOs, and professionals. These committees would represent community concerns and create a platform for dialogue with authorities, fostering mutual understanding and coordinated action. KCC can take lead in this process and other Institutes such as Khulna Development Authority (KDA), the Office of the Deputy Commissioner, and the Department of Environment (DoE) should cooperate with local communities in a more friendly and supportive manner. In summary, restoring the Mayur River’s health demands a multifaceted approach involving community participation, youth engagement, stricter governance, and effective enforcement of environmental policies. Collaborative efforts among stakeholders, including government bodies, NGOs, and the community, are essential for addressing pollution and ensuring the long-term sustainability of the river.

When it comes to the management of water resources, Khulna City lacks institutional coordination for implementing The National River Conservation Commission Act, 2013. The

primary cause of this is the various ownership arrangements of the water bodies. Insufficient waste management frameworks, poor coordination among government bodies, and limited community involvement further hinder effective river management. The city corporation did the work without any proper survey and technical analysis for river excavation. In 2014-15, about Tk 5.78 crore was spent by Khulna city corporation for the river's excavation, and the outcome was almost zero. The city corporation did the work without any proper survey and technical analysis. Here the lack of coordination between various institutions is very evident.

Transparency in governance remains weak, with corruption in development projects eroding public trust. According to KCC, a technical committee was formed in February 2019 to compile a list of illegal grabbers. They listed 362 establishments, constructed by 470 individuals and organizations occupying the river and 26 adjoining canals (Roy, 2022). The grabbers are not active at present, alleged locals, after the political shifts they fled. A youth lead river protection committee with local people's participation can potentially be formed to protect illegal encroachment.

Additionally, there is a lack of public awareness, youth engagement, and integrated strategies that consider the social, environmental, and economic aspects of sustainable water management an approach of integrated water resource management.

Furthermore, there is an insufficient focus on public awareness and education about the consequences of pollution, as well as a lack of strategies to engage youth in cleanup efforts, research, and advocacy in different existing policies. Overall, current policies neglect integrated and sustainable approaches that consider the social, environmental, and economic dimensions of river management.

4. Conclusion

In conclusion, the Mayur River exemplifies the challenges faced by river systems in rapidly urbanizing regions, particularly in developing countries like Bangladesh. Despite its critical role in supporting the ecosystem, local livelihoods, and urban infrastructure of Khulna City, the river is severely degraded due to unchecked pollution, weak governance, and insufficient waste management systems. Governance failures, including poor coordination among stakeholders, lack of transparency, and limited community engagement, have compounded the problem, leading to ineffective management and policy implementation. However, the current political landscape in Bangladesh offers a unique opportunity to address these issues through reform and innovation. To enable active participation and improve governance for restoring the Mayur River, several measures can be adopted. To achieve meaningful improvements, establishing community river committees and incentivizing local participation through grants or recognition programs can empower both youth and communities. Additionally, strengthening environmental regulations with stricter enforcement and penalties can effectively stop illegal river encroachment. Public-private partnerships and stakeholder coordination forums can attract investments in waste management and wastewater treatment initiatives. Furthermore, educational programs and youth engagement initiatives can foster environmental awareness and a sense of responsibility within the community, ensuring sustainable management of the river for future generations.

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PRESENTATION NO: 01

Title: Bridging the Water Governance Gap: Youth Engagement and Political Reforms in Bangladesh

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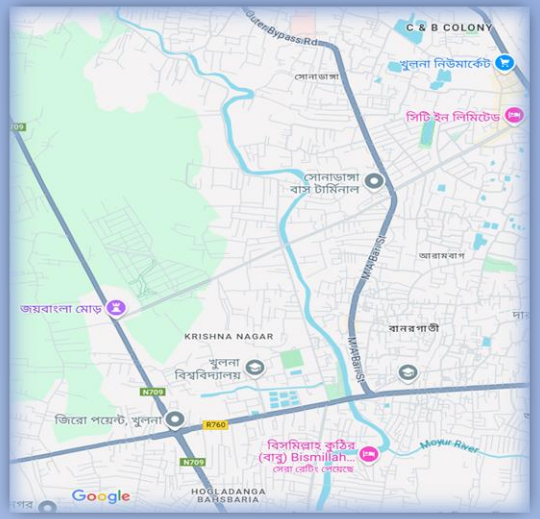
Bridging the Water Governance Gap: Youth Engagement and Political Reforms in Bangladesh

A Case Study on the Mayur River, Khulna

Background


Rangpur
Mymensingh
Sylhet
Rajshahi
Dhaka
Khulna
Chittagong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খুলনা নিউমার্কেট
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সোনাডাঙ্গা
বাস টার্মিনাল
জয়বাংলা মোড়
KRISHNA NAGAR
খুলনা
বিশ্ববিদ্যালয়
বানরপাতা
জিরো পয়েন্ট, খুলনা
Moyur River
Google

Excessive Solid Waste Dumping

Mixed Municipal Wastewater Discharge

No water flow in the River, River sedimentation

The sluice gate is not opened and closed on time

Illegal encroachment

- In 2014-15, about Tk 5.78 crore was spent by Khulna city corporation for the river's excavation, and the outcome was almost zero.

- A technical committee was formed in February 2019 to compile a list of illegal grabbers.
- The grabbers are not active at present, alleged locals, after the political shifts they fled.

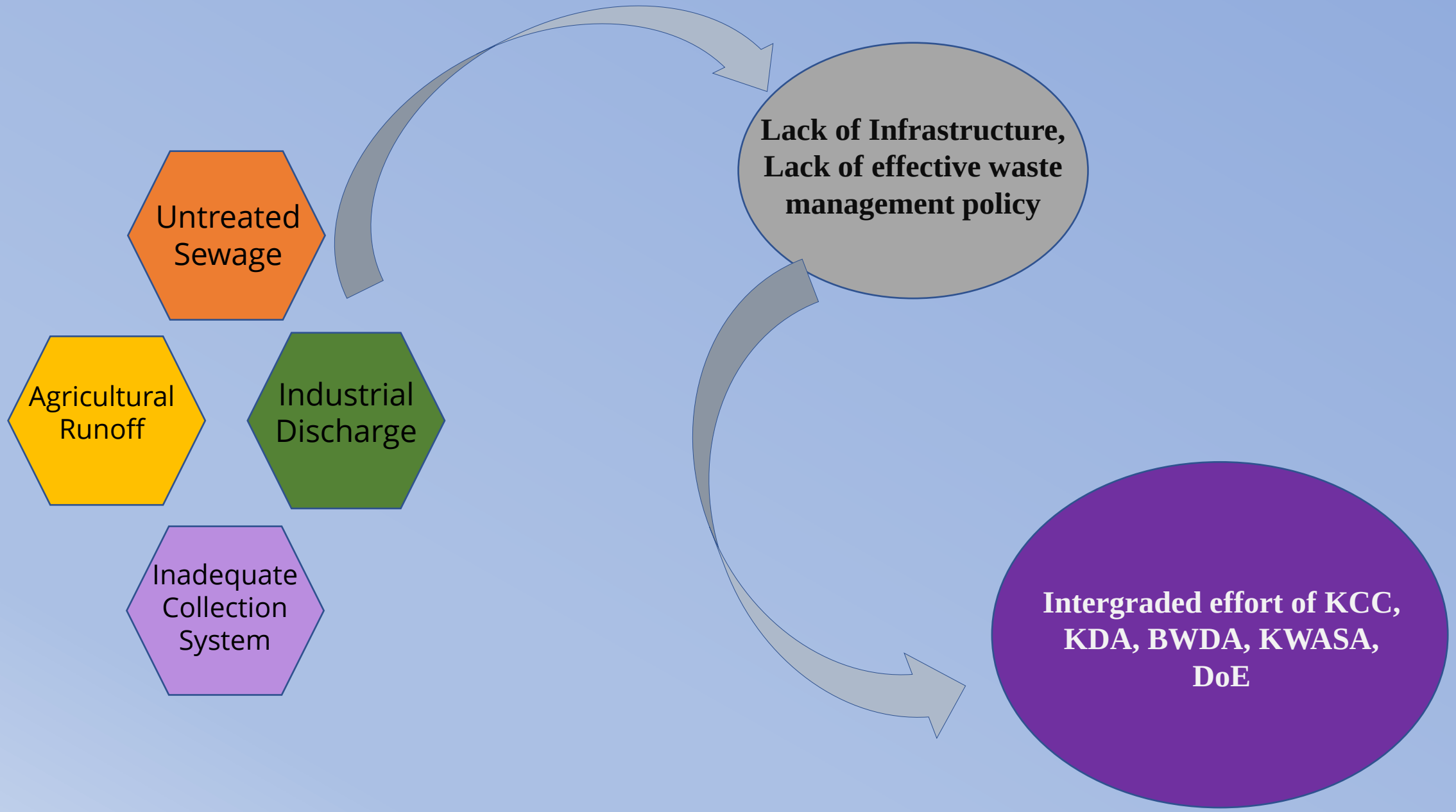
KCC

DoE

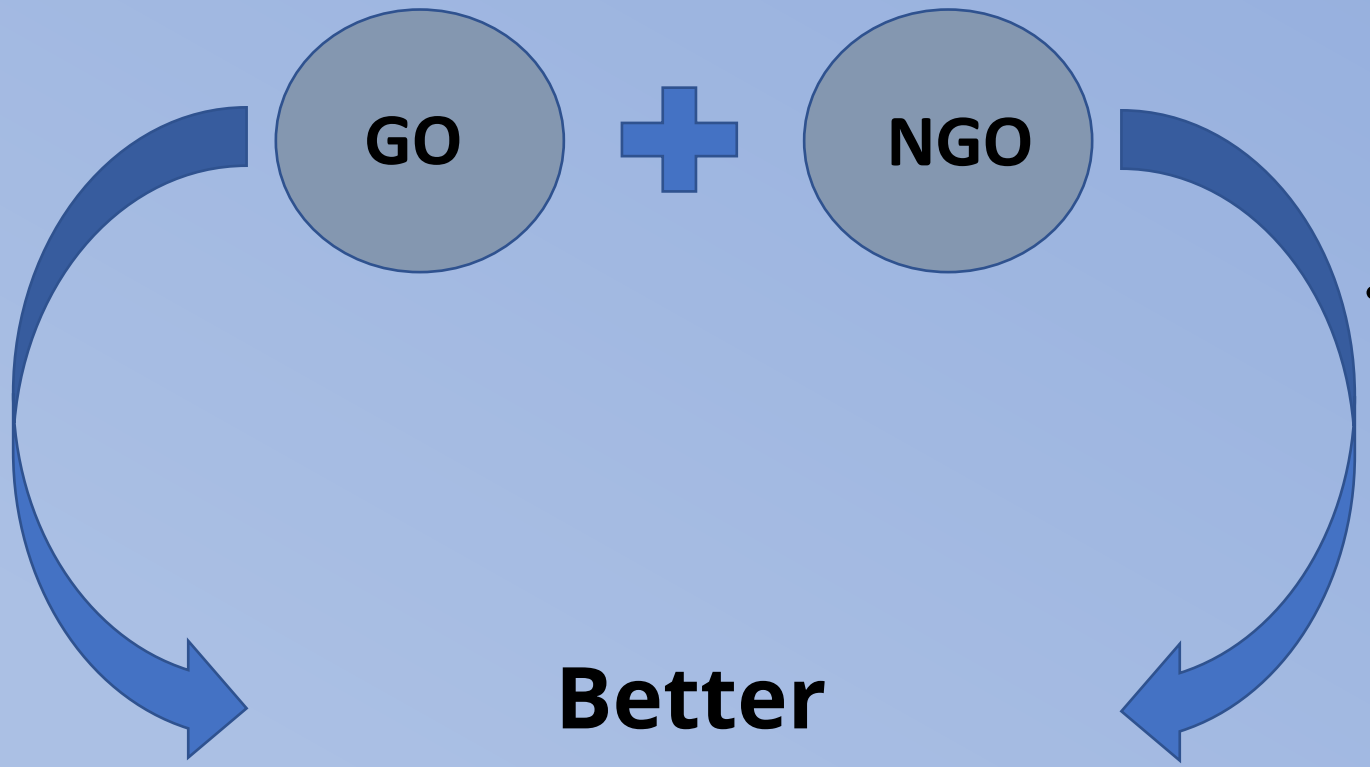
WASA

Community Participation

Youth Involvement


Untreated Sewage
Agricultural Runoff
Industrial Discharge
Inadequate Collection System
Lack of Infrastructure, Lack of effective waste management policy
Intergraded effort of KCC, KDA, BWDA, KWASA, DoE

- Integrating them into national and regional plan
- Primarily should provide funding



- Strong Community Connection

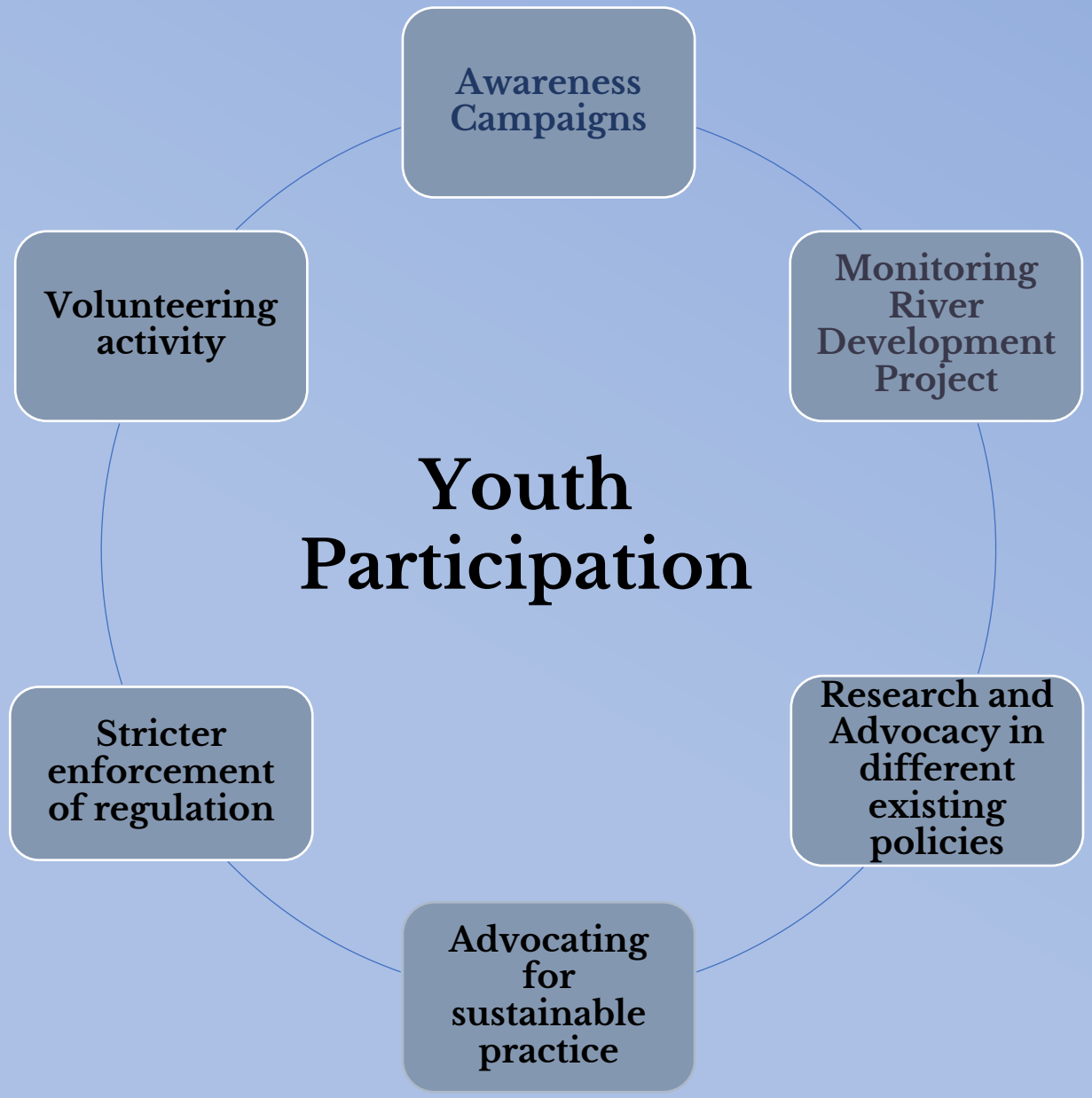
River Committee

KCC

Local Resident

Youth & Women

NGO and Professionals


Awareness Campaigns
Monitoring River Development Project
Research and Advocacy in different existing policies
Advocating for sustainable practice
Stricter enforcement of regulation
Volunteering activity
Youth Participation

Political reform

Aspiration Paper
Theme: Water and Delta Governance: Aspiration of the Youth'

Title: Study on scope of Greywater Management and Rainwater Harvesting through Cooperative Systems with Local Governance in Khulna Region

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ABSTRACT

This study investigates on the identification of the scope of potentiality of the rainwater harvesting system and greywater management within the framework of cooperative governance in Khulna City Corporation, Bangladesh, with a strong focus on the youth engagement. Urbanization creates water stress including groundwater depletion and inefficient water use. Innovative governance strategies are highly necessary to address these issues. This research offers a transformative approach to water governance by fostering transparency, inclusivity and accountability. This study addresses the scope of empowering youth as a key stakeholder in achieving water sustainability to reduce the deltaic urban challenges. The study focusses on key informant interviews, focus group discussions and policy analysis to understand the socio-economic, environmental and governance factor in evaluating the potential for centralized rainwater harvesting and greywater management system by recycling in household level in the Khulna region. It also advocates for phased implementation strategies and scalable models on the basis of information and result of KII and FGD among different experts. This study also emphasizes the critical role of participatory governance, where youth engagement, community participation and the institutional collaboration can achieve sustainable water management in the local level. This leverages the local technical solutions from the young researchers alongside the national policies.

1.Introduction and Background

Water is an important finite resource. The demand of water is increasing with increasing population. Water governance in the delta regions is a critical challenge due to urbanization, climate change, and resource mismanagement. Due to the increase of urban population in the developing country, a large amount of freshwater is needed for domestic purposes and a greater volume of wastewater is generated (Lazarova and Bahri, 2005; Qadir *et al*., 2007; Asano *et al*., 2007). Almost 80% of the generated wastewater is being discharged to the natural waterbody without any treatment (UNESCO, 2003). Annually 725 Mm^3 of wastewater is being produced from the urban areas of Bangladesh (ESCAP, 2019). This significant amount of greywater goes directly to the drainage system and pollutes the natural waterbody.

Khulna, Bangladesh's third-largest city, has a high population density and is mostly built-up. Greywater production (1000 m^3/day) varies across areas, relying heavily on groundwater, which may decline significantly by 2030 (Rahman *et al.,* 2014, Alam *et al*, 2009, Mott MacDonald,1997). The city receives 1,924 mm of annual rainfall, and improved rainwater harvesting could help ease groundwater pressure. Greywater, often discarded, represents a potential resource for reuse, while rainwater harvesting can alleviate freshwater scarcity (Lewis *et al.,* 2024). Also, Khulna city faces water crises exacerbated by salinity intrusion, waterlogging, and inefficient water management systems. Surprisingly, the sub-section 4.6 in the National Water Policy (NWP) (1999) of Bangladesh recognizes excessive groundwater withdrawal and untreated greywater discharge as major issues. It highlights urban water scarcity and outlines key measures: promoting rainwater harvesting, preserving urban water bodies, and ensuring wastewater treatment through public institutions.

Bangladesh suffers from youth disengagement and poor policy execution, despite international models of effective governance and technological advancements in water management. Although youth are a powerful force that may have proper sustainable practices, they are still not heavily involved in water governance. Also, lack of proper implementation of policy at regional and local level has been noticed. Top-down approaches in policy formulating, engagement of local people in preparing policing and setting up strategies, implementing and monitoring and operation also created this problem. Exclusion of expertise, for example university professors, NGOs working at the root level are another factor that is contributing to the issue.Sustainable greywater management and rainwater harvesting practices differ globally that reflect different socio-economic and governance contexts. Some developed regions such as Europe and North America demonstrate the successful decentralized wastewater treatment and rainwater systems. Local governance, community participation and institutional coherence play significant roles for this system. The Germany encourages household level participation for the rainwater harvesting and the reuse of greywater but in United States implement regulations about the wastewater reuse (De Gouvello, Gerolin, and Le Nouveau, 2014; Kim *et al.*, 2016; Reams, 2021 Tri, 2022; Godyń, 2022; Prati, Ruscica, and Veigelts, 2024).

In contrast, Bangladesh faces institutional fragmentation, weak enforcement, and limited public awareness. Although urban areas like Khulna and Dhaka are highly vulnerable to water stress and salinity intrusion, integrated water governance remains inadequate. While rainwater harvesting has been piloted in rural areas, urban adoption remains limited. This highlights the need for a participatory governance model that leverages global best practices while addressing local socio-economic realities.

This paper proposes a governance model focusing on governance model combining greywater management and centralized rainwater harvesting through a cooperative system to foster sustainable water use in urban delta regions. This model integrates community participation, institutional coherence, and technological innovation, addressing water governance gaps in delta regions. Implementing greywater management and centralized rainwater harvesting systems can transform water governance in delta regions. This approach ensures resource efficiency, reduces dependency on freshwater sources, and mitigates flood risks. Moreover, integrating these systems into local governance frameworks encourages community participation, fosters environmental integrity, and supports climate resilience.

2. Objectives

i. To identify governance gaps hindering a centralized rainwater harvesting system within the Khulna City Corporation (KCC) implementation and propose actionable solutions for effective adoption.

ii. To identify governance challenges in the adoption and regulation of household-level greywater recycling plants in KCC and recommend strategies to address these gaps.

3. Methodology

3.1 Policy Analysis

National Water Policy (1999) of Bangladesh and Organization for Economic Co-operation and Development (OECD) principles of water governance were analyzed to identify the sustainable management of water and the way of youth participation and stakeholder engagement.

3.2 Key Informant Interviews

Key Informant Interviews is a method of questioning the relevant person to gather information of the specific objectives. For this study, a various question was asked to the young researcher who had done research on the potentiality of rainwater harvesting and also greywater treatment plant in the household, the professors of Khulna University and Khulna University of Engineering and Technology who are

experienced in the Drainage system of Khulna Development Authority, Local people in ward level of Khulna City Corporation and the NGO (Uttaran) who work for the environment.

3.3 Focus Group Discussion

Focus Group Discussion (FGD) is another method that is used to elicit the opinions, attitudes, beliefs and perceptions from a group insight about the objectives of the project. For this study young researchers and students from different disciplines (Environmental science, Sociology, Economics, Development Studies, Civil engineering, Urban and Regional planning) were gathered together to discuss the importance and potentiality of the rainwater harvesting system in centralized way and greywater management in household level for the Khulna City Corporation. A NGO (Uttaran), Water development authority of Khulna (KWASA, KDA, KCC) was played major role in this discussion.

4. Results and Discussion

4.1 Implications for Centralized Rainwater Harvesting Systems

After interviewing a young researcher of Environmental Science, it was obtained from his previous research that the highly suitable wards (12, 15, 16, 17, 18, 19, 20, 21, and 23) of Khulna City Corporation for rainwater harvesting highlights areas where centralized rainwater systems could be effectively implemented. These wards, characterized by extensive built-up areas, high precipitation levels, and gentle slopes, present an optimal environment for large-scale rainwater collection systems. The suitability of these areas aligns with studies emphasizing the importance of built-up areas and precipitation intensity in rainwater harvesting potential (Fernandes, Terêncio, and Pacheco, 2015; Kim *et al*., 2015).

The experts of relevant fields in the KII and FGD were also encouraged to take the necessary pilot-scale initiative to implement a centralized rainwater harvesting system. Young architects and civil engineers also took part to share design and planning of the centralized rainwater harvesting system by a design of two-layer drainage system. The collected rainwater can be supplied by the KWASA, and local people accepted this proposal as they faced salinity problems in winter season due to the depression of groundwater level.

4.2 Integrating Greywater Recycling into Urban Water Governance

The potential of greywater recycling complements the rainwater harvesting initiatives in KCC. Greywater, which constitutes 80% of urban wastewater, represents a largely untapped resource for non-potable uses such as irrigation and toilet flushing (Lewis *et al*., 2024). In highly suitable wards, where dense residential and commercial activity produces significant greywater volumes, installing small-scale treatment units can optimize water resource efficiency. Studies in developed regions highlight the success of such systems when supported by appropriate governance frameworks (De Gouvello, Gerolin, and Le Nouveau, 2014; Tri, 2022). Experts from different institutes (KU, KUET) in focused group discussion were agreed to establish such recycling system to develop a sustainable city in future. The expert of Urban and Regional Planning Discipline of Khulna University admired that it is necessary to take household greywater treatment system in the developing satellite city around the KCC such as Mayur residential area.

4.3 Governance Strategies for Implementation

Youth participation, public awareness campaigns, skill-building workshops, and participatory governance structures, as highlighted in global studies, can bridge the gap between technical feasibility and community buy-in (OECD, 2015). It has been observed that KWASA is running the project of water drainage system with ADB and Indian consultancy farm that is not considered the regional and local perspective of Khulna City Corporation. There is lack of involvement of the regional experts and institutions who were more valuable for the feasibility study on the aspect of geology, hydrology, and socio-economic factors of Khulna coastal region. Though there was scope for young researchers from different institutions such as Khulna University and Khulna University of Engineering and Technology in the planning and management section for the assessment of water quality and the construction of the system, they were not engaged with this

project. A collaborative framework is required that will be encompassing governmental institutions, private stakeholders and community groups to implement this model. KWASA (Khulna Water Supply and Sewerage Authority), BWDB (Bangladesh Water Development Board), KCC (Khulna City Corporation), KDA (Khulna Development Authority) are the key authority of government body who will oversee water infrastructure and regulatory compliance, provide technical expertise and ensure the community engagement and project execution at the municipal level. The recent graduates' students from the Civil Engineering Department of KUET, Architecture and URP Discipline from Khulna University can be a key actors in the participatory level. The young students can integrate their research to enhance the output. The young researcher of Environmental Science can monitor the water quality data in the laboratory and the researcher of Sociology, Economic and Development Studies can collect the qualitative data from the people who are living around the Khulna City Corporation. There are experts of different institutions (Khulna University and Khulna University of Engineering and Technology) who might be another key actor. It is important to establish a water governance committee that will integrate all relevant stakeholders to ensure coherence and accountability to solve the fragmented institutional roles and lack of coordination.

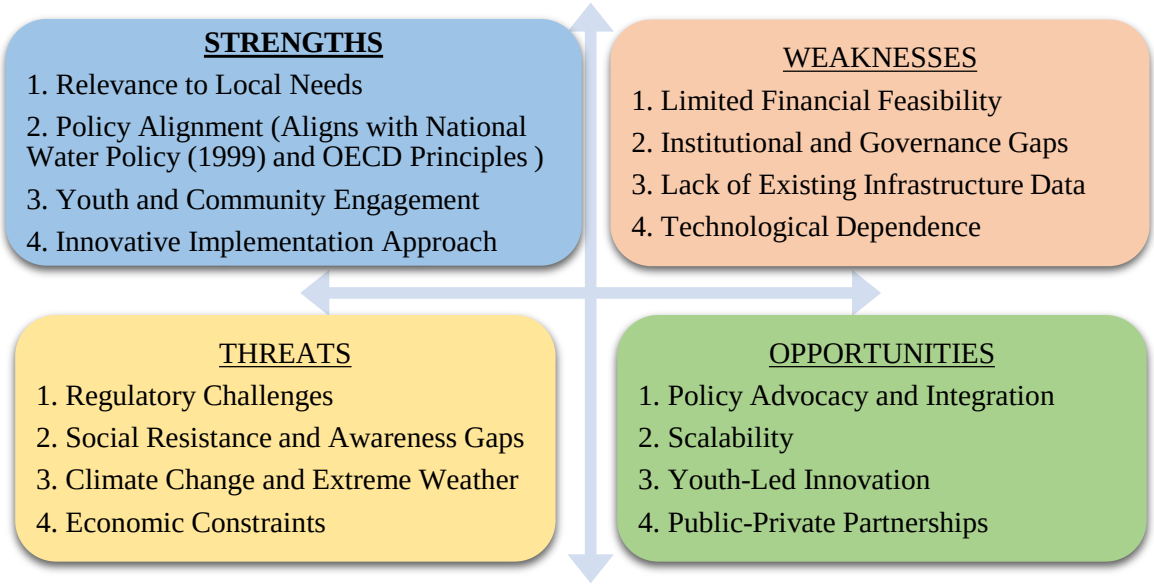

Figure 01. SWOT Analysis of Water Governance in Khulna

5.4 SWOT Analysis of Water Governance

Climate change, urbanization, and socioeconomic constraints in Khulna provide complicated concerns that must be addressed through effective water governance. A SWOT analysis was carried out to evaluate the internal and external elements influencing water governance in the region. Strengths include relevance to local requirements, adherence to the National Water Policy (1999) and OECD standards, youth and community engagement, and innovative implementation strategies. However, disadvantages such as low financial feasibility, institutional and governance gaps, a lack of current infrastructure data, and technical reliance are significant impediments. Opportunities exist for policy advocacy and integration, scalability, youth-led innovation, and developing public-private collaborations. Threats such as legislative obstacles, social resistance, the effects of climate change, and economic limits continue to stymie progress. In order to guarantee sustainable water resource management in Khulna, this analysis identifies areas for strategic intervention and offers an organized framework for comprehending the governance environment.

Table 1: Policy Provisions, Governance Gaps, and Proposed Interventions for Water Management in Khulna

Policy Source (Section)	Policy Provision	Gap in Local Governance	Proposed Interventions
BNBC (Part 3, Section 3.5.10)	Promote rainwater harvesting systems for buildings exceeding a specific area threshold.	Rainwater harvesting is rarely implemented during new construction	Enforce mandatory systems in new buildings; periodic inspections by **KDA** and **KCC**.
National Water Policy (1999, Section 4.6(b))	Prevent groundwater over-extraction through the use of alternative water sources like rainwater.	Over-extraction of groundwater continues unabated in Khulna	Regulate alternative sources like rainwater/greywater; provide subsidies.
Environmental Conservation Act (1995, Section 7)	Mandate wastewater treatment for industrial establishments.	Many industries discharge untreated wastewater into natural water bodies, violating environmental regulations.	Conduct regular inspections; penalize non-compliance; incentivize treatment plants.
Local Government Act (2009, Section 44)	Ensure proper collection, segregation, and disposal of municipal waste.	Municipal waste management remains inefficient, with no segregation at the source and insufficient infrastructure for disposal in Khulna.	Decentralize systems; promote waste segregation with community participation.
National Water Policy (1999, Section 4.13)	Engage stakeholders, including NGOs and communities, in water and waste governance processes.	Stakeholders like NGOs, youth, and community groups are not effectively involved in governance, limiting participatory decision-making processes.	From a participatory governance committee comprising KCC, NGOs like Uttaran, and academic institutions like KU and KUET.
Bangladesh Delta Plan (2100, Section 4.3.5)	Adopt green infrastructure for flood and urban water management.	Urban planning in Khulna lacks integration of green infrastructure such as wetlands, permeable pavements, and urban green spaces, worsening flood risks.	Incentivize wetlands, permeable pavements, and urban greenery; train planners.
Environmental Conservation Act (1995, Section 12)	Monitor urban development projects for environmental compliance.	Weak monitoring systems result in frequent non-compliance with environmental standards for urban development projects.	Partner with NGOs/academia for regular monitoring; enforce penalties.
National Water Policy (1999, Section 5.3(d))	Incorporate youth into governance and decision-making processes.	Youth engagement remains low despite their potential for innovation and long-term impact on governance practices.	Launch programs, hackathons, and training for active governance roles.

4.5 Governance Gaps and Strategic Interventions in Water Management

A robust assessment of water administration policy analysis in Khulna finds major disparities between legislative provisions and their actual execution. Key difficulties include a failure to enforce rainwater collection standards, unregulated groundwater exploitation, industrial noncompliance with wastewater treatment regulations, and insufficient municipal waste management systems. Furthermore, the lack of participatory governance institutions, restricted youth engagement, and insufficient integration of green infrastructure exacerbate these difficulties.

The proposed strategies to close these gaps prioritize regulatory enforcement, community participation, and sustainable infrastructure development. Enforcing rainwater harvesting systems, encouraging trash segregation through community involvement, and incentivizing green urban planning can all help to build resilience to water-related difficulties. The participation of youth and NGOs in participatory governance frameworks emphasizes the possibility of long-term, sustainable change. This analysis emphasizes the critical need for a multi-stakeholder strategy emphasizing the youth to close governance gaps and promoting climate-resilient urban water management.

5.5 Phased Implementation

Though the National Water Policy (1999) emphasized rainwater harvesting and household used water treatment, but the local government of Khulna didn't take any initiative to reduce the pressure on groundwater and the surface water management. A project entitled "Khulna Sewerage System Development Project" has been running since 2018 but there is lack of involvement of local expert, youth and the local people who are the main owner of the water. There is also a lack of piloting of the project.

The implementation strategy can be divided into three phases (Pilot phase, Evaluation phase and Scaling phase). In the *Pilot phase*, a ward in Khulna City Corporation with 1000 household can be focused. There install greywater recycling units installed in 100 households and a rainwater harvesting system over 10 hectares. The pilot phase is for conduction of baseline studies and there have to be arrange awareness campaigns. In the *Evaluation phase*, it is necessary to monitor the pilot outcomes including focusing on resource efficiency, cost-effectiveness and public participation. For the evaluation different metrics can be used as a tool such as water reuse rate, maintenance costs and community feedback. The third phase is *the Scaling phase* and it is the expansion of the framework into the entire city based on the pilot success. It includes the policy amendments that will incorporate greywater reuse and the rainwater harvesting in the urban planning codes.

The engagement of Youth is highly essential for long-term success. Youth engagement can be possible by arranging different programs such as Skill Building workshops for training in the maintenance of greywater system and installation of rainwater harvesting system, Hackathons for youth to innovate the affordable water management solutions, and social media campaigns to raise awareness about the sustainable water practices among the youth generation and shown in figure 01.

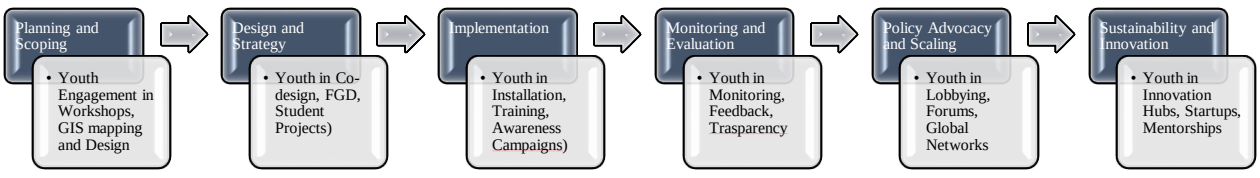

Figure 02. Youth Engagement in Water Management Strategies.

Expert's inclusion is another major part of this solution. Many governments and NGOs are taking projects but they are not taking experts like university teachers who are expert in the relevant field. Their inclusion in these projects can provide more significant knowledge and will help to form sustainable solutions.

5.4 Monitoring and Evaluation (M&E)

To address financial barriers, collaborative financing models, such as low-interest loans for household installations, can make these systems more accessible (Reams, 2021). Moreover, a robust monitoring and evaluation (M&E) framework, incorporating metrics such as water reuse rates and cost savings, is essential to assess the success and scalability of these initiatives. To evaluate the framework after implementing the city corporation it is necessary to use different metrics such as water savings (amount of greywater reused and the rainwater harvested), cost-effectiveness (reduction of per capita in water bills), community engagement (people participation rates in the workshops and awareness programs). The evaluation process should be completed in quarterly independent audits and publish the annual report to the public to ensure transparency and stakeholder accountability. It is necessary to share the findings with the stakeholders for transparency and the collaborative solution of the problem.

7. Conclusion

This governance model integrates knowledge of youth, especially relevant young researchers and experts from educational institutions (KU, KUET), institutional coherence, and community participation to address water challenges in delta regions. By focusing on greywater management and centralized rainwater harvesting, it promotes resource efficiency, reduces climate vulnerabilities, and aligns with the National Water Policy (1999) and OECD Principles on Water Governance, particularly in enhancing transparency, accountability, and environmental integrity. As youth, our aspiration is to inspire transformative water governance practices that balance technical innovation with inclusive participation, ensuring a sustainable future for water management in delta regions. This governance model combines technical innovation with inclusiveness, transparency, and environmental integrity to address water challenges in Khulna's delta region. By focusing on greywater management and centralized rainwater harvesting, it offers a scalable solution that aligns with both global frameworks and local needs.

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PRESENTATION NO: 02

Title: Study on scope of Greywater Management and Rainwater Harvesting through Cooperative Systems with Local Governance in Khulna Region

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10th International Conference on Water and Flood Management - ICWFM 2025, 22-24 February 2025, Dhaka, Bangladesh.

Water and Delta Governance: Aspirations of the Youth

Study on Scope of Greywater Management and Rainwater Harvesting Through Cooperative Systems with Local Governance in Khulna Region

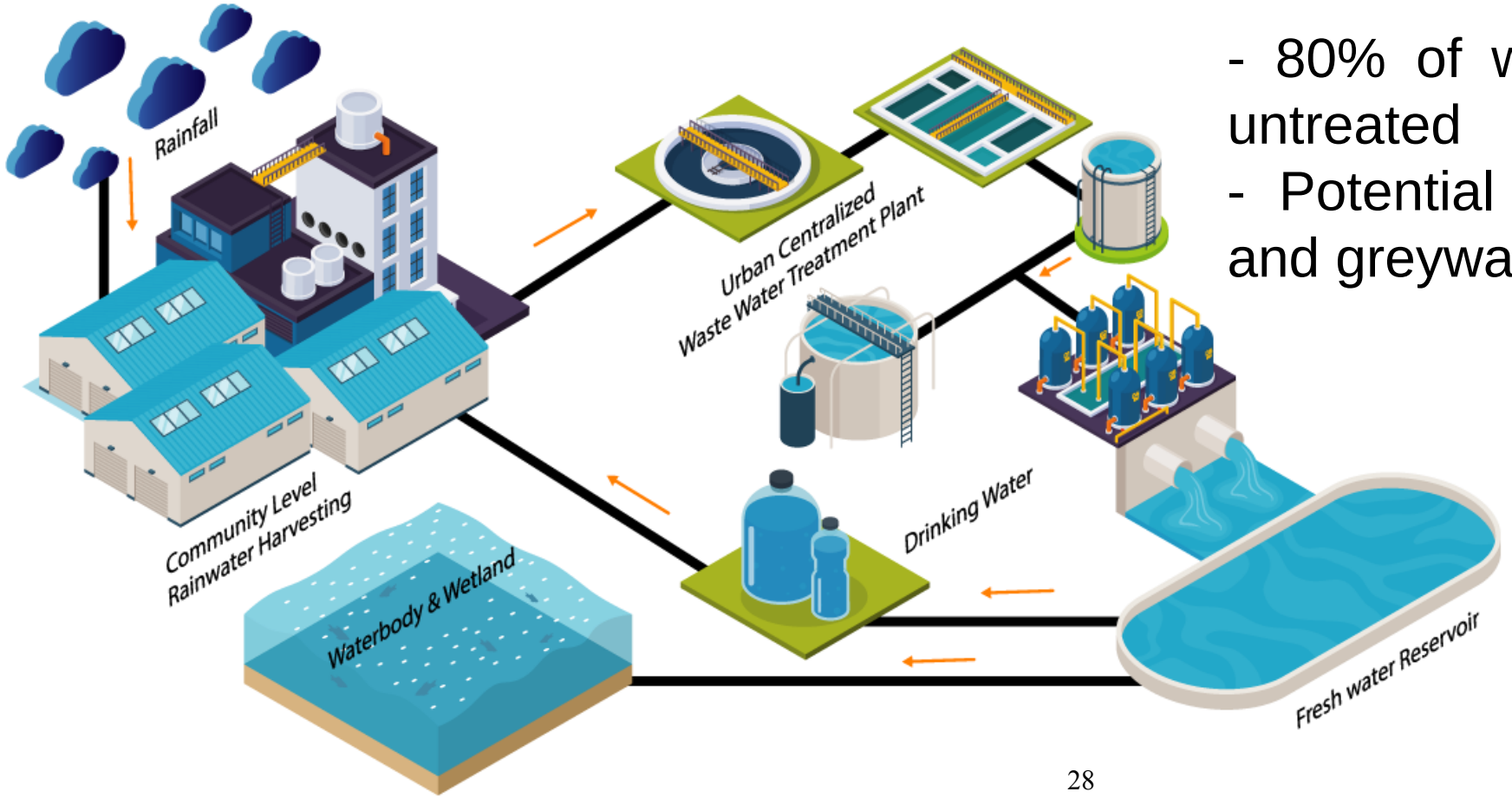
Md. Salman Hossen[1], S.M. Shams Kahled Rafi[1], Ayesha Shiddika[1], Sabrina Jesmin[1], Md. Marufur Rahman[1], Zahid Amin Shashoto[2], Masudur Rahman[1], Nazia Hassan[1]

Presented by:

Environmental Science Discipline, Khulna University

Introduction & Background

- Rapid urbanization in Khulna increases water stress
- Groundwater depletion and wastewater mismanagement
- 80% of wastewater is discharged untreated
- Potential for rainwater harvesting and greywater reuse



Governance Challenges & Policy Gaps

National Water Policy , 1999

Policy Provision (PoI.P)

Section 4.6(b) Prevent groundwater over-extraction	Over-extraction of groundwater continues
Section 4.13 Engage stakeholders in governance processes	Stakeholders like NGOs, youth, and community groups are not effectively involved
Section 5.3(d) Incorporate youth into decision-making processes	Youth engagement remains low despite their potential for innovation and long-term impact on governance practices.

Gap in Local Governance (GLG)

Environmental Conservation Act,1995

(PoI.P)	Mandate wastewater treatment for industries	Many industries discharge wastewater into natural water bodies (GLG)
(PoI.P)	Monitor urban development projects for environmental compliance	Weak monitoring systems result in frequent non-compliance with environmental (GLG)

Local Government Act , 2009

(PoI.P)	Ensure proper collection, segregation, and disposal of municipal waste.	Municipal waste management remains inefficient, no segregation, insufficient infrastructure (GLG)

Bangladesh National Building Code

(PoI.P)	Promote rainwater harvesting systems for buildings exceeding a specific area threshold.	Rainwater harvesting is rarely implemented during new construction (GLG)

Bangladesh Delta Plan 2100

(PoI.P)	Adopt green infrastructure for flood and urban water management.	Urban planning lacks integration of green infrastructure (wetlands, permeable pavements, and urban green spaces) (GLG)

Governance Challenges & Policy Gaps
(Proposed Interventions)

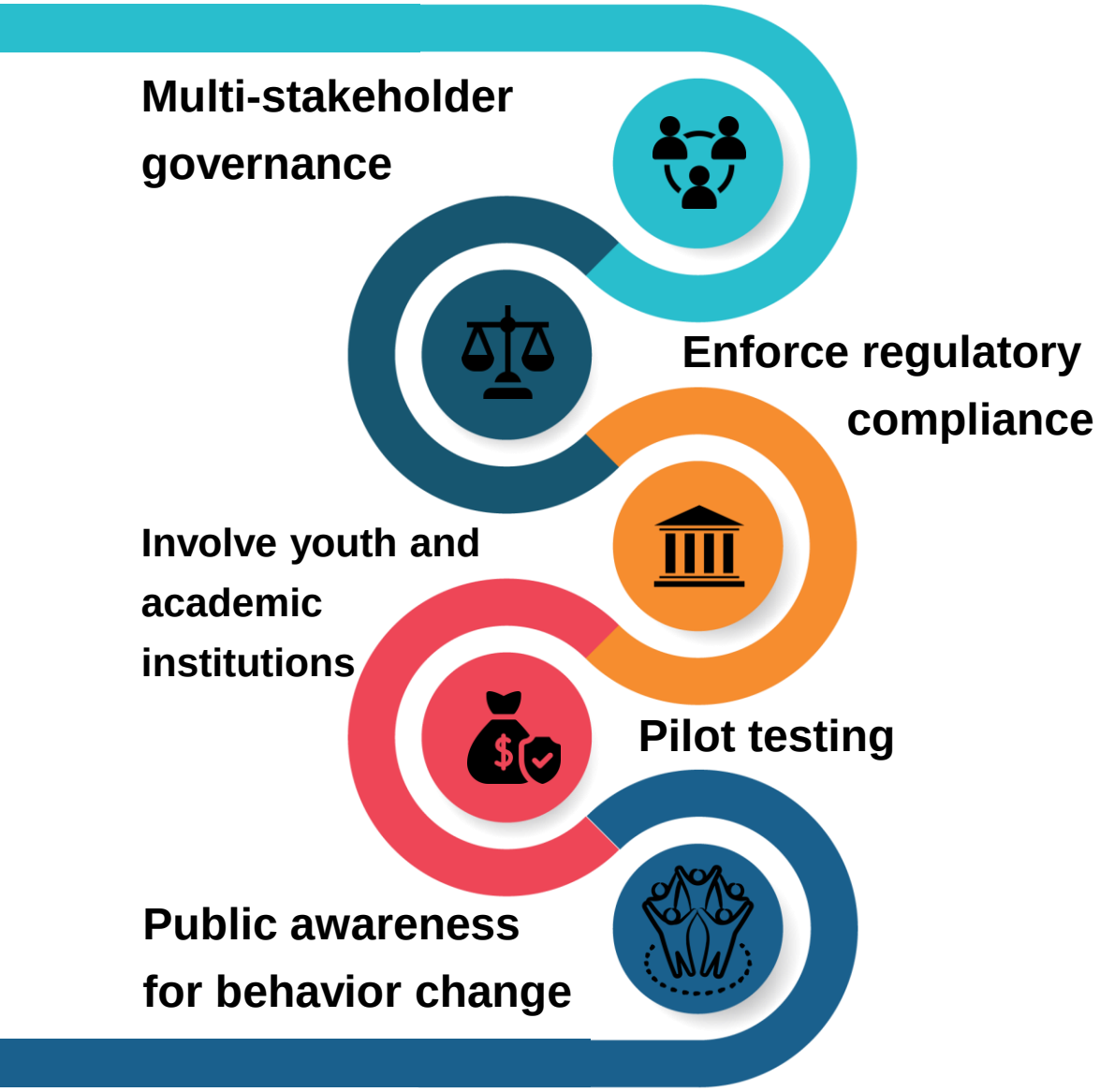
National Water Policy (1999)
Regulate alternative sources like rainwater/greywater; provide subsidies.
Launch programs, hackathons, and training for active governance roles.

Bangladesh National Building Code
Enforce mandatory systems in new buildings;
periodic inspections by KDA and KCC.

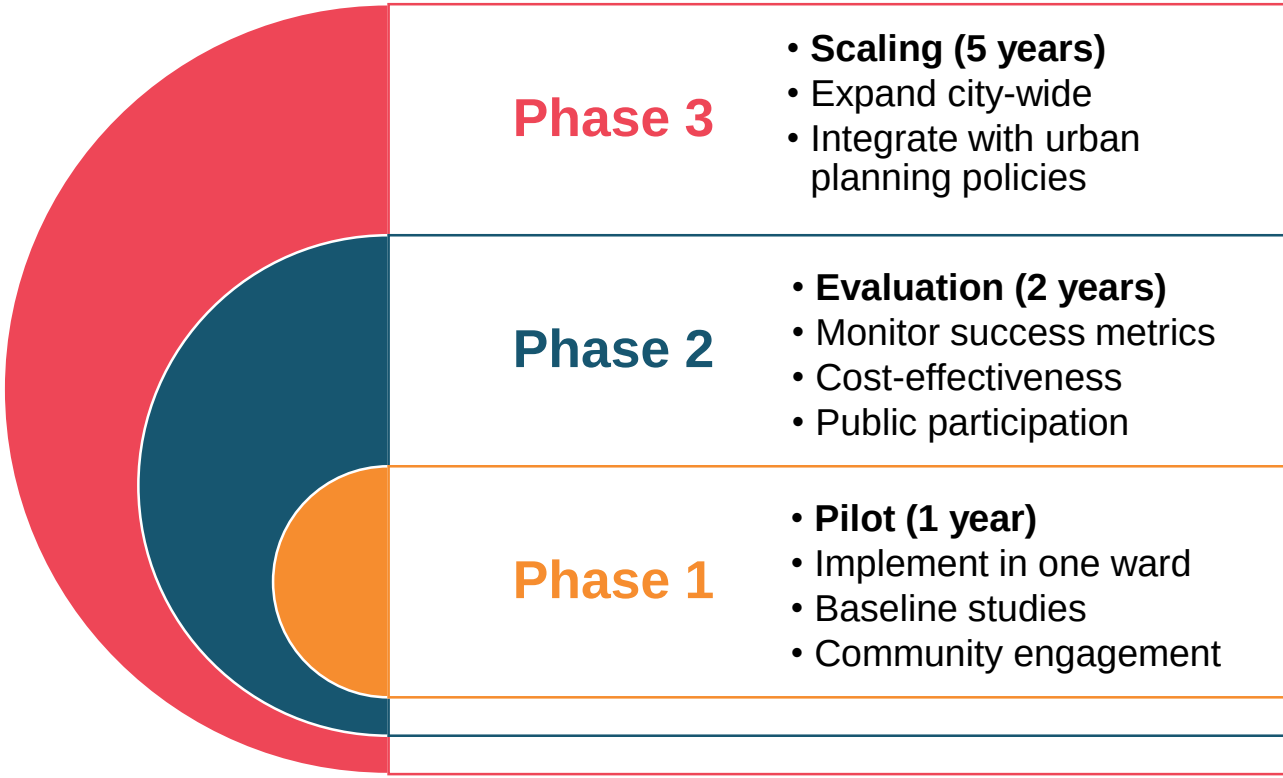
Bangladesh Delta Plan (2100)
Incentivize wetlands, permeable pavements, and urban greenery;
train planners.

Environmental Conservation Act (1995)
Conduct regular inspections; penalize non-compliance;
incentivize treatment plants

Proposed Governance Strategies



Phased Implementation Plan



Role of Youth in Water Governance

Youth Engagement in Workshops, GIS mapping and Design

Youth in Innovation Hubs, Startups, Mentorships

Youth in Monitoring, Feedback, Transparency

Youth in Co-design, FGD, Student Projects

Youth in Installation, Training, Awareness Campaigns

Youth in Lobbying, Forums, Global Networks

Conclusion

- Water governance needs participatory, youth-driven solutions
- Youth can drive innovation and awareness in urban water management

THANK YOU

Aspiration Paper
Theme: Water and Delta Governance: Aspiration of the Youth

Title: Conflicts Between Traditional and Centralized River Management in Southwestern Coastal Bangladesh: A Case Study of Tidal River Management in Tala, Satkhira

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BACKGROUND

Covering approximately 47,203 square kilometers, the coastal zones of Bangladesh face escalating challenges from rising sea levels and extreme weather events linked to climate change (Islam et al., 2024). These challenges are especially severe in southwestern coastal Bangladesh, where issues like salinity intrusion, frequent flooding, riverbank erosion, and freshwater scarcity are prevalent (Akter et al., 2024; Ashrafuzzaman, 2024). Effective delta management and governance are essential to adapt to these climate impacts.

In parts of southwestern coastal Bangladesh, Tidal River Management (TRM) has emerged as a community-driven, indigenous technique developed to address tidal inundation, salinity intrusion, and riverbank erosion (Kazi et al., 2022). TRM involves directing sediment-rich tidal waters toward low-lying areas. This process not only elevates depressed areas, transforming them into arable land, but also prevents tidal rivers from silting up (Islam et al., 2020).

TRM's significance lies in its cost-effectiveness, simplicity, and role as a nature-based solution for adapting to climate change impacts in coastal regions (Gain et al., 2022). It is considered an affordable, locally led strategy to combat climate-induced disasters, particularly in countering southwestern Bangladesh's persistent issues with waterlogging, salinity intrusion, and drainage congestion. This approach contributes to agricultural productivity, food security, local livelihoods, and improved waterway navigation (Seijger et al., 2018). Rooted in Indigenous knowledge, TRM reflects the value of community engagement and sustainable practices in delta governance (Masud et al., 2023).

ABOUT THE CASE STUDY

In the early 1960s, the coastal polders were constructed by the Pakistan government to reduce erratic floods and promote agricultural development in the region. A total of 139 polders had been built in coastal regions under the Coastal Embankment Project (CEP) as a Green Revolution intervention. The motive was to convert seasonally flooded saline wetlands into arable lands and prevent human settlements from storm surges. However, the polders were beneficial until the 1980s, when the amount of sedimentation was increasingly drained from the Ganges delta and gradually blocked the riverbank. It was due to the construction of embankments that ultimately resulted in drainage congestion and waterlogging (Hafiz et al., 2023). Additionally, flawed design and poor management further disrupted the natural land-building process within the polder.

To solve this problem, the local community in parts of Satkhira came up with an Indigenous solution called 'osthomasi badh,' a system in which embankments were seasonally maintained (Wings, 2021). For example, the embankments were closed amid non-monsoon seasons to protect farmland and opened during the monsoon season to allow sediment-rich freshwater flow to restore soil fertility. Eventually, this local approach was accepted as TRM, a formal method by government authorities to mitigate drainage congestion (Mutahara, 2018).

Although TRM offers a promising long-term solution to the region's environmental and social challenges, it has not yet yielded the desired outcome. Over-reliance on engineering-focused polder management and insufficient integration of TRM have led to conflicts with local communities (Kibria, 2011). Additionally, the top-down management approach has neglected the social aspects of river management, further complicating efforts. While past studies have highlighted TRM's benefits and the environmental and livelihood impacts of climate change in southwestern Bangladesh (see – Gazi & Moniruzzaman, 2014; Naz et al., 2024; Tareq et al., 2018), the conflicts between centralized management and community-led TRM have not been fully explored.

In this context, this study intends to investigate the following questions:

- Why did TRM, an indigenous river management system, fail in southwestern coastal Bangladesh?
- What conflicts arose due to social exclusion and consideration of only engineering dimensions in tidal river management?

This research seeks to address these research questions through a case study from Tala Upazila in the Satkhira district of southwestern coastal Bangladesh. Additionally, it explores the conflicts that arose between the social and engineering dimensions of river management. By investigating these challenges, the study aims to contribute to the inclusive discourse on how the TRM, a locally led river management system, can be efficiently integrated with modern governance frameworks to sustain delta management in the most vulnerable regions. The findings will contribute to minimizing the mismatch between local initiatives and formal government strategies, thereby enhancing more inclusive and sustainable water and river management.

METHODOLOGY

The study region is located in Tala Upazila, Satkhira District, in the southwestern part of Bangladesh (Figure 1). With the boundary of Jessore on the north and the Bay of Bengal on the south, Satkhira has a unique coastal pattern. The rivers of Satkhira are unique not just because of their high sediment drainage but also because of their ecologically significant brackish water, which is naturally formed by freshwater from rivers and the tidal influence of the Bay of Bengal. Rivers like Kobodak, Kalindki, Kakashi, Betti, Kholpetua, and hundreds of unnamed canals make up a critical river management system for the region. Geographically, the upazila is a low-elevated area close to the Bay of Bengal and the Sundarbans. This region's deltaic landscape is shaped by rivers, including the Kopotakho, Shalikha, and Betna. Climate-induced disasters like waterlogging, salinity intrusion, and potable water scarcity largely affect the people and livelihoods of this upazila. The rationale behind selecting this study area is its chronic vulnerability to waterlogging, freshwater scarcity, and siltation that severely affects agricultural productivity and local livelihoods.

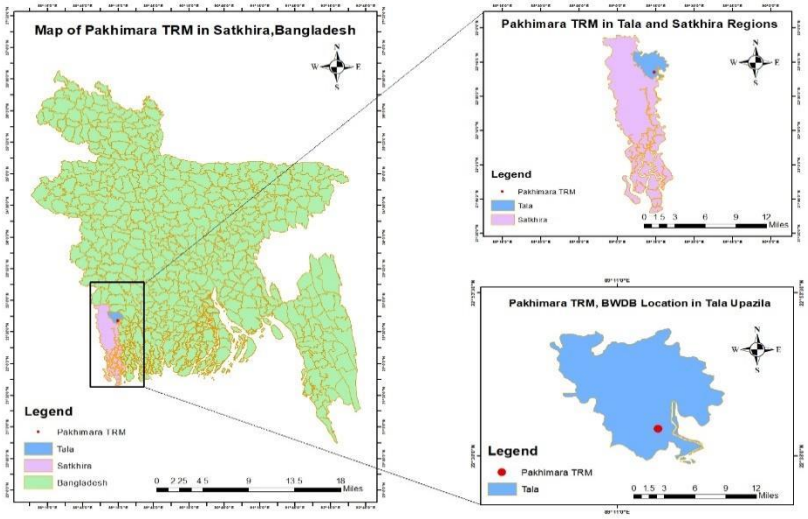

Figure 1: Location map of the study area in southwestern coastal Bangladesh.

A survey was conducted in the summer of 2023 to reflect on the opinions of local people to address the research questions. The survey was conducted in Pakhimara Beel, where the only active TRM project in Bangladesh persists. Following a purposive sampling method, a total of 58 participants (n=58) were surveyed to assess their stake in decision-making regarding TRM and the effectiveness of current management. A semi-structured questionnaire was used to collect data on relevant environmental and social challenges and the decision-making power of the locality. The local people were interviewed in Bengali, and after the survey, transcriptions were translated into English without changing any information from the original survey. The collected data was organized and analyzed quantitatively. The qualitative insights were also captured from the community for a comprehensive view of local perspectives on these water management strategies. NGO representatives, community leaders, and government officials were also interviewed as key informants (KI).

FINDINGS

CHALLENGES IN SUSTAINABLE DELTA GOVERNANCE IN TALA, SATKHIRA

i. The centralized top-down engineering approach

The failure of TRM in Tala, Satkhira is intricately connected to a non-participatory, corrupted, and ineffective water governance approach that is rooted in centralized governance. In our survey, 74% of the respondents claimed that they are not involved in the decision-making process, and it is centrally taken by the authority. The majority (40%) identified polder construction around the year 1960 as the most crucial contributor to the failure of sustainable delta management. Mismanagement of TRM, corruption, and inefficiency were identified by 24%, 19%, and 24% of the participants respectively. This result aligns with previous studies that linked the misappropriation of large budgets with non-participatory governance (Hoque & Shamsudduha, 2024). We also found that the authority tends to deliberately extend the project period so that additional funding can be availed for further intervention (Figure 2).

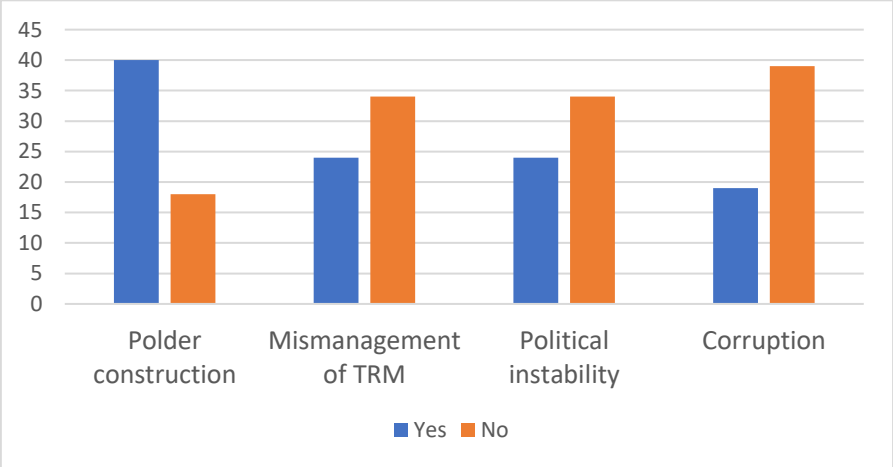

Figure 2: Factors behind the failure of sustainable delta management

Another core reason for the TRM's failure is the unfair and delayed compensation for the sedimentation-affected and temporarily displaced landowners (Salam et al., 2021). We found that influential and relatively large landowners get more compensation for their political connections. Marginal farmers and/or landowners suffer the most and get minimal compensation (16% of the participants) to no compensation at all (84% of the participants), further exaggerating the situation. It was found that, due to such growing distrust of authorities, landowners are reluctant to give up their land for project implementation in the area.

ii. Conflicts arose from environmental and social issues

Social and environmental issues are interlinked. Environmental issues such as increasing salinity, water scarcity, chronic waterlogging, and agricultural land damage are the most common environmental challenges in the region (Figure 3).

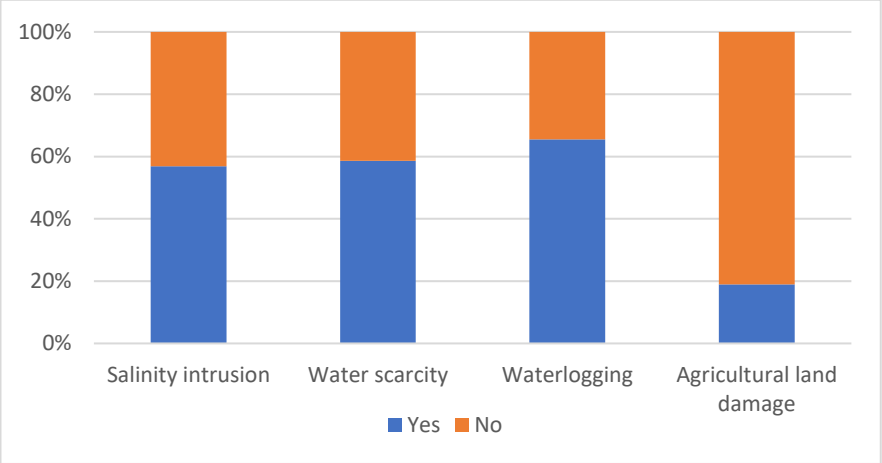

Figure 3: Environmental challenges in the region.

In our survey, 66% (i.e., 38 out of 58 participants) referred to waterlogging as one of the major environmental concerns in the region while 33 participants (57%) and 34 participants (59%) identified salinity intrusion and water scarcity respectively. Additionally, 11 participants (19%) mentioned agricultural land loss as another commonly experienced environmental issue (Figure 3).

These environmental challenges are complicated by mal-governance and sociopolitical conflicts, exacerbating social challenges. People's livelihoods in the region mainly depend on agricultural activities and shrimp culture. Comparably well-off and powerful shrimp landowners require saline water which is detrimental to marginal farmers' agricultural land that demands freshwater. We found that the increasing amount of shrimp farming in the region often leads to conflicts with traditional agriculture This situation changes power dynamics and creates social and political inequality in the locality (Hoque & Shamsudduha, 2024). This condition leads to tensions over land use and livelihood sustainability in affected communities.

Another concern is related to migration in search of livelihood. The affected people look for alternative livelihood options and migrate to cities like Khulna, Mongla, and Dhaka to manage the monthly expenses of their families. We found that almost every household has to buy their drinking water from a nearby desalination plant, which again puts an extra financial burden on the marginalized people ranging from 800 to 2000 BDT per month. A large number of people from the study area live in mud houses and semi-buildings, and they have to repair their houses after devastating cyclones, as the area faces frequent and catastrophic cyclones each year. Over time, lack of government commitments and misuse of funds have resulted in distrust among the local people. Economic instability, tension due to extra financial burden, migration, and conflicts are the most noticeable social issues that are faced by the local people in Tala, Satkhira. Table 1 illustrates the multidimensional challenges and their influence on the success of TRM in Tala Upazila, Satkhira.

Table 1. Challenges and their impacts on the successful implementation of TRM

Challenges	Nature of challenge	Impacts	Impacts on TRM's success
Bureaucratic	Top-down decision-making	Limited community inputs and implementation.	Reduces TRM's effectiveness as a community-based solution and disrupts participatory governance.
	Corruption and mismanagement	Resource misallocation and inefficiencies.	
	Delayed Compensation	Reduced local acceptance.	
Environmental	Waterlogging and sedimentation	Loss of land and agricultural viability.	Perpetuates the complexity of the delta governance and disrupts TRM efforts to adapt to climate change impacts.
	Increased salinity	Decreased freshwater availability and affects crop health.	
	Biodiversity loss	Affected ecosystem health.	
Social	Social conflicts	Tensions between Shrimp farming vs. traditional farming	Affects TRM's livelihood and economic sustainability.
	Distrust in governance	Lack of community engagement increases resistance.	
	Displacement and livelihood impacts	Environmental degradation causes socioeconomic losses.	

WHY EXISTING INITIATIVES FAIL TO SOLVE THE ISSUE

i. Lack of procedural clarity

The Bangladesh Water Rules (2018) and Participatory Water Management Rules (2014) do advocate for participation, but they lack specificity in terms of timelines, procedures, and mechanisms to ensure meaningful stakeholder involvement. Both frameworks emphasize the importance of community participation and inter-agency collaboration but fail to provide detailed guidelines on how these processes should be operationalized. This absence of structured mechanisms—such as clear steps for stakeholder consultations or predefined timelines for participatory processes—undermines the inclusivity and efficiency of water governance. Consequently, stakeholders are left without a roadmap to ensure their meaningful involvement in decision-making, leading to inconsistent and often ineffective outcomes.

ii. Inequitable compensation and benefit sharing

The compensation mechanisms outlined in these rules, particularly in contexts such as land acquisition or sedimentation impacts under TRM projects, are often inequitable and delayed. Larger, politically connected landowners frequently benefit disproportionately, while marginalized communities bear the brunt of the negative impacts without adequate redress. This inequitable distribution of benefits fosters mistrust and resistance among affected communities, further complicating the implementation of water management projects.

iii. Superficial participation

While the Participatory Water Management Rules (2014) advocate for the formation of Water Management Groups (WMGs) and Water Management Associations (WMAs), the participation of these bodies is often superficial. Stakeholders, particularly women, small farmers, and marginalized groups, remain underrepresented in decision-making processes.

PROPOSED SOLUTIONS

To address complex socio-environmental issues entangled in bureaucratic challenges, an inclusive delta governance approach is essential in Satkhira and other coastal regions. Bridging the gap between top-down governance and local socio-environmental needs requires a strong role from civil society organizations. Specifically, local NGOs, along with scientific/technical committees can advocate effectively for local communities, their rights, and social justice. A robust institutional framework involving local populations, government authorities, and civil society can expedite this process, fostering co-management and coordination that enhances project transparency, accountability, and public participation.

For such an approach to be efficient and impactful, targeted legal instruments should address corruption and conflicts directly, with policies stipulating time-bound resolutions through a dedicated institutional body representing local representatives, government officials, NGOs, and scientific experts. Additionally, local stewardship and capacity building should be ensured with fair representation of youth, women, and any indigenous community. A fair benefit-sharing mechanism would further ensure community support.

Recognizing traditional knowledge within the policy framework and integrating it into planning processes can enhance long-term governance sustainability. This recognition can be complemented by technical and financial support from national and international sources. Before implementing any activities, prioritizing information exchange and strategic planning for specific areas and activities should be central to the approach.

Notes:

‘Brackish water’ is a mixture of seawater with fresh water.
‘Polder’ is an encircled embankment that is constructed to create new land, increase agricultural yields, and provide flood protection.
‘Osthomasi Badh’ is a Bengali term that means embankment lasting for eight months over the year.
‘Pakhimara’ is the only active TRM project that is active in Bangladesh in Pakhimara Beel which is located in the Jalalpur union of Tala upazila of Satkhira District.
‘Beel’ is a type of wetland that is formed by inundation of low-lying lands due to flooding.

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PRESENTATION NO: 03

Title: Water and Delta Governance" Assessing Institution, Coordination, Coherence, and Capacity Buildup of Flash Flood Management in Sylhet Haor Region

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NOTE: The group of United International University did not submit the presentation file.

"Water and Delta Governance"
Assessing Institution, Coordination, Coherence, and Capacity Buildup of Flash Flood Management in Sylhet Haor Region

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Abstract

This study used Water Governance Principles to assess current water governance practices, policies, and frameworks, including the Bangladesh Water Act (2013) and Water Rules (2018), and institutionals roles and responsibilities to identify critical gaps in the governance of flash flood management in the Sylhet Haor region. The study highlights the challenges of institutional governance challenge in terms of interaction, coordination, coherence and public participation in decision-making. By conducting key informant interviews (KII) with experts from different institutes, this study provides insight into systemic problems and proposes actionable solutions. These solutions include improving cross-sectoral coordination, enhancing community resilience, ensuring adequate funding for flood prevention, and developing a coherent governance roadmap for long-term disaster management. These findings emphasize the need for integrated planning, policy amendments, and stakeholder inclusivity to build socioeconomic resilience in the Sylhet Haor region and mitigate the impact of future flash floods. This study advocates a collaborative, community-driven, and sustainable approach to water governance to protect vulnerable communities and ecosystems from the increasing threats of flash floods in the Haor region while implementing the Haor masterplan.
Keywords: Delta Governance, Flash floods, Haor, Key informant interviews (KII), Water

Introduction

Bangladesh is a riverine country with a network of rivers, canals, and other water bodies. Floods are a common phenomenon in the low-lying floodplains of the Bengal Delta. Approximately 25% of the area of Northeast Bangladesh is a bowl-shaped floodplain depression, locally known as Haors [1]. These Haors serve as water reservoirs and the region has a unique ecosystem. Flash floods are sudden and rapid flooding in the Haor region due to heavy rainfall and runoff from the upstream hills of Asam and Meghalaya. Even without rainfall, flash floods can occur due to the sudden release of water. Human interference in the natural Haor system and blockage of the natural drainage passage worsen the flood situation in this area [2]. From 2017 to 2024, flash floods have repeatedly impacted various districts in the Sylhet Division, primarily Sylhet, Sunamganj, and Moulvibazar, owing to heavy monsoon rains and upstream water flows from Meghalaya and Asam, India. These floods have caused significant disruptions to infrastructure, agriculture, and livelihoods. In mid-2022, the northeast region experienced its heaviest rainfall in 122 years, flooding over 60% of Sylhet and 80% of Sunamganj, affecting four million people [3], [4].

Flash flood management is a complex task that requires effective coordination among various stakeholders owing to the Haor's unique geographic and climatic conditions. Different flood management organizations at the government level can work collaboratively to reduce vulnerability to flood risk. Strengthening multilevel coordination, enhancing community involvement, capacity building, and investing in technology and infrastructure is essential for more effective flash flood management in the Sylhet Haor region [5-7]. At the government level, the Bangladesh Water Development Board (BWDB) plays a significant role in managing water resources and implementing flood control measures such as constructing and maintaining dams, embankments, and drainage systems. The Local Government Engineering Department (LGED) is responsible for constructing and maintaining local infrastructure, including flood protection structures and drainage systems [5]. In addition, the Department of Bangladesh Haor and Wetlands Development (DBHWD) focuses on the conservation of haor biodiversity, wetlands, flood management, infrastructure development, and

livelihood development. Many national and international NGOs, such as UNDP and BRAC, are involved in the research and capacity building of flash flood management [4, 6]. Moreover, many university students and faculty members are involved in flash flood research in the haor region and monitoring by remote sensing, GIS, and technical reporting.

Policies and activities must be aligned among stakeholders to control flash floods in Sylhet effectively. Coherence ensures that national catastrophe plans such as the National Plan for Disaster Management (NPDM) translate into local activities. Water management, agriculture, urban planning, and disaster response must be integrated into cross-sectoral policies that support institutional, technical, and community collaboration to achieve a comprehensive and successful outcome [4]. Enhancing policy coherence in Sylhet can strengthen flood resilience and reduce socioeconomic impact. This study examines water governance in the Haor Region, highlighting institutional inefficiencies, funding gaps, and limited community involvement. It assesses frameworks such as the Bangladesh Water Act (2013) and Water Rules (2018) to identify governance and stakeholder engagement issues [5, 7].

Using the OECD Water Governance Principles, this study provides a roadmap for reducing flash flood risks through institutional cooperation, community engagement, and financial sustainability. It identified policy gaps, redundant mandates, and ineffective grassroots involvement. The findings emphasize integrated planning, policy changes, and stakeholder inclusion as ways to improve Sylhet's long-term water governance resilience [6]. It identifies natural, human-induced, and governance-related causes, focusing on institutional inefficiencies, insufficient funding, and lack of community involvement in decision-making. This study highlights gaps in policy effectiveness and proposes solutions such as improving institutional coordination, enhancing community resilience, ensuring financial sustainability, and developing a governance roadmap for long-term socioeconomic stability.

Methodology

Study area: The study area is in the northeastern part of Bangladesh, in the Haor region of Sylhet. There are approximately 374–400 haors, which is almost 43% of the district [2, 8]. Among the four districts of the Sylhet division, Sunamganj and Sylhet are at a high risk of flash floods in the pre-monsoon season (April-May).

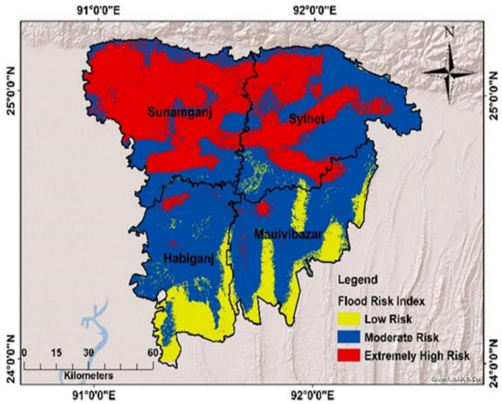

Figure 1. Study area of the Sylhet Haor Region, Bangladesh

Literature Review and Institutional Analysis: The review section examines previous research papers, books, articles, seminar papers, government and non-government reports, policies on water and haor governance in Bangladesh, and related documents to gain a clear understanding of flash flood management in the study area.

Key Informant Interviews (KII): A questionnaire focusing on key themes, such as flood risk management, local governance, and law enforcement roles, was collected through structured interviews. Key informants remained anonymous. Interviews were conducted with the executive engineers of the Bangladesh Water Development Board (BWDB) (K1) and Water Resources Planning Organization (WARPO) (K2) to identify the gaps and issues in the management system. We also interviewed academic experts and researchers at Jahangirnagar University, including the departments of Geography

and Environment (K3), Environmental Sciences (K4), Public Administration and Government and Politics (K5).

Results and Discussion

Institutional Analysis

The Ministry of Water Resources' Water Resources Planning Organization (WARPO) is responsible for national-level water planning (Water Policy 1999). The Bangladesh Water Development Board (BWDB) Act (2000) defined BWDB's framework and processes to manage projects exceeding 1,000 hectares, with smaller initiatives handled at the local level. The Bangladesh Water Act (2013) established the National Water Resource Council and its executive committee, integrating government and non-government bodies. To support flash flood management in the Haor region of Sylhet, the Institute of Water Modelling (IWM) and the Center for Environmental and Geographic Information Services (CEGIS) offer data-driven insights, modeling capabilities, and decision-making tools [9]. To address flood risks, the Flood Forecasting and Warning Centre (FFWC) and BWDB monitor the situation throughout and beyond the monsoon season as required [7]. The Bangladesh Meteorological Department (BMD) provides alerts for potential flash floods, while the Department of Disaster Management (DDM) is responsible for coordinating disaster response and preparedness efforts. There is the Department of Bangladesh Haor and Wetlands Development (DBHWD) focusing on the conservation of Haor biodiversity, wetlands, flood management, infrastructure development and livelihood development of the people.

According to the Bangladesh Water Rules (2018), the management of embankment operates through four levels of water resource management committees: central, district, Upazila, and union. The Director General of the WARPO heads the Central/Executive Committee. The District Integrated Water Resources Management Committee is led by the District Commissioner and includes 19 members from various water-related sectors. Similarly, the Upazila Integrated Water Resources Management Committee is chaired by the UNO with 17 sector representatives. At the grassroots level, The Union Chairman led the Union Integrated Water Resources Management Committee which constituted 13 members [10]. The union and Upazila-level committees oversee embankment maintenance and repair, enabling locals to report issues promptly. Technical committees at each level were tasked with planning and incorporating local knowledge to build sustainable and robust embankments. Each committee is allocated a specific budget for emergency embankment repair [5]. These committees ensure a hierarchical chain of command and promote stakeholder engagement through regular meetings.

Moreover, there is a Haor Masterplan (2012-2032) by the DBHWD with 17 development sectors: water resources, agriculture, fisheries, pearl farming, livestock, biodiversity, and wetlands [11]. From the interview findings, it is evident that there are gaps in the interaction between different institutions in the Haor region's flash flood management. Coordination among agencies such as BWDB, DDM, and local administrations is weak. Overlapping activities lead to inefficiencies and delays in the flood response. BWDB might work on large-scale water management, whereas LGED focuses on smaller infrastructure projects such as canals and roads, which can create conflicts of interest in flash flood regions. This overlap can lead to challenges in the coordination and efficient management of flash flood effects. From these findings, it can be said that laws and regulations have already been established, but their implementation is lacking.

Gaps in Institutional coordination, coherence and capacity

Institutional coherence is crucial for effective flood management in Haor regions. While BWDB plays a central role, collaboration between local government bodies and NGOs is often fragmented. The promotion of inter-ministry and inter-agency coordination would greatly improve this situation. Coherent coordination mechanisms are vital for managing flash floods. Fundings in management projects should be raised and not misused. The findings suggest that a better alignment between national-level institutions and local stakeholders is needed. Faculty members (K3, K4, and K5) advocate research-driven approaches to bridge gaps between theoretical understanding and policy implementation. Academic input highlights the need to integrate scientific tools into capacity-building. One major cause of these gaps is the top-down approach, in which local stakeholders may not be fully involved in decision making. To address this issue, policies should be made more inclusive by actively involving local communities and stakeholders in the planning process. For example, Boro rice is a pre-

monsoon crop, but continuous year-round farming affects monsoon water flow management, particularly in Tahirpur and Dharmapasha. According to K1, "We can't release upstream water (from India) timely due to the year-round farming in the Haor region. There are crops in the Haor, so we delay the opening of sluice gates". According to K2, "There is the inadequacy of land use planning and its role in exacerbating flood risks, GIS-based flood modelling is required for predictive planning." The local, Administrative, and Public participatory gaps in the flashflood region are listed in Table 1.

Table 1: List of Local, Administrative, and Public participatory gaps in the flashflood region

Types of Problem	Gaps
Local Governance	Political interference delayed the work of flash flood management.
Administrative	Inadequate land use planning.
	Insufficient funding restricts the implementation and maintenance of robust flood prevention and mitigation measures.
	Mismanagement and misuse of funds allocated for flood management projects.
	Inadequate drainage systems and lack of urban planning.
	Geo-bags to mitigate flash floods are unsustainable
	Lack of modern technical capacity.
Public Participation	Lack of effective public participation from the responsible bodies due to the top-down approach.
	Local people have a lack of interest in public participatory programs.

Although recently the "Haor Flood Management & Livelihood Improvement Project" includes a participatory approach including local people by establishing WMG (Water Management Group), WMA (Water Management Association), and WMF (Water Management Federation) under WMO (Water Management Organization) but there has lack of proper participation of local people. Enhancement of the participatory approach by increasing the willingness of higher authorities to incorporate local populations into project implementation, amplify the voices of local inhabitants, and elevate their interest in project participation can address this issue. Building institutional and community-level capacity is essential to mitigate the impact of flash floods in the Haor region. Community awareness campaigns can empower residents and enhance their overall resilience to flooding. Policy coherence is critical for addressing the unique challenges faced by haor regions. A unified framework that integrates environmental, geographical, and governance perspectives is needed . Bridging the gap between policy formulation and ground-level implementation can ensure sustainable flash flood management which requires several steps. Table 2 presents the framework regarding institutions, coordinates, and coherence-related problems and their realistic solutions.

Table 2. Governance problem and solution framework at the institutional level

Governance problem	Problems	Solutions
Institutional interaction	Weak interaction	Establish a centralized platform for stakeholders involving the DBHWD and its Haor master plan.
	Conflict of interest	Integrated management system.
	Insufficient technical capacity	Introduce advanced flood prediction tools, real-time data analysis and collaboration with international experts.
	Mismanagement & misuse of fund	Ensuring proper fund management considering feasibility studies, real-time budget alignment, regular monitoring and audits.
Institutional Coordination	Lack of coordination	Ensure stakeholder involvement from project preparation to implementation, assign post-project maintenance responsibility

	Lack of public participation	Strengthening bottom-up participatory approach and communication effectively
	Interference by political group	Ensure political neutrality
Institutional Coherence	Inter-ministerial collaboration lacking	Develop clear unified guidelines by NDMC in collaboration with relevant ministries and departments for Haor.
	Lack of land use policy	Introduce a smart land use management policy that incorporates a flood risk zone for Haor
	Lack of awareness among stakeholders	Conduct awareness campaigns

Conclusion

Flash floods in Sylhet's Haor region pose significant threats to its infrastructure, agriculture, and livelihoods, exacerbated by climate change, upstream activities, and inadequate governance. Despite having comprehensive water-related policies, institutional frameworks, and acts, the inefficiencies in institutional coordination, lack of stakeholder engagement, and insufficient funding hinder effective water resource management in the region. The hierarchical gaps in committee formation and the absence of root-level stakeholder involvement further weaken the embankment management system, resulting in recurrent and devastating flash floods. Addressing these challenges requires a holistic and integrated approach to water governance and implementation of the Haor masterplan. Strengthening institutional coordination, ensuring stakeholder inclusion, enhancing capacity, and fostering community resilience are critical. Thus, Bangladesh can build an inclusive, transparent, and efficient water governance roadmap to combat flash flood risks and ensure socio-economic resilience in the Haor region.

Acknowledgement

We want to express our sincere gratitude to all the participants and experts for sharing their insights, knowledge, and expertise in water governance and flash flood management.

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PRESENTATION NO: 04

Title: Water and Delta Governance" Assessing Institution, Coordination, Coherence, and Capacity Buildup of Flash Flood Management in Sylhet Haor Region

Sadia Akter[1], Yeasmin Mushtary[2], Kazi Nabila Obaid[3], Ahsan Ahmed Parvez[4], Abdur Rahman[5], and Mashura Shammi[6]

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“Water and Delta Governance” Assessing Institution, Coordination, Coherence, and Capacity Buildup of Flash Flood Management in Sylhet Haor Region

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Ahsan Ahmed Parvez
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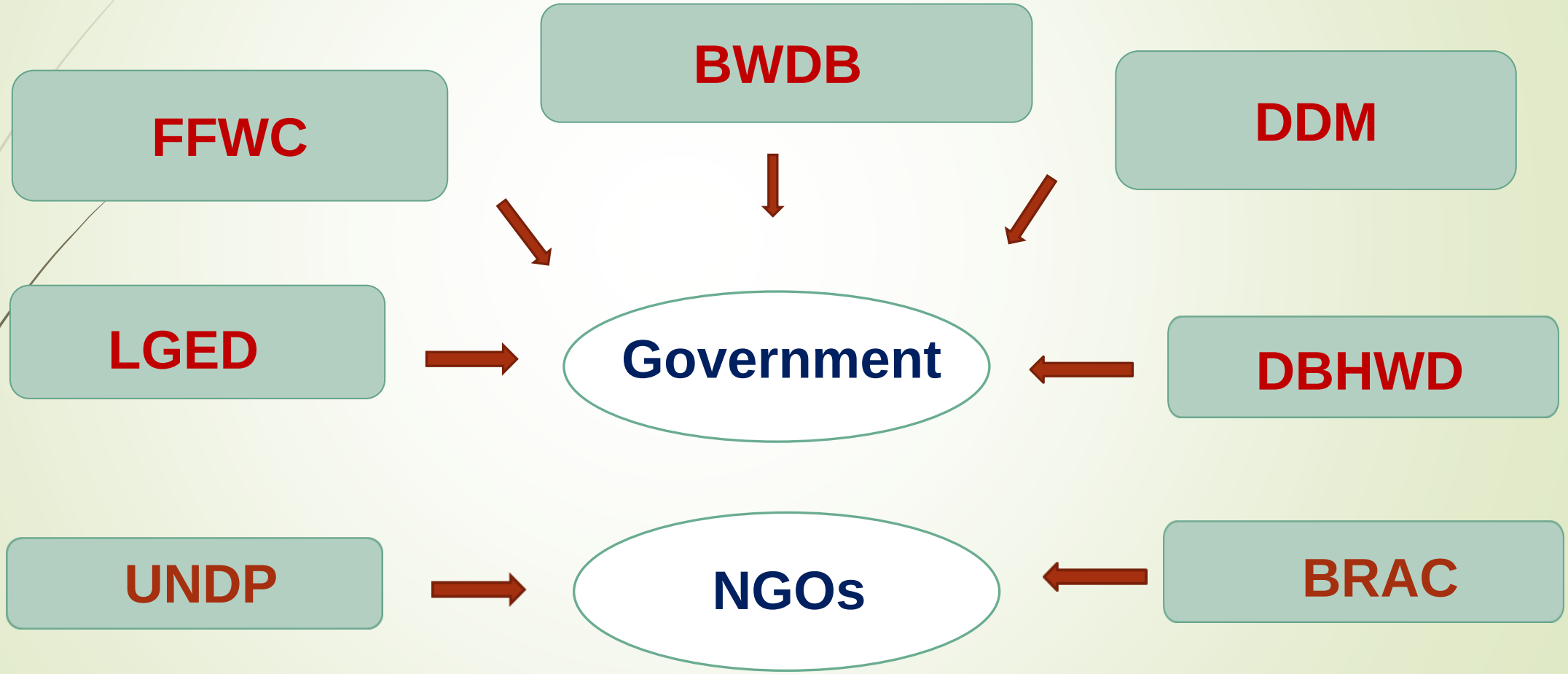
Mashura Shammi (Supervisor)

Department of Environmental Sciences,
Jahangirnagar University

Major Institutions in Flashflood Management



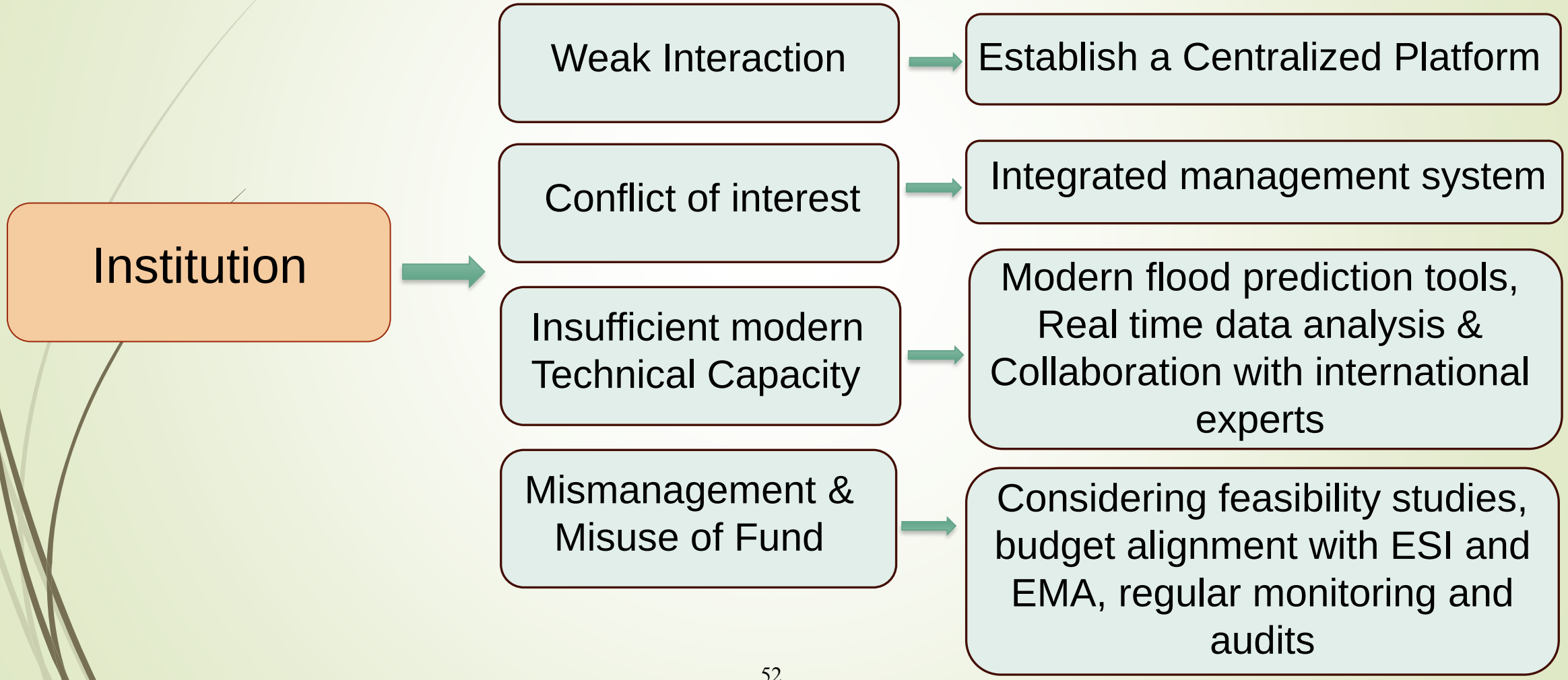
Governance Gaps

3

Local Governance	Political interference
	Inadequate land use planning
Administrative	Insufficient funding
	Lack of modern technical capacity
Public Participation	Lack of effective public participation
	Lack of interest in public participatory programs.

Proposed Solutions Regarding the Problems

4



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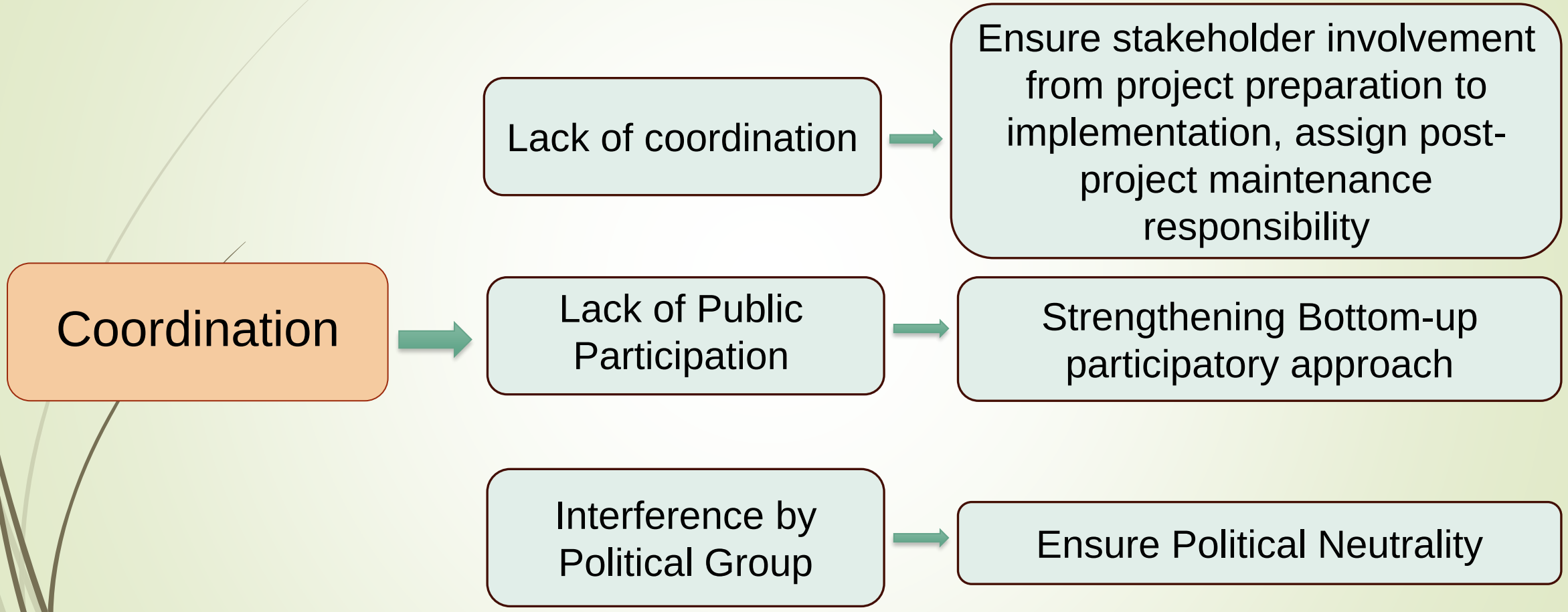
Coordination
Lack of coordination
Ensure stakeholder involvement from project preparation to implementation, assign post-project maintenance responsibility
Lack of Public Participation
Strengthening Bottom-up participatory approach
Interference by Political Group
Ensure Political Neutrality

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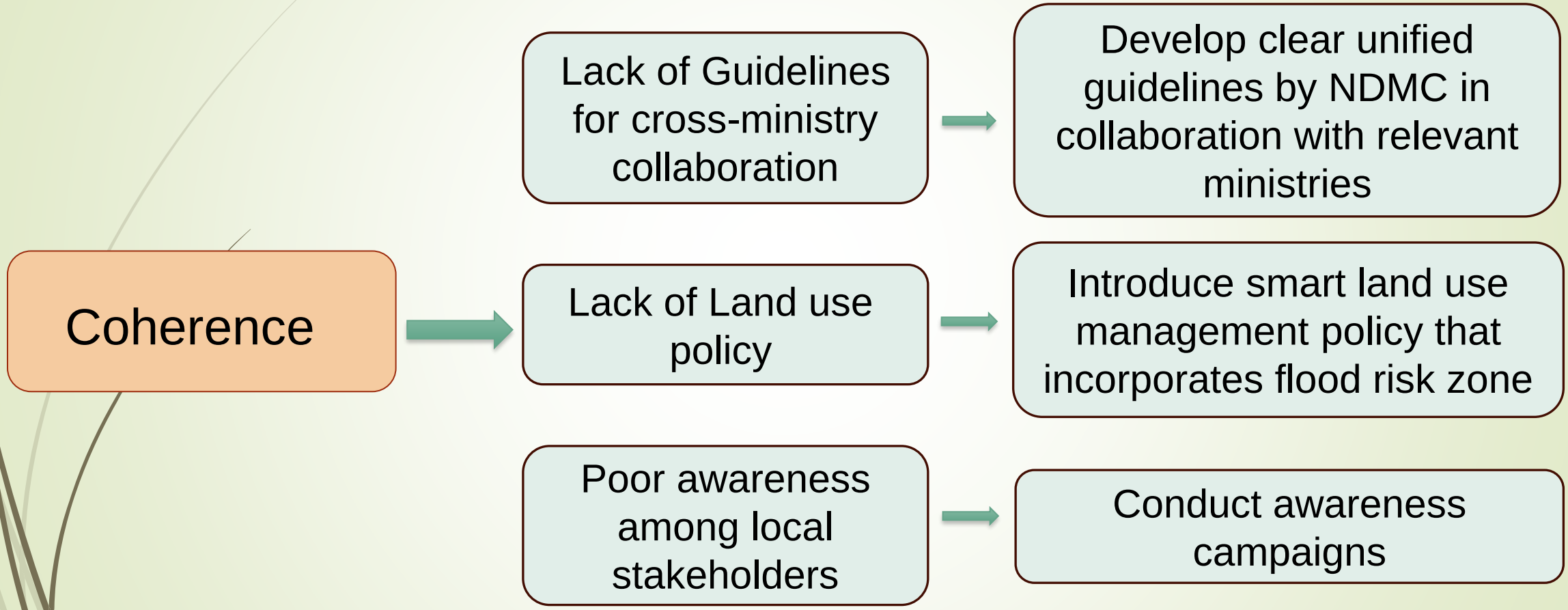
Coherence
Lack of Guidelines for cross-ministry collaboration
Develop clear unified guidelines by NDMC in collaboration with relevant ministries
Lack of Land use policy
Introduce smart land use management policy that incorporates flood risk zone
Poor awareness among local stakeholders
Conduct awareness campaigns

Conclusion

- Strengthen collaboration among water management agencies, reduce conflicts, streamline policy implementation, and address hierarchical gaps in committee formation to improve embankment management and flood prevention.
- Ensuring Stakeholder Inclusion and Community Resilience in decision-making processes to enhance flood preparedness and response strategies.
- Implementing the Haor Masterplan with Sustainable Funding and developing a transparent, inclusive governance roadmap to mitigate flash flood risks and ensure socio-economic stability in the Haor region.

Thank You

Any Questions?
Any Comments?
Any Suggestions?

POSTER PRESENTATION

Six selected poster presentation files of the special session on **Water and Delta Governance: Aspiration** of the Youth of 10th International Conference on Water and Flood Management - ICWFM 2025, 22-24 February 2025, Dhaka, Bangladesh has been attached.

10th International Conference on Water and Flood Management - ICWFM 2025, 22-24 February 2025, Dhaka, Bangladesh.

Reforming Water Governance in Bangladesh through AI-Driven Flood Prediction and Adaptive Management

Shafayet Rahman*, Ashfaqur Rahman, Md Mahtab Ishmum, Safwan Hasan Salvi
Faculty Guide: Prof. Dr. Aysha Akter

Introduction

Bangladesh faces escalating flood risks due to its **deltaic geography, monsoon climate, and climate change impacts**, yet **existing water governance struggles to adapt**.

- **Key Challenges:** Institutional fragmentation | Outdated flood forecasting | Limited AI-driven decision-making | Low community engagement

Artificial Intelligence (AI) and Machine Learning (ML) offer a **transformative approach** to **enhancing flood prediction and adaptive governance**, bridging gaps in **data integration, policy, and community resilience**.

Contemporary Issues in Water Governance

- Challenges in Existing Governance Systems

✅ Dispersed Accountability – Multiple agencies, lack of coordination
✅ Restricted Predictive Capability – Outdated forecasting models, data scarcity
✅ Low Community Involvement – Lack of localized flood mitigation strategies
✅ Inefficient Resource Allocation – Focus on post-disaster response over prevention

📌 Need for AI-Driven Governance Reform

- Real-time Flood Forecasting – AI-driven models enhance prediction accuracy and lead time
- AI-Based Risk Assessment & Decision-Making – Data-driven policies for proactive flood management
- Community Engagement via Smart Alerts & Early Warnings – Timely dissemination of flood risk information to at-risk populations

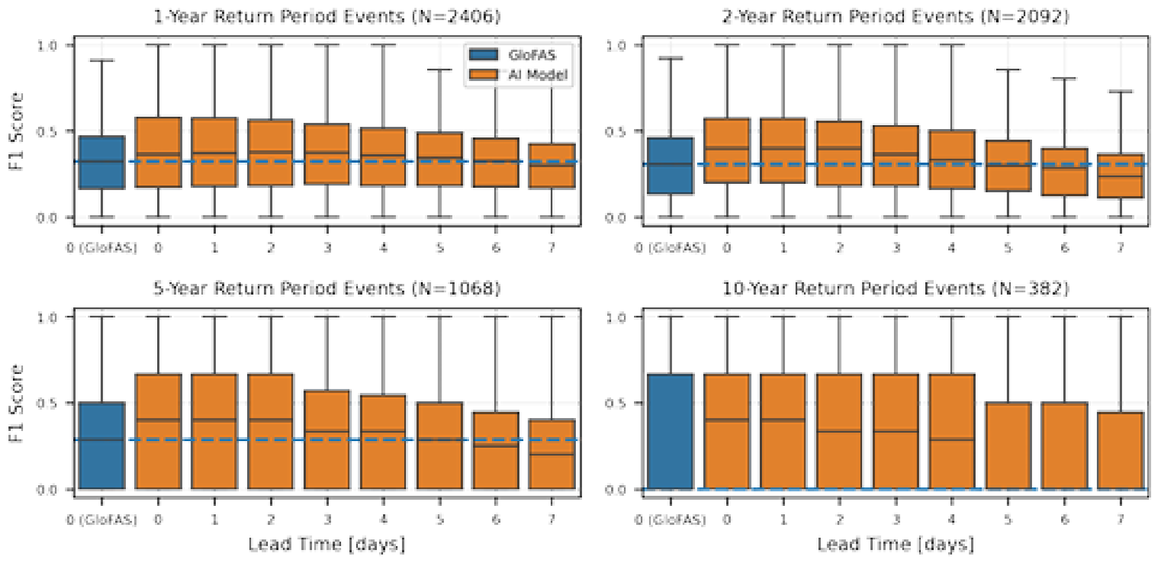

Fig. 1: *AI-based flood models (orange) outperform the GloFAS model (blue) across flood return periods (1, 2, 5, 10 years), offering higher accuracy, especially for shorter lead times.*

The Role of AI in Flood Prediction and Management

AI **revolutionizes flood mitigation** through **big data analytics, sensor networks, and predictive modeling**.

✅ **Case Studies on AI-Driven Flood Management**
📌 **Google's AI Flood Prediction System** – Uses **LSTM neural networks**, issued **100M flood alerts** (Bangladesh & India, 2021), reduced **casualties & economic damage**.
📌 **FloodGuard Initiative (Bangladesh)** – AI + GIS-based flood modeling, **85% accuracy** in predicting flood zones, benefited **agriculture & infrastructure protection**.
📌 **Dutch 'Room for the River' Initiative** – AI-powered **hydrological models** for floodplain management, lessons applicable to **Brahmaputra-Jamuna basin**.
📌 **Jakarta's AI-Driven Early Warning System** – ML-based flood forecasting (**72-hour lead time**), reduced **urban flood damage by 40%**.

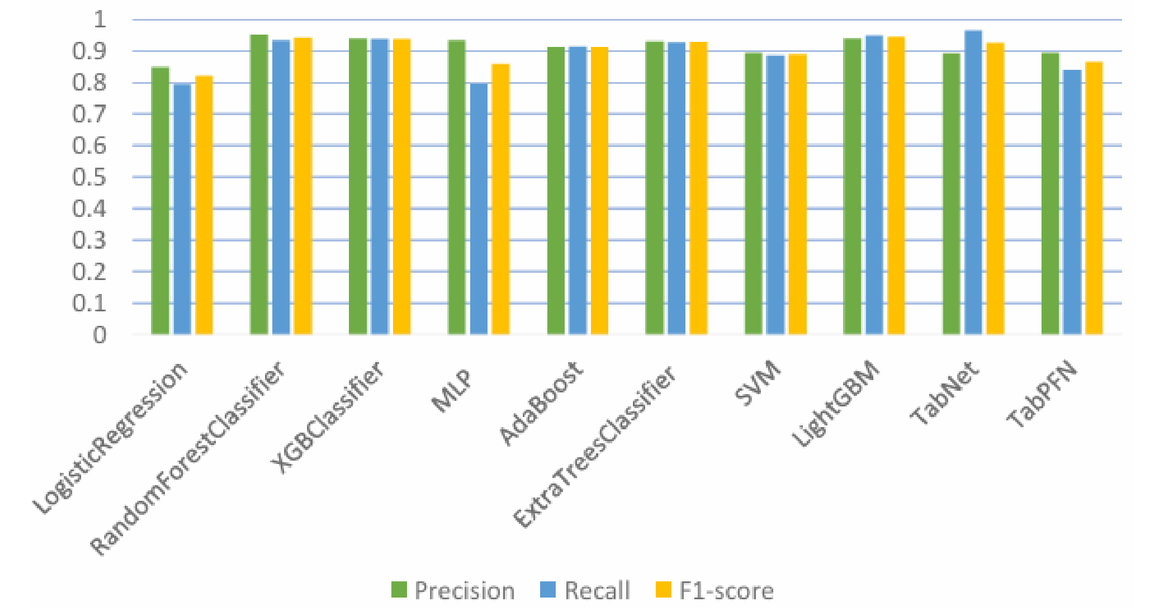

Fig. 2: *This chart evaluates the precision, recall, and F1-score of various machine learning classifiers in flood prediction. Models like XGBoost, LightGBM, and TabNet demonstrate high accuracy and balanced recall, making them strong candidates for AI-driven flood forecasting and adaptive water governance.*

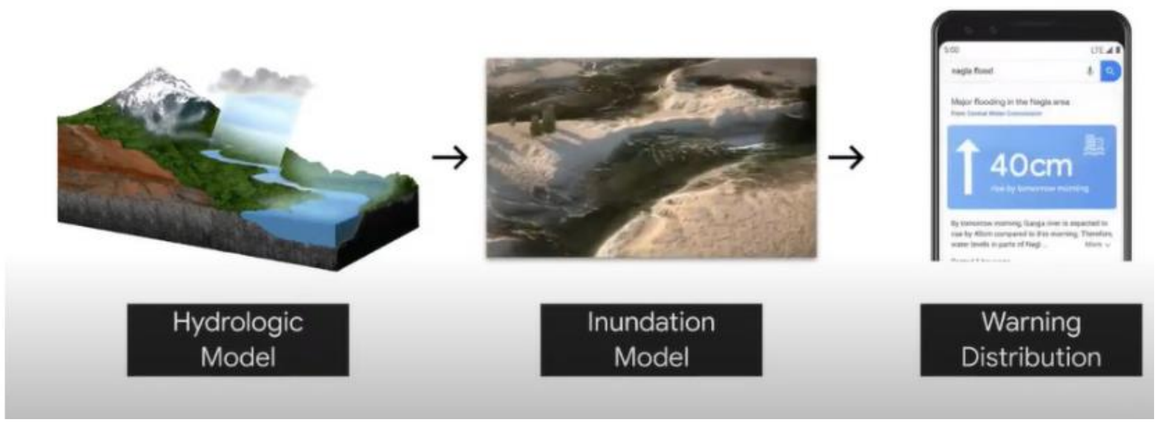

Fig 3: *AI-driven flood prediction integrates a **Hydrologic Model** (rainfall-runoff simulation), **Inundation Model** (flood extent prediction), and **Warning System** (real-time alerts via mobile notifications) for early disaster response.*

AI-Based Governance Reform Framework

To ensure effective AI adoption in flood governance, the following **policy interventions** are recommended:

📌 **1. Centralized Data Integration**
•Establish **National Flood Prediction & Response Center (NFPRC)**
•AI-driven **multi-agency coordination**
📌 **2. Capacity Building & Training**
•Develop **AI literacy programs** for policymakers & emergency responders
📌 **3. Community-Centric Governance**
•Implement **crowdsourced flood monitoring** via mobile apps
📌 **4. Policy Alignment & Transparency**
•**Open-access platforms** for real-time flood prediction
•Align with **OECD Water Governance Principles**

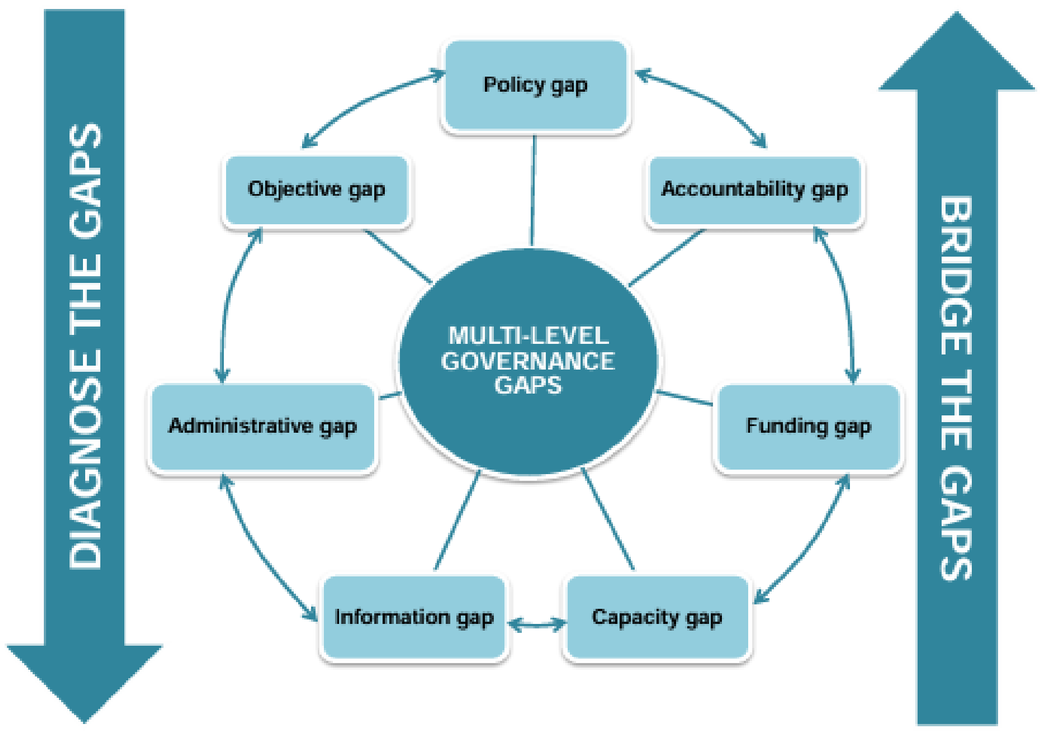

Fig. 4: *Multi-level governance gaps—policy, accountability, funding, and capacity—hinder flood management. AI-driven reforms can diagnose and bridge these gaps, ensuring efficient, data-driven decision-making.*

Implementation Strategy

A phased AI-integration model for Bangladesh's flood governance:
📌 **Phase 1 (2025-2026): AI Pilot Programs** – Test ML-based flood prediction in high-risk areas | Develop AI task forces & policy roadmaps
📌 **Phase 2 (2027-2029): Nationwide AI Integration** – Expand AI-driven flood forecasting across river basins | Establish AI Innovation Hubs for R&D
📌 **Phase 3 (2030 Onward): Adaptive Governance** – AI-powered real-time flood risk assessment | Regional transboundary water governance collaborations

Expected Impact & Conclusion

- **Reduction in flood-related economic losses**
- **Increased accuracy in flood forecasting**
- **Stronger public engagement in flood governance**
- **Efficient policy implementation & infrastructure resilience**

AI-driven flood management will transform Bangladesh's water governance, fostering resilience, sustainability, and climate adaptation.

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Assessing River Bank Erosion in Harirampur, Manikganj

Sanjida Parvin, **Sarah Zahir***, Mahzabin Malik, Tasfia Nakib Sifwa, Efath Hossain Tazim, and Mashura Shammi

Background

- Riverbank erosion is a severe and recurring natural hazard in Bangladesh, particularly impacting Harirampur, Manikganj, along the Padma River, leading to significant land loss and displacement of communities.
- Between 1988–2017, 42,689.59 hectares were eroded, with peak erosion at 2,089.69 ha/year (1988–1993) (Ophra et al., 2018).
- Governance gaps include poor policy implementation, inadequate infrastructure, and limited community involvement (Bangladesh Water Act, 2013).
- Existing measures by BWDB are reactive and insufficient for long-term solutions (Bangladesh: Flood and Riverbank Erosion Risk Management, 2021).

Methodology

1.Literature review
2.Personal interviews from researchers
3.Secondary data analysis

Objectives

- To assess the impact of riverbank erosion in Harirampur.
- To evaluate existing governance mechanisms for erosion control.
- To propose governance strategies with active youth engagement.

Map of the study area

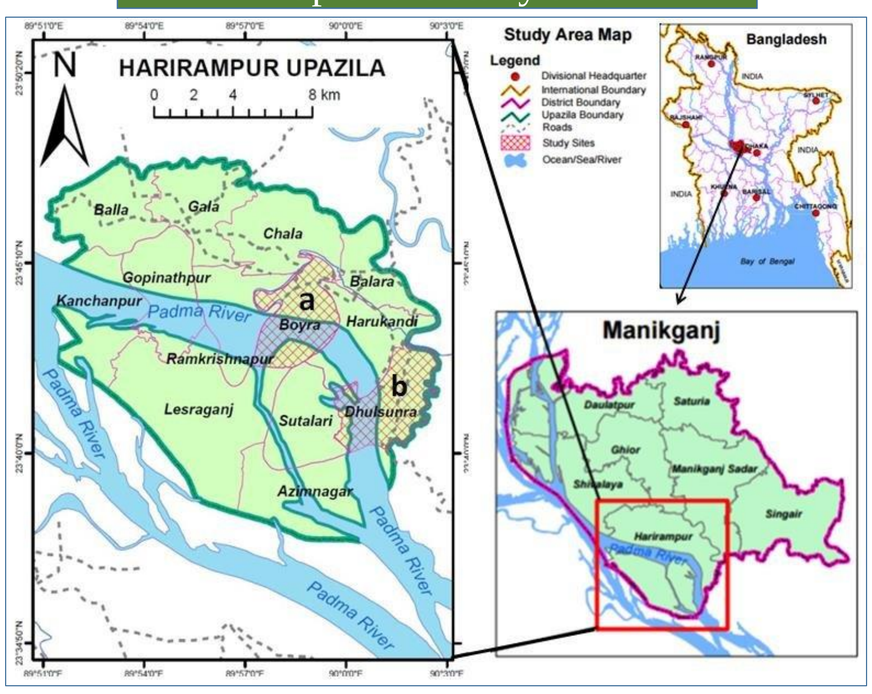


Figure 1:Map of Harirampur Upazila,Manikganj, Source:(Islam et al., 2016)

Existing Governance

- Construction of embankments by BWDB
- Local Government Initiatives
- NGO involvement

Governance Gaps

- Inadequate Infrastructure and Resources.
- Poor Inter-Agency Coordination.
- Data and Monitoring Deficiencies.
- Inequitable Resource Allocation.
- Limited Youth and Stakeholder Engagement

Impact of River Erosion

- Displacement of local communities
- Increased Poverty
- Urban Challenges Due to Migration
- Biodiversity loss
- Destruction of infrastructure

Result

Riverbank erosion in Harirampur, Manikganj, requires integrated, sustainable solutions that combine nature-based approaches, community involvement, and youth engagement.
By addressing governance gaps and implementing long-term strategies, we can mitigate erosion, protect livelihoods, and build resilience in vulnerable communities.

INCLUSIVE MEASURES TO ADAPT CLIMATE CHANGE AND WATER STRESS OF BARIND TRACT IN BANGLADESH

Sumaya Tabassum, Md. Imtiaz Hassan, Md. Sultanul Islam, **Muktaky Akter***, Iqbal Hossain Khan

Introduction

The Barind Tract in Bangladesh experiences low rainfall and frequent droughts, making it highly vulnerable to climate change and water stress. Groundwater levels have drastically declined due to over-extraction for irrigation, particularly for rice production.

Communities relying on shallow tubewells face financial losses and are forced to change professions, leading to production deficiencies and economic challenges.

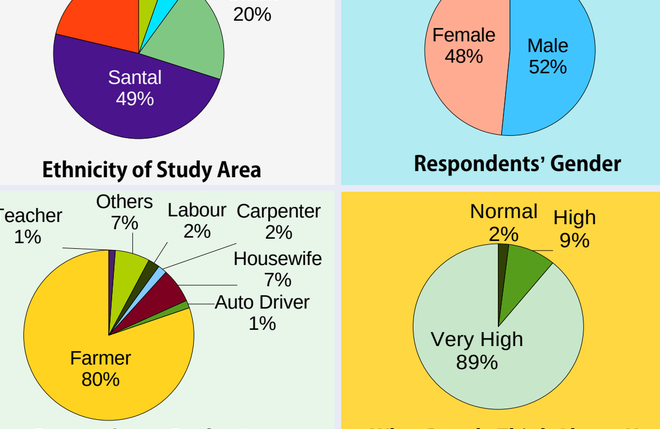
The region's clayey soil limits groundwater recharge and is deficient in key nutrients. Higher water withdrawal rates exacerbate the stress on limited resources.

Objectives

To assess the vulnerabilities that various indigenous communities of Barind Tract face due to climate-induced natural disaster and locally led adaptive measures to mitigate the impact of climate change.

Methods

Study Area



Survey Questionnaire

The survey intends to collect information on the following:

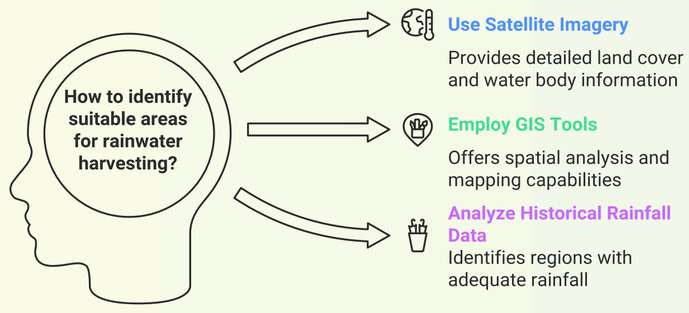
- Intensity of heat
- Intensity of rainfall
- Climate-induced natural disaster
- Change of habitance due to disaster related to climate change
- Change of profession due to disaster related to climate change

Results: Data Summary

Sample Size: 409

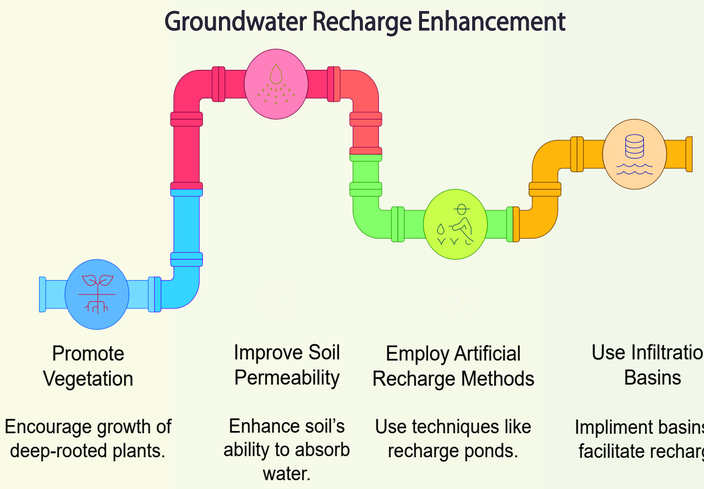
Adaptive Strategies

- **Rainwater picking and Groundwater Revival:**



- **Groundwater Recharging:**

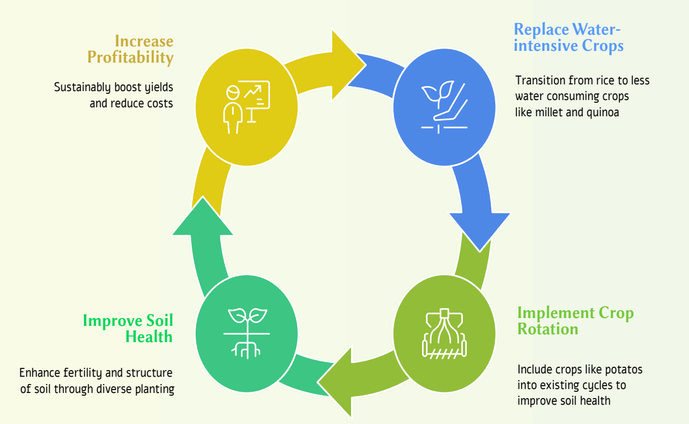
Utilizing multiple methods in combination to strongly influence the overall recharge capability of ground.



- **Crop Diversification and Food Habits:**

Replacing water-heavy crops like rice with alternatives such as wheat, pulses, oilseeds, etc.

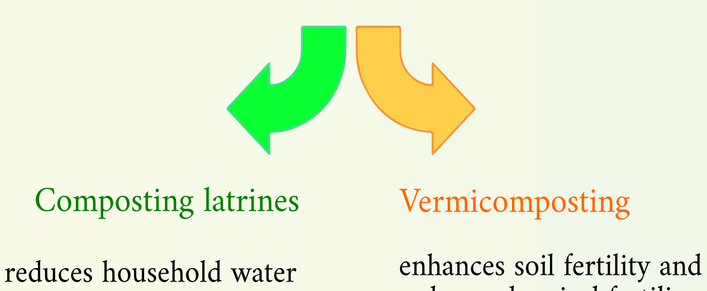
Encouraging crop rotation, e.g., integrating potatoes into rice-fallow periods, to improve soil health.



- **Water-Saving Techniques:**

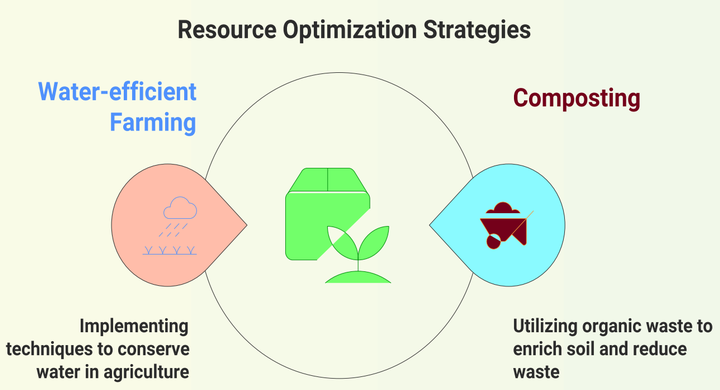
Adopting composting latrines to reduce water use in houses and promote ecological sanitation.

Promoting vermicomposting to improve soil fertility and minimize applications of chemical fertilizers.



- **Resource Optimization:**

Affordable and scalable solutions to address financial constraints.



Innovations

Solar Integration

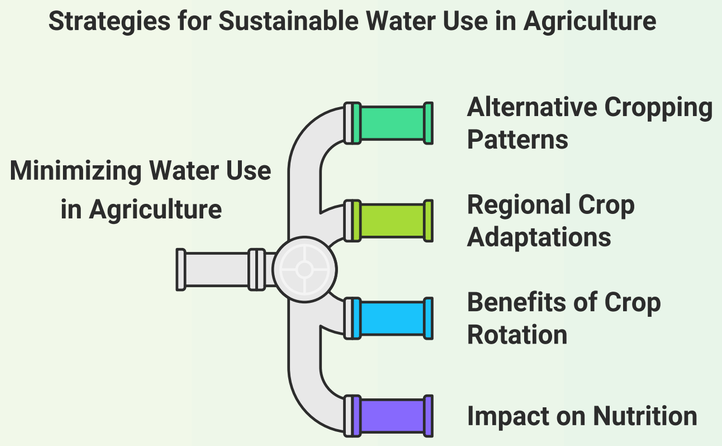
Integration of solar energy with communication technologies for agriculture

Collaborative Efforts

Organizations working together to enhance water-saving sanitation and agriculture.

Conclusion

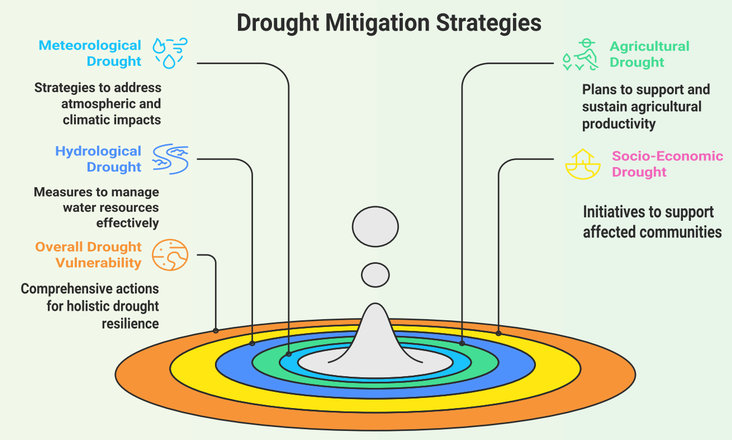
- **Innovative Water Balance and Management:**



- **Climate-Resilient Policy Recommendation:**

Developing and using drought vulnerability maps to support public-private initiatives and allocate resources efficiently.

Enhancing stakeholder engagement (OECD Principle 10) to raise awareness and encourage community participation in adaptive measures.



Acknowledgments

The survey work was supported by the Center for Research and Training (CRT), Uttara University, Dhaka, Bangladesh.

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Further References

TIDAL RIVER MANAGEMENT (TRM) WITH GIS: A NATURE-BASED SOLUTION FOR SUSTAINABLE WATER AND DELTA GOVERNANCE IN BANGLADESH

Md Abdul Helal Kafy*, Nusrat Jahan Moitry, Sadia Jannat Jussi, Abdul Awal Chowdhury Masud

Abstract

Bangladesh, a riverine country, faces significant water governance challenges such as waterlogging, sedimentation, and poor drainage, particularly in its southwestern coastal regions, including Satkhira, Khulna, and Jessore. Traditional embankment-based water management has disrupted natural sediment dynamics, exacerbating these issues and increasing vulnerability to climate change. Tidal River Management (TRM), a community-driven, nature-based solution, utilizes tidal flows to restore river depth, reduce water stagnation, and enhance resilience against climate-induced disruptions. This study evaluates TRM as a sustainable alternative to conventional engineering approaches, aligning with the OECD Principles on Water Governance to promote effective and inclusive water management. Geospatial analyses using the Normalized Difference Water Index (NDWI) in ArcGIS will be conducted to identify waterlogged areas. Satellite images and digital elevation model (DEM) data will be obtained using the USGS EarthExplorer (EE) tool for this assessment. Different scenarios will be developed based on inlet placement, flow regulation through the beel using open or gated inlets, and seasonal variations. To improve local acceptance, we propose restricting TRM implementation to the monsoon season, allowing dry-season crop cultivation and minimizing salinity intrusion. Additionally, TRM can enhance sedimentation, helping counteract sea-level rise in sinking deltas. By integrating TRM into water governance strategies, Bangladesh can achieve sustainable water management, equitable resource distribution, and long-term deltaic ecosystem health.

Introduction

Bangladesh, a low-lying deltaic country, faces significant water management challenges due to rapid urbanization, population growth, and infrastructural interventions. The southwestern coastal regions, in particular, suffer from severe waterlogging, sedimentation, and drainage congestion, impacting agricultural productivity, freshwater availability, and livelihoods. Traditional embankment-based water management strategies have proven unsustainable, exacerbating water stagnation and salinity intrusion. To address these challenges, Tidal River Management (TRM)-a nature-based, community-driven approach that utilizes tidal dynamics to restore river depth, enhance drainage, and mitigate waterlogging-has emerged as a sustainable solution. TRM involves the controlled inundation of low-lying areas (beels) during high tides to allow sediment deposition, which raises the riverbed and improves water flow capacity during low tides. In 2011, the Executive Committee of the National Economic Council (ECNEC) approved a TRM project in Pakhimara Beel, Tala, Satkhira, to mitigate waterlogging (2). However, both intended and unintended waterlogging affected 5,090 acres of agricultural land, 729 acres of homesteads, and 201 acres of water bodies, raising concerns about implementation challenges and socio-economic impacts (2). This study evaluates the effectiveness of TRM in addressing waterlogging and sedimentation, its alignment with national water policies like the Bangladesh Delta Plan 2100, and proposes key policy recommendations for enhancing sustainable water governance in Bangladesh.

The Problem: Waterlogging and Sedimentation in the Delta

The southwestern coastal regions of Bangladesh face persistent waterlogging and sedimentation, impacting agriculture, livelihoods, and the environment (Fig 1). Key causes include:

- Excessive sedimentation in rivers (e.g., Hari, Kobadak, Bhadra) due to embankments and reduced tidal flows.
- Disrupted natural drainage from polders and flood control infrastructure.
- Limited community involvement in decision-making, leading to unsustainable interventions.

Fig 1. Severe waterlogging in southwestern coastal Bangladesh due to drainage congestion.

Consequences:

- Loss of agricultural land from prolonged flooding.
- Increased salinity intrusion, reducing freshwater availability and food security.
- Riverbed rise and drainage failure, exacerbating climate change vulnerability.

Tidal River Management (TRM): A Nature-Based Solution

TRM leverages natural tidal flows to restore river depth, improve drainage, and manage sedimentation (Fig. 1). It involves:

- **Controlled Inundation:** Flooding low-lying areas to deposit sediments, raising riverbeds and floodplains.
- **Riverbed Restoration:** Outflowing water removes silt, deepening channels.
- **Land Reclamation:** Over 3-5 years, sediment elevates land for agriculture.
- **Floodplain Resilience:** Improved drainage reduces reliance on embankments.

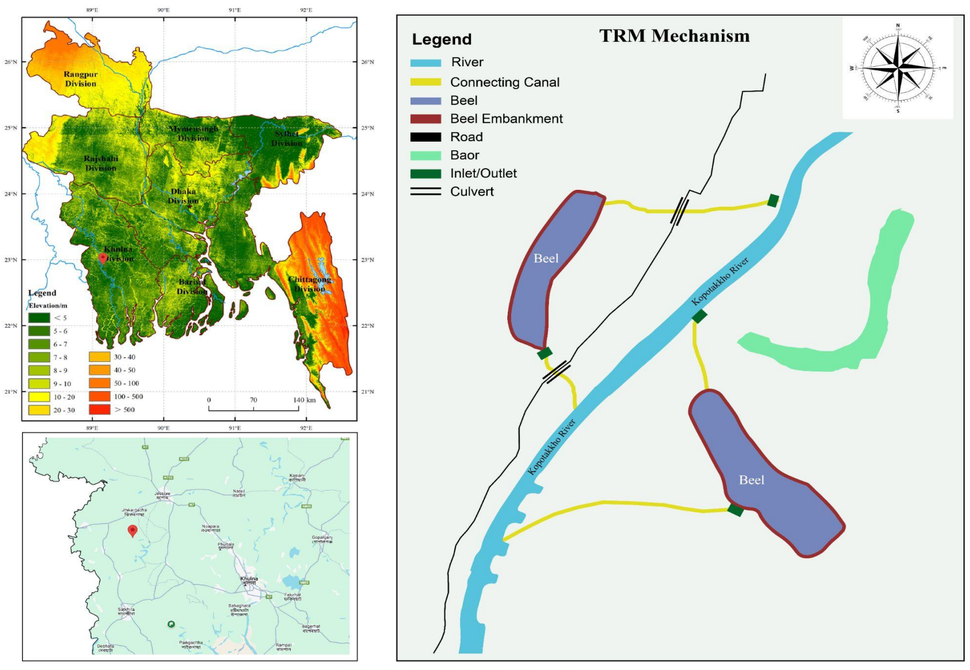

Fig 2. TRM Mechanism

Benefits of TRM:

- Enhanced soil fertility and agricultural productivity.
- Improved drainage, preventing waterlogging.
- Biodiversity conservation and ecosystem restoration.
- Climate resilience by reducing flood vulnerability.

Sediment Deposition and TRM Implementation

Previous studies indicate that utilizing two inlets-whether with or without flow regulation via gates-enhances total sediment deposition and improves the uniformity of sediment distribution compared to a single inlet without a gate (Fig 3); (1). In the case of a single inlet, sediment deposition is typically higher near the inlet side, although the total sediment deposition remains unaffected by the inlet's location. In contrast, dual inlets promote a more even distribution of sediment deposition. Furthermore, successive gate operation with two inlets results in greater sedimentation compared to simultaneous gate operation. However, considering the complexity and cost associated with gate operations, the most feasible Tidal River Management (TRM) approach is to implement two inlets on opposite sides of the *beel* (wetland) without flow regulation, despite the fact that flow regulation with successive gate operation yields higher sediment deposition.

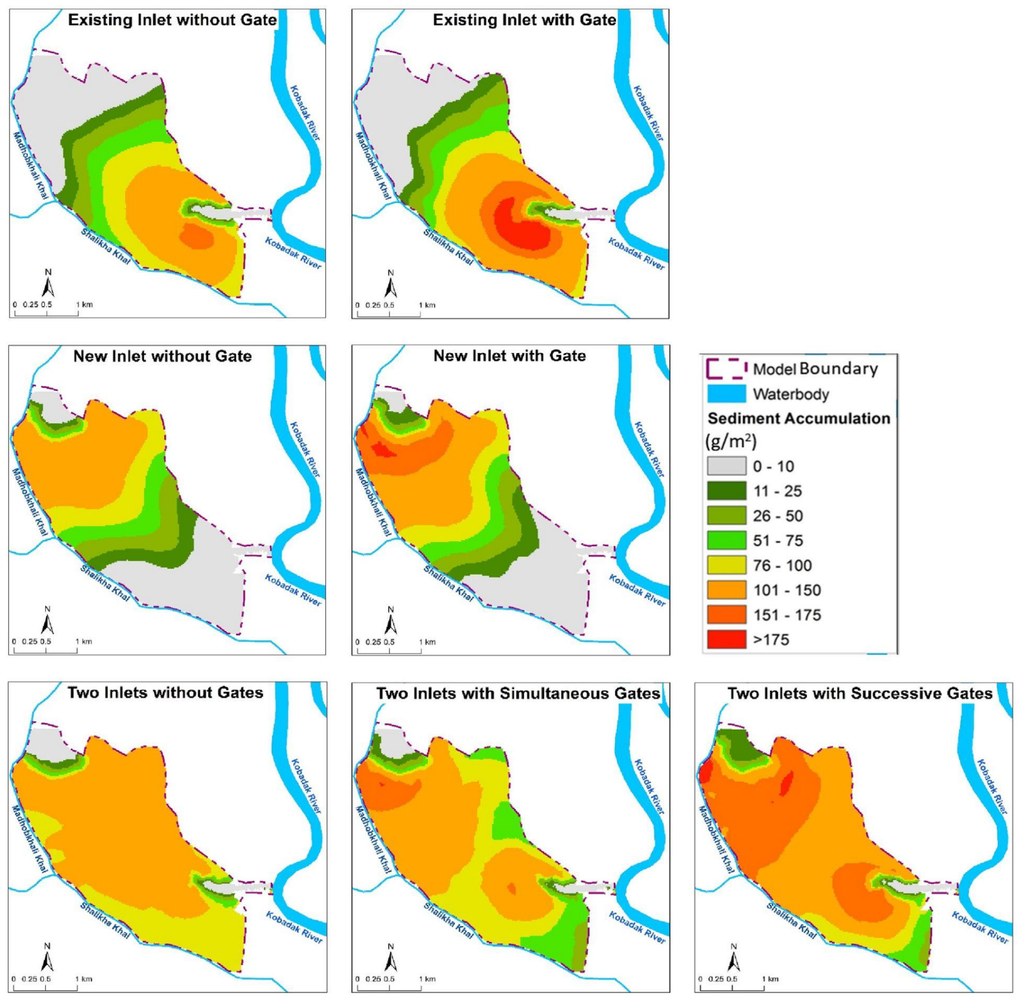

Fig 3. Spatial pattern of sediment deposition for different scenarios during monsoon

TRM Alignment with OECD Principles on Water Governance

Successful TRM implementation requires:

- **Institutional Effectiveness:** Coordinated cross-agency collaboration.
- **Policy Coherence:** Integration into the Bangladesh Delta Plan 2100.
- **Data and Technology:** Use of GIS, remote sensing, and AI for planning.
- **Community Participation:** Establishment of Water User Associations (WUAs).
- **Financial Sustainability:** Compensation mechanisms and sustainable funding models.

Challenges and Policy Recommendations:

- **Land Ownership Conflicts:** Ensure fair compensation and livelihood support.
- **Institutional Barriers:** Strengthen coordination between agencies (e.g., BWDB, WARPO).
- **Technical Gaps:** Improve site selection and maintenance using hydrological modeling.

Policy Actions:

- Institutionalize TRM as a national water governance strategy.
- Adopt digital tools for monitoring and planning.
- Ensure equitable compensation for affected communities.
- Strengthen inter-agency collaboration for efficient implementation.

Youth Call to Action:

- **Policy Advocacy:** Engage in research and discussions to influence policy-making for improved TRM implementation.
- **Identifying Institutional Barriers:** Conduct surveys and studies to highlight bureaucratic and infrastructural challenges hindering TRM effectiveness.
- **Community Engagement:** Raise awareness and mobilize local communities to participate in decision-making processes.
- **Socioeconomic Solutions:** Address land ownership conflicts by collaborating with stakeholders to develop fair compensation and rehabilitation strategies.

Conclusion

TRM offers a cost-effective, climate-resilient solution to waterlogging and sedimentation in Bangladesh. By aligning with OECD principles and integrating community involvement, TRM can enhance institutional effectiveness, policy coherence, and technological innovation. Its success depends on long-term vision, political commitment, and active community participation, ensuring a sustainable future for deltaic regions.

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Proposal for Impact based Flood Forecasting to support informed action of the stakeholder at the time of disaster

Md Omar Faruq*, Tanvir Hossain, Alok kumar Paul, Biswajit Karmakar, Md. Sajjad Hossain, Md Feroz Islam

Introduction

Bangladesh experiences flood every year. The frequency and intensity of floods are projected to increase with climate and anthropogenic changes. Flood causes about 4% loss of rice production every year and about 1% of gross domestic product (GDP) is lost every year[1] endangering food security of the country. The Standing orders on disasters (SOD), 2019 of Bangladesh defines roles for national, regional (district) and local (upazila) level government agencies for pre-flood, during flood and post flood event. FFWC of Bangladesh provides forecast of water level at river sections. However, damage due to floods to crops and comprehensible flood forecast to farmers to take informed mitigation measures are not available yet. Flood damage forecast can assist the government agencies to initiate the release of funds for recovery, prepare for crop import to ensure food security and provide adequate information to the farmers to take early action to reduce damage.

Objective

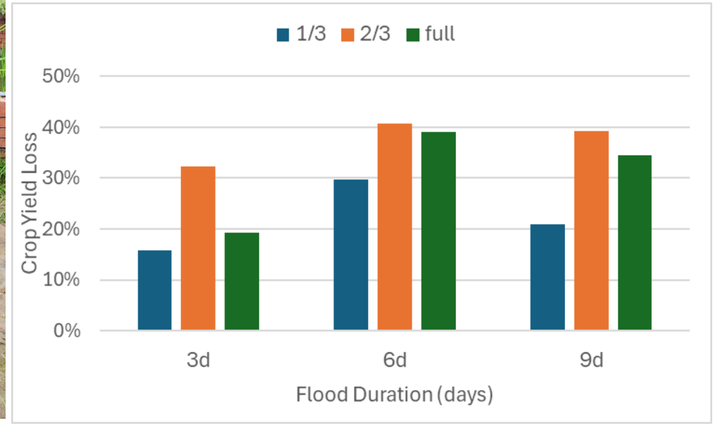
(i) Understand the depth-duration-damage effect of flood on rice yield with field experiment

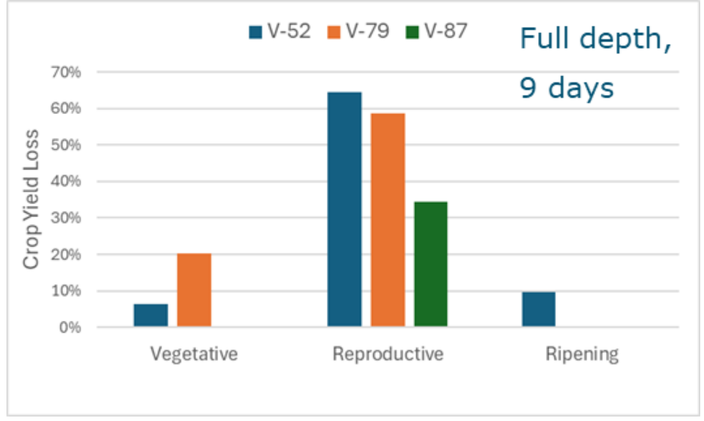
(ii) Develop methodology to generate flood maps and flood damages with data driven model

(iii)Identify challenges and provide suggestive policy measures using the OECD Water Governance Framework

Understand the depth-duration-damage effect of flood on rice yield with field experiment

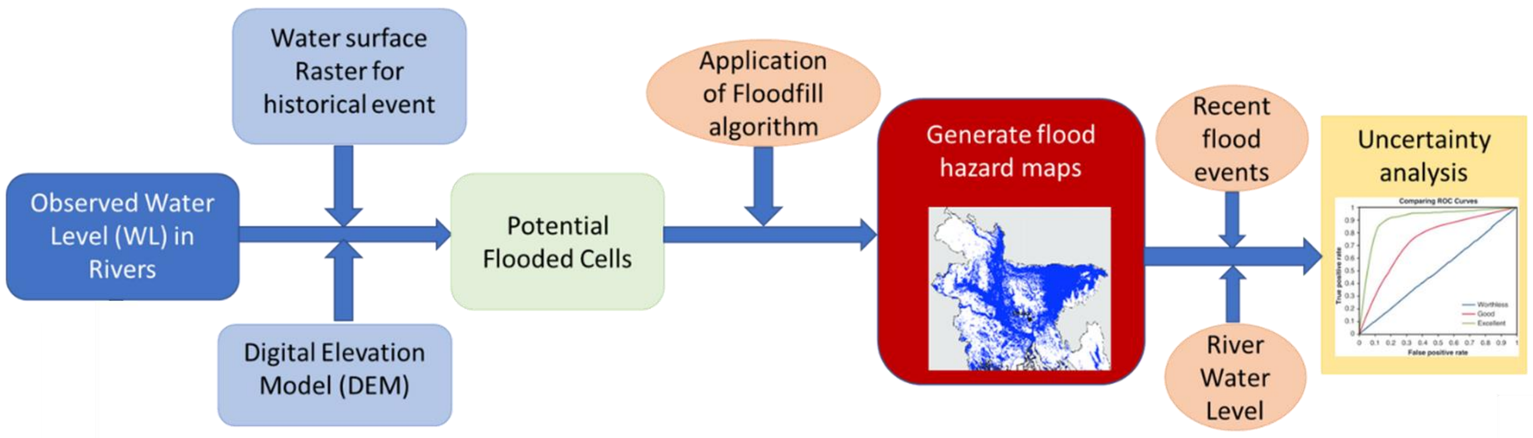
STAGE	DEPTH-1	DEPTH-2	DEPTH-3
Vegetative	7''	14''	34''
Reproductive	25''	33''	41''
Ripening	29''	39''	56''



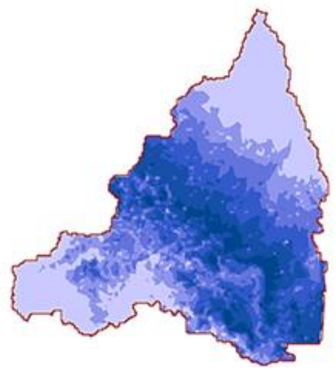


- Flood depth and duration both effects crop yield
- Reproductive stage is most vulnerable
- Different varieties react differently

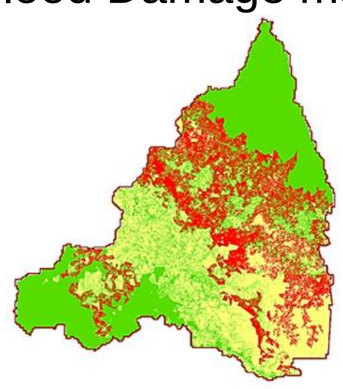
Develop methodology to generate flood maps and flood damages with data driven model



Flood map



Flood Damage map



Identify challenges and provide suggestive policy measures using the OECD Water Governance Framework

Principle 1. *Clear Roles and Responsibilities*
Principle 5. *Data and information*

National level – Use flood impact forecast based financing to initiate the funds required to recovery sooner by Ministry of Disaster Risk Management and assessment of requirement of crop import to ensure food security by Ministry of Food, Knowledge institutes to play a role in scientific under pinning

Regional and local level – Ministry of public administration to use impact forecast to prioritize areas at need and relevant activities. The local government to engage with farmers and provide the informed suggestive actions

Challenges

- Ensure coordination among the ministries and fund for knowledge institutes for scientific underpinning and research
- Instill confidence on forecast
- Ensure engaging of actors at all levels through capacity building and trainings
- Ensure access to data and identify methods for have maximum reach among the stakeholders

Bairagi, S., Bhandari, H., Das, S. K., & Mohanty, S. (2021). Flood-tolerant rice improves climate resilience, profitability, and household consumption in Bangladesh. *Food Policy*, *105*, 102183.

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Kingdom of the Netherlands

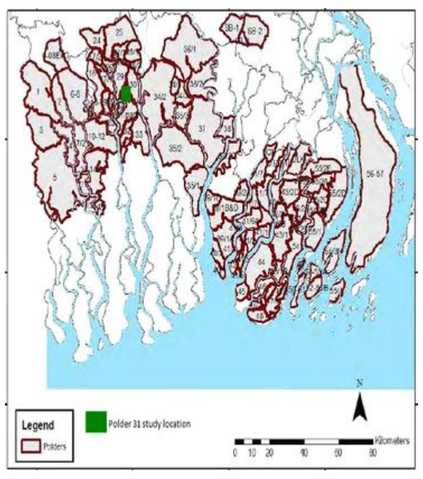
Uttaran

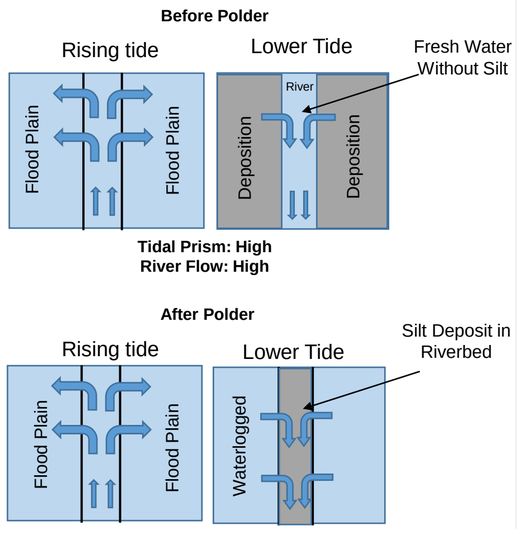
FROM GRASSROOTS TO GOVERNANCE: THE EFFECTIVENESS OF PEOPLE LED WATER MANAGEMENT FOR CLIMATE RESILIENCE IN BANGLADESH

A B M Hasanuzzaman[1*], Md. Mehedi Hasan[2], Badhan Fouzder[3]

"Every drop of water that runs to the sea without its full commercial returns to the nation is an economic waste."

- Rich biodiversity, including diverse fish and salt-tolerant rice.
- Indigenous knowledge system for water and river basin management.
- "Doser badh" or "Ostomasi badh": Community-built earthen embankments, low dikes, and wooden sluice gates.
- Tidal flow management and sediment deposition in "beels" (wetland basins) for land formation.
- Community-based system rooted in "solidarity economy" and indigenous ecological knowledge.
- Maintained balance between sedimentation and land subsidence, leading to ecological equilibrium.
- Shift from community-led to state-controlled water resources.
- Techno-economic approach considered traditional practices "backward" and "unscientific."





1950s-1980s

- UN Krug Mission (1957)
  - Proposed a 20-year Water Master Plan.
- 1959: Established East Pakistan Water Development Authority (EPWDA) established.
- 1960s: Coastal Embankment Project (CEP)
  - 39 polders, 282 sluice gates and 1500 KM
- Embankments caused sedimentation and long-term waterlogging issues.
- 1962: Constructed Farakka Barrage
  - Reduced freshwater flow, worsening siltation.

1990s

- KCERP (1986-1990)
  - Community knowledge was not taken into consideration
  - Local people did not accept the project
- KJDRP (1993–94)
  - Proposed to construct regulators.
  - People's participation
- Long term plan was not considered.
- Severe waterlogging in 1997
- Communities in Beel Dakatia (1997–98) breached embankments, pioneering TRM.

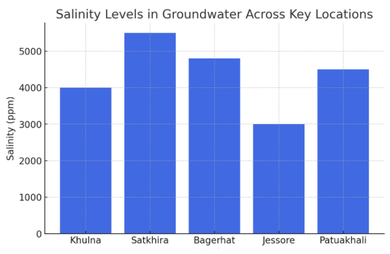
2000s

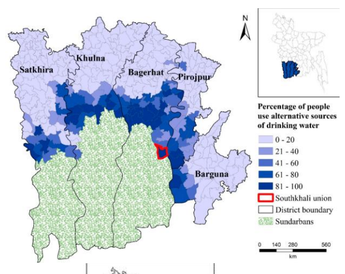
- 2002 - Guidelines on Participatory Water Management (GPWM) introduced.
- Key TRM projects:
  - Beel Bhaina (1997–2001)
  - Kedaria TRM (2002–2005)
  - Khukshiya TRM (2006–2013)
  - Beel Pakhimara TRM (2011–2016)

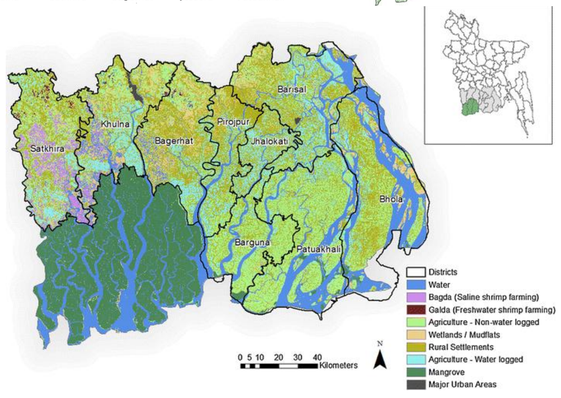
2010-2020

- TRM integrated into Bangladesh Delta Plan 2100.
- Uttaran, Paani Committee, CEGIS, and IWM develop a plan of action for 11 rivers.
- Compensation delays, bureaucratic inefficiencies, and land conflicts hindered progress.
- No major TRM projects after 2013
- Since 2016, no major waterlogging in the Kapotakkho River basin.

Current Scenario







60,000 hectares of agricultural land have been converted to shrimp farms,

International Food Policy Research Institute (IFPRI) reported that over 20% of agricultural land in Bangladesh is affected by salinity

This exacerbates existing social vulnerabilities have led to displacement of over 500,000 people

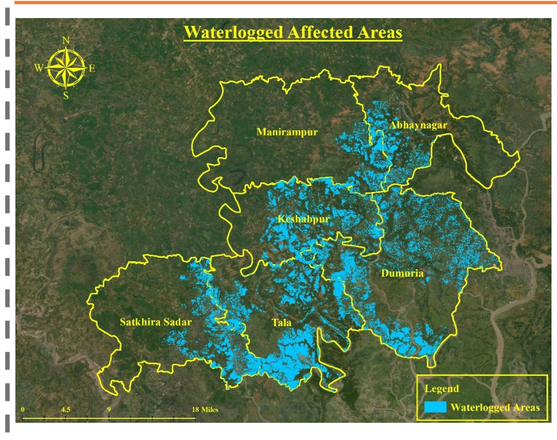
Shrimp farming is dominated by wealthy landowners and corporations, with poor, landless, and indigenous communities suffering the social and environmental costs.

Around **35 million** people in the coastal areas are exposed to climate-induced risks due to environmental degradation and mangrove destruction

According to FAO, around 30% of coastal land has become too saline for traditional crops

DEATH OF RIVER

People led initiative to remove Stagnant Water



Severe flooding in Jashore, Satkhira and Khulna worsened waterlogging, displacing families, destroying livelihoods, and forcing many into shelters. Sanitation collapsed, waterborne diseases spread, and access to clean water, education, and jobs declined. Increased salinity further degraded land and biodiversity. After years of irregular rainfall, 2024 saw prolonged water stagnation, intensifying the crisis.

People's Plan of Action

❶ Assessment and Planning:

- Mapping of dysfunctional canals to understand the extent of the waterlogging problem.
- Community meetings facilitated by Uttaran and Paani Committee to identify severely affected areas and gather local knowledge.
- Engagement with water management experts to assess sluice gate damage and propose solutions.
- Designing alternative routes to redirect water flow and improve drainage.

❷ Immediate Actions (Short-Term Relief):

- Community members, coordinated by Uttaran and Paani Committee, removed debris and other obstructions from critical streams and channels.
- Identifying alternative drainage pathways to provide temporary relief while sluice gate repairs were underway.

❸ Infrastructure Improvement (Long-Term Solutions):

- Community members, with Uttaran's guidance and BWDB support, removed debris and sediment from canals to restore natural drainage capacity.

❹ Advocacy:

- Community in collaboration with Uttaran advocated with government authorities for resources to repair and maintain the sluice gates, ensuring effective water flow regulation. This included developing a long-term maintenance strategy.
- Uttaran and Paani Committee facilitated community meetings to raise awareness about the importance of functional sluice gates and effective water management.
- Emphasis on community ownership and empowerment in managing water resources.
- Combining community-led action with institutional support and technical expertise for sustainable solutions.

Recommendations