

Living Polders

Dynamic Polder Management for Sustainable Livelihoods, Applied to Bangladesh

Why Living Polders?

In Mid 1960's **polders** (earthen embankments) were established to mitigate problems associated with tidal flooding, storm surges, food security etc. around the Bengal Delta, by offering flood protection, reduced salinity intrusion and food production. After 10-15 years of proper functioning, polderization caused siltation of riverbeds, land subsidence, water logging and drainage congestion, leading to salinity intrusion.

In the 1990's, to solve the water logging issue, spontaneous breaching of embankments (to re-allow sediment laden water inside the polders) and bottom-up sediment management system was introduced, defined as **Tidal River Management (TRM)**. The concept was not fully addressed then. Still now, due to some fundamental knowledge gaps regarding physical and institutional boundary conditions its full potential could not be achieved.

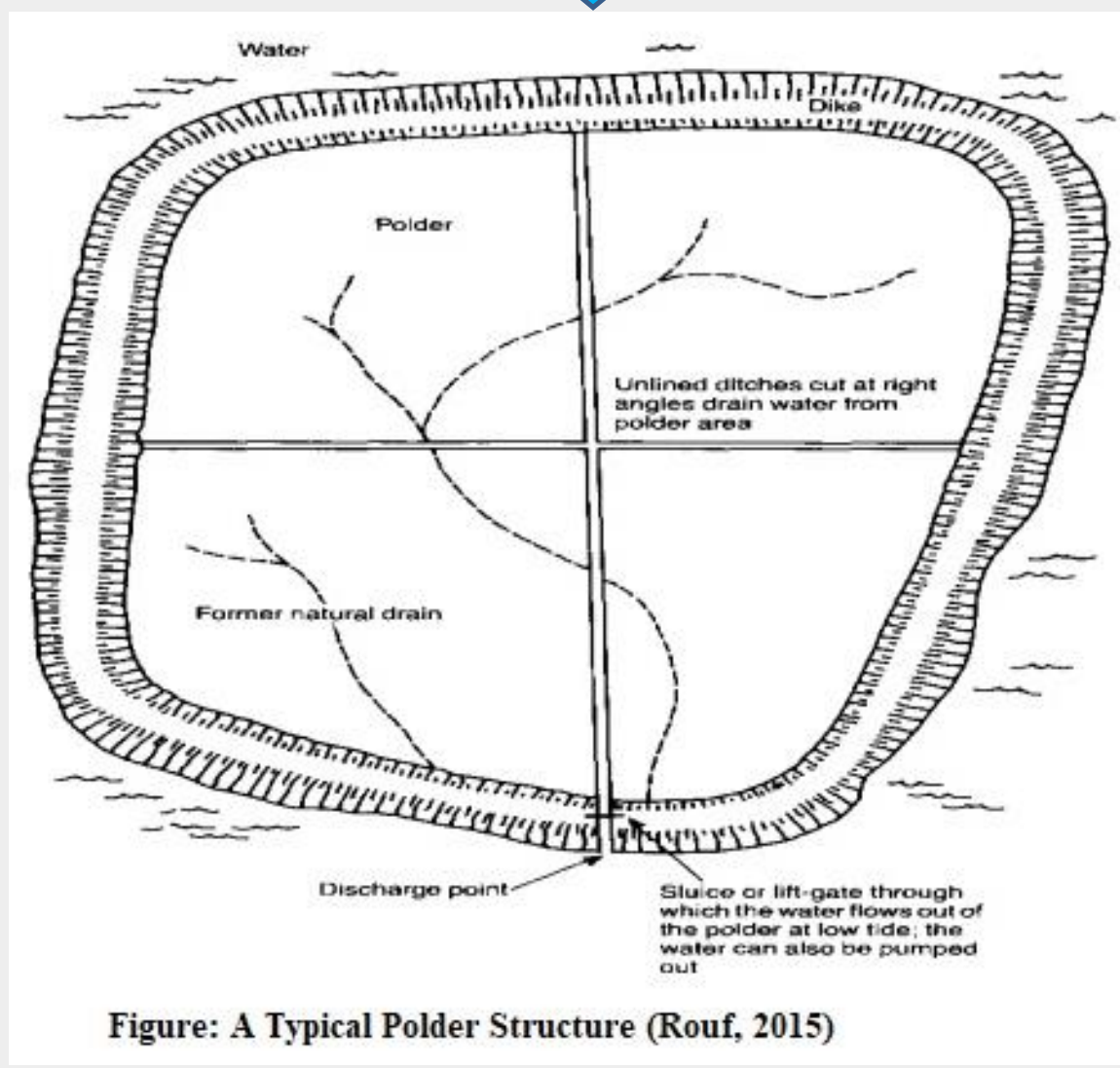


Figure: A Typical Polder Structure (Rouf, 2015)

"Living Polders" project is funded by NWO, Netherlands Organisation for Scientific Research, aiming to minimize the gaps through physical modeling and designing governance approaches. This project will take TRM a step further by focusing on sediment deposition.

Research Objectives

- Developing a decision support model for governing the 'living polders' by raising land through establishing cyclic polder re-sedimentation and changing food production schemes.
- Understanding the institutional boundary conditions for developing a viable business model for optimizing institutional arrangements for deploying 'Living Polders' with sustainable livelihood opportunities.

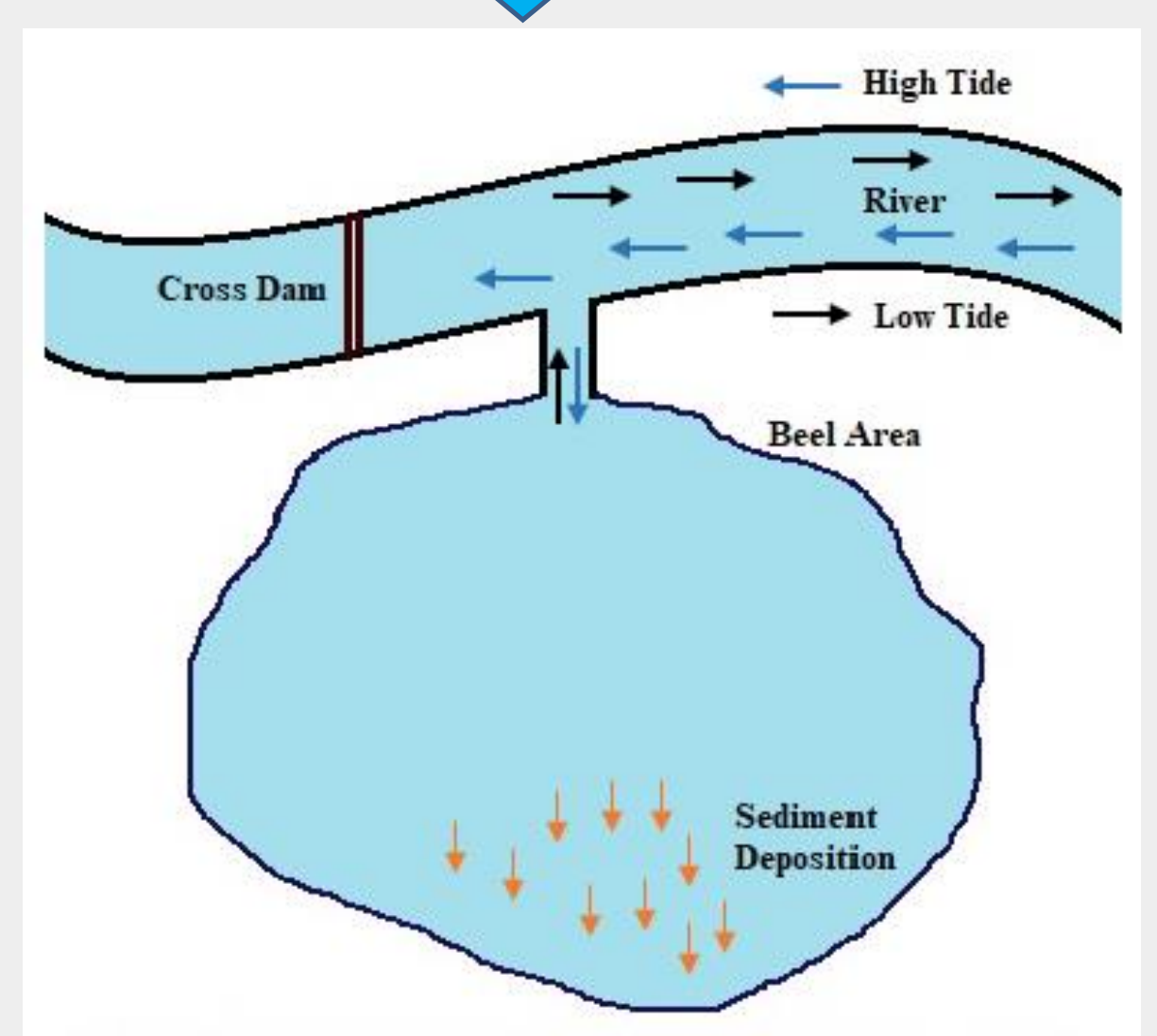


Figure: Tidal River Management Mechanism (Credit: Nureza Hafiz)

Main Research Questions

- How should inflow points into a polder and gate operation be designed for maximum sediment deposition – from river-dominated to tidal area?
- How much time is needed for sufficient sediment deposition inside a polder?
- To what extent does polder sedimentation reduce silting up of main channels?
- How productive is the land after suspended matter has settled on it?
- Which nutrients and contaminants accumulate with the sediment: is it fertile or toxic?
- How can TRM be applied with at the same time improving agricultural productivity?
- Is the agricultural yield sufficient for sustainable livelihood?

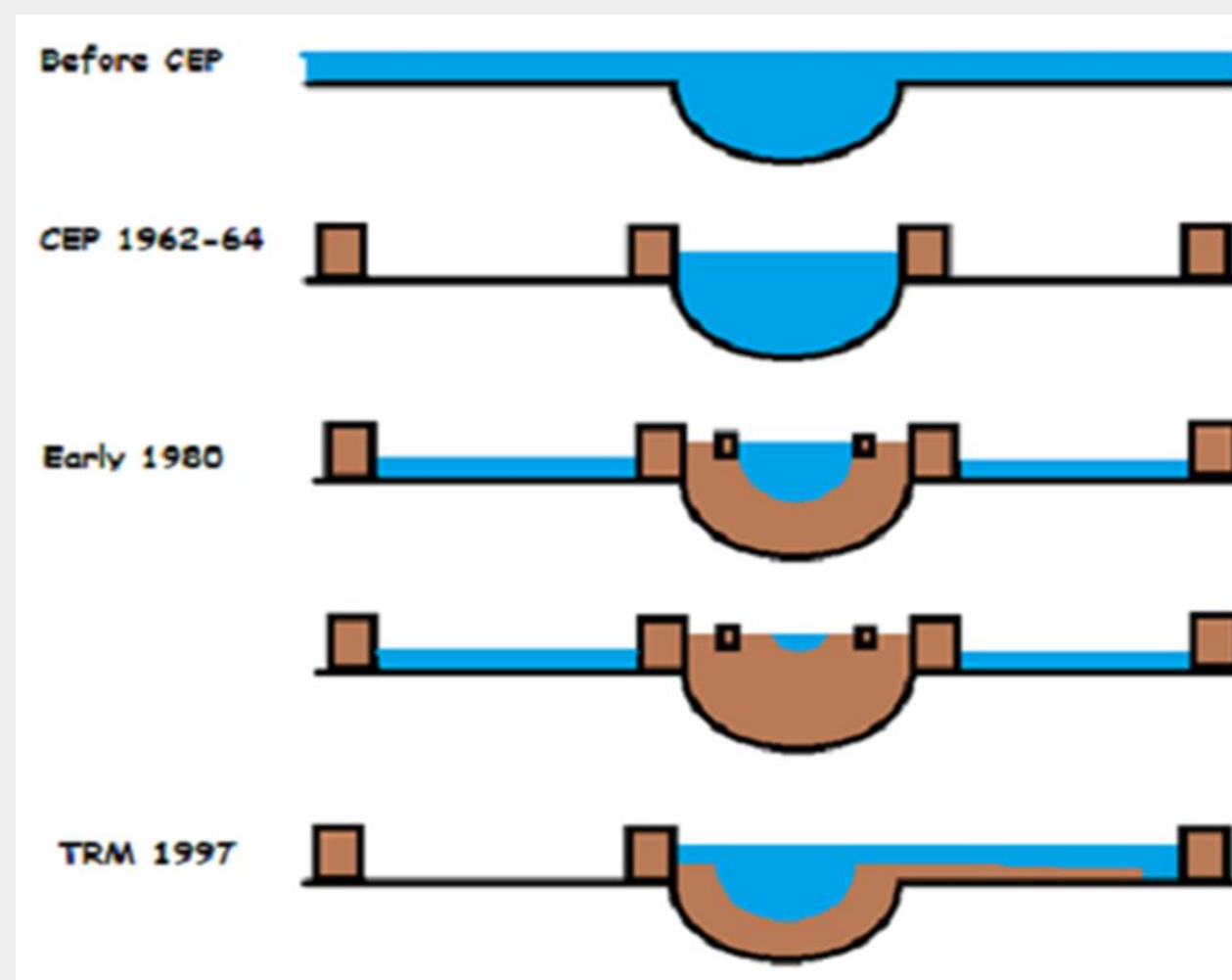


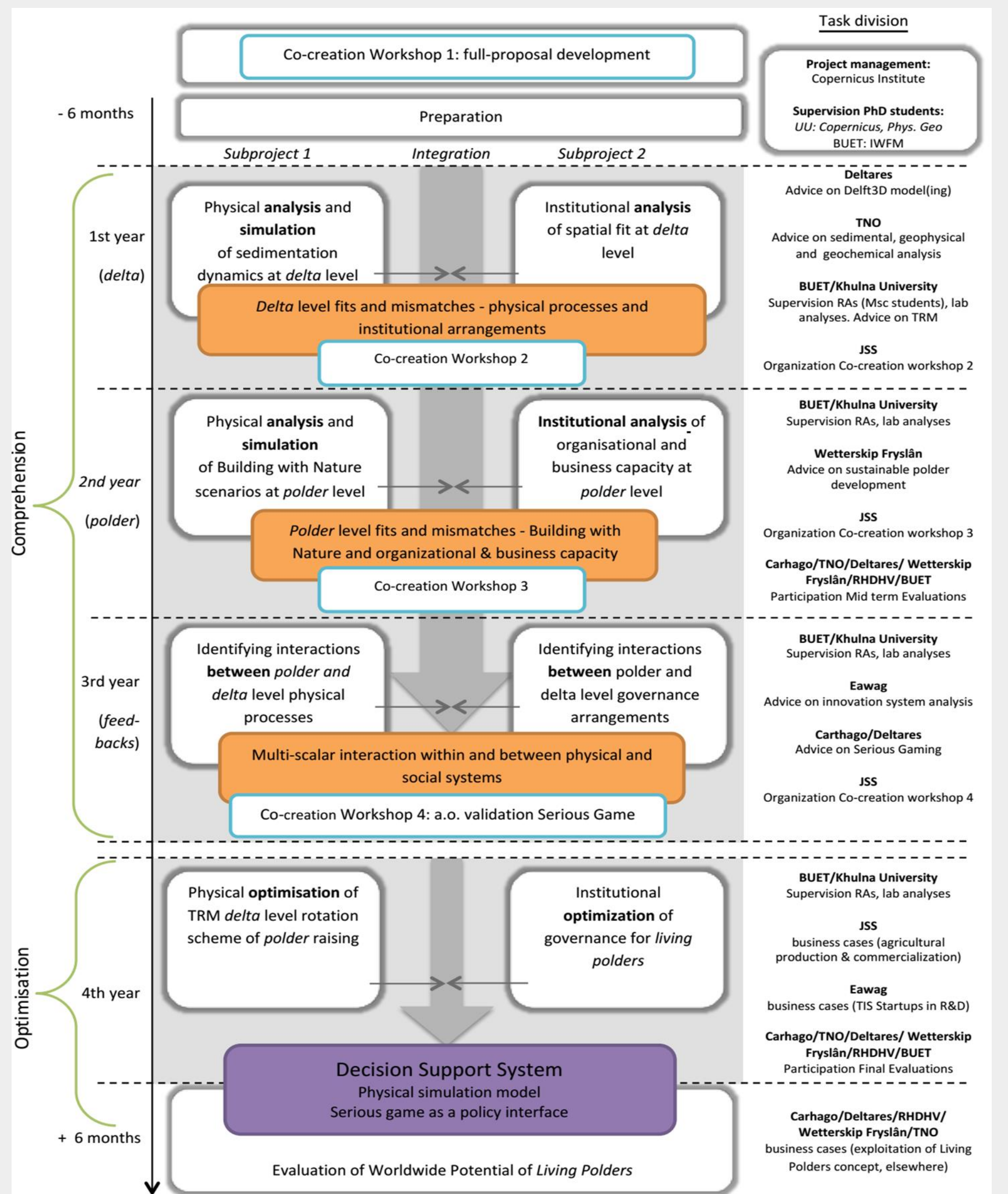
Figure: Tidal River Management



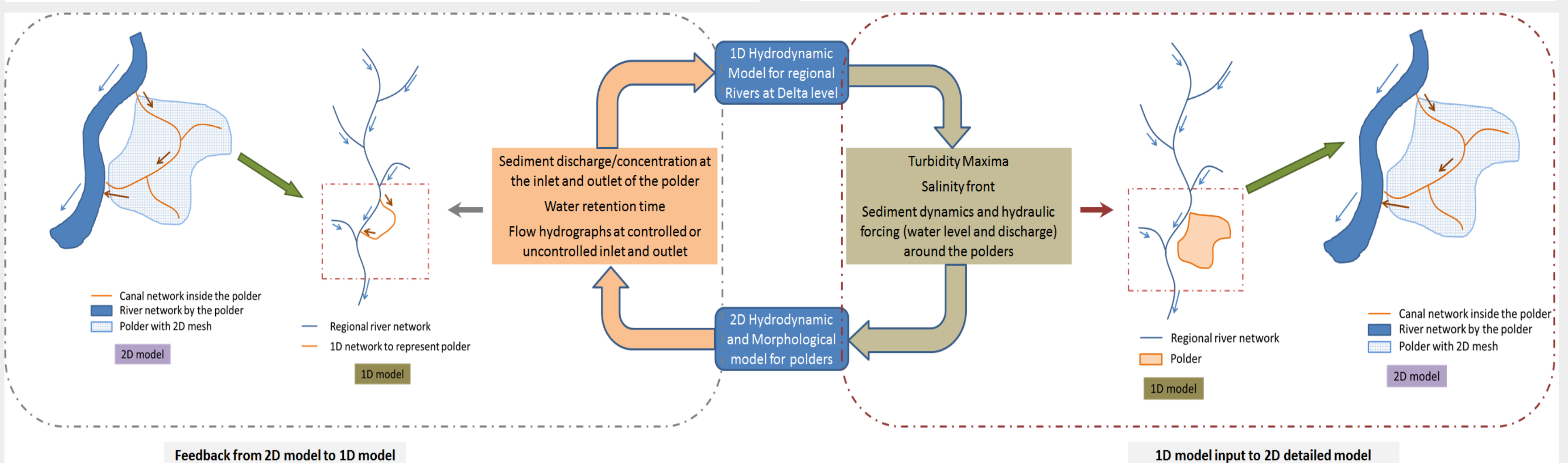
Silted up Canal (Credit: Nureza Hafiz)

Expected Outputs

- Knowledge and Research products**
 - Analyzing and simulating delta and polder developments in time and place (spatio-temporal models, MSc. Theses, articles, dissertations),
 - Analyzing institutional arrangements at delta and polder level and
 - Facilitating participatory decision making and awareness raising (Decision Support System (DSS) in serious game setting)
- Communication & stakeholder engagement**
 - Validating fits and mismatches identified during the research work (2 workshops with local and relevant stakeholders)
 - Project results- policy briefs, websites, blog posts, articles etc. being communicated to practitioners in Bangladesh and elsewhere.
- Capacity building and knowledge sharing**
 - 1 PhD, 1 Post-Doc, 2 MSc. students are currently trained (Dissertation, MSc. Theses, Articles)
 - Training of stakeholders, decision makers and end users about using DSS tool
- Monitoring & evaluation-** project progress and final outcomes



Agricultural Condition in Beel Bhaina (Credit: Nureza Hafiz)



Project Innovation and practical values

- Both the natural and human dimensions are considered to devise a successful strategy for sustainable livelihoods;
- The interdependency of local (polder) scale processes and regional (delta) scale processes is considered;
- A Decision Support System will provide stakeholders with the joint design of scenarios and policies for sustainable development of delta communities;
- Provide prospects of a worldwide potential of Living Polders.



Visit on a Project Site (Credit: Nureza Hafiz)



Fisheries Condition in Beel Khuklia (Credit: Nureza Hafiz)



Informal Group Discussion in Polder 30 (Credit: Mukta Dutta)

Funded by: Netherlands Organisation for Scientific Research
Duration: 2016-2021

NWO
Netherlands Organisation for Scientific Research

Project Partners



Utrecht University



JJS
Jagrata Juba Shamba



Deltares

CARTHAGO consultancy

TNO

eawag aquatic research

WETTERSKIP FRYSLAN

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Enhancing Society Together

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Living Polders

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Expected Outcomes

- **Research products** will lead to:
 - Design of spatial-temporal rotation schemes in planning efforts;
 - Alignment of local and regional governance arrangement with delta- and polder level physical interactions;
 - Participatory decision making, using the DSS, that will lead to legitimate proposals, raised awareness, and empowerment.
- **Communication & stakeholder engagement**
 - Co-creation workshops will lead to better research and higher awareness;
 - Briefs and website will increase the likelihood that the Living Polders concept will get taken-up, in BD and elsewhere.
- **Capacity building and knowledge sharing** output will lead to:
 - Continued use of the DSS in delta and polder planning;
 - Future leaders in delta management (PhDs, MScs, in BD and elsewhere).
- **Monitoring & evaluation** is aimed at improving the project's policy engagement processes to influence change improved.

Impacts

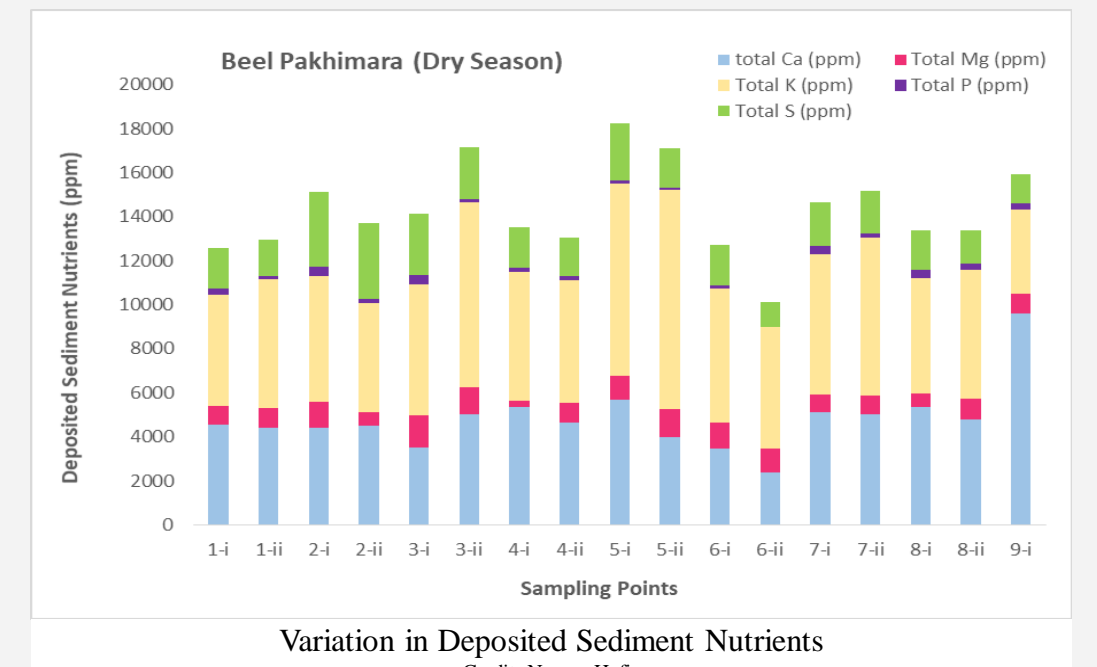
- Sustainable and entrepreneurial polders in Bangladesh by increased flood protection and food security
- Increased sustainability, in terms of FIETS:
 - Financial: (i) communities and the national government have less financial expenditures on the polders, and (ii) increased entrepreneurship and innovation enable the development of businesses
 - Institutional: Institutional arrangements guarantee good delta-level governance, and polder-level organization
 - Environmental: building with nature approach ensures interventions that are in tune with natural processes
 - Technological: A national Technological Innovation System (TIS) provides customized solutions to delta problems
 - Social: The DSS renders decision making participatory, and empowers end-users to take charge of how they want to live in and with polders.
- Enhanced cooperation between Netherlands and Bangladesh
- Delta improvement throughout the world by using the Living Polder concept

Outline of Methodology

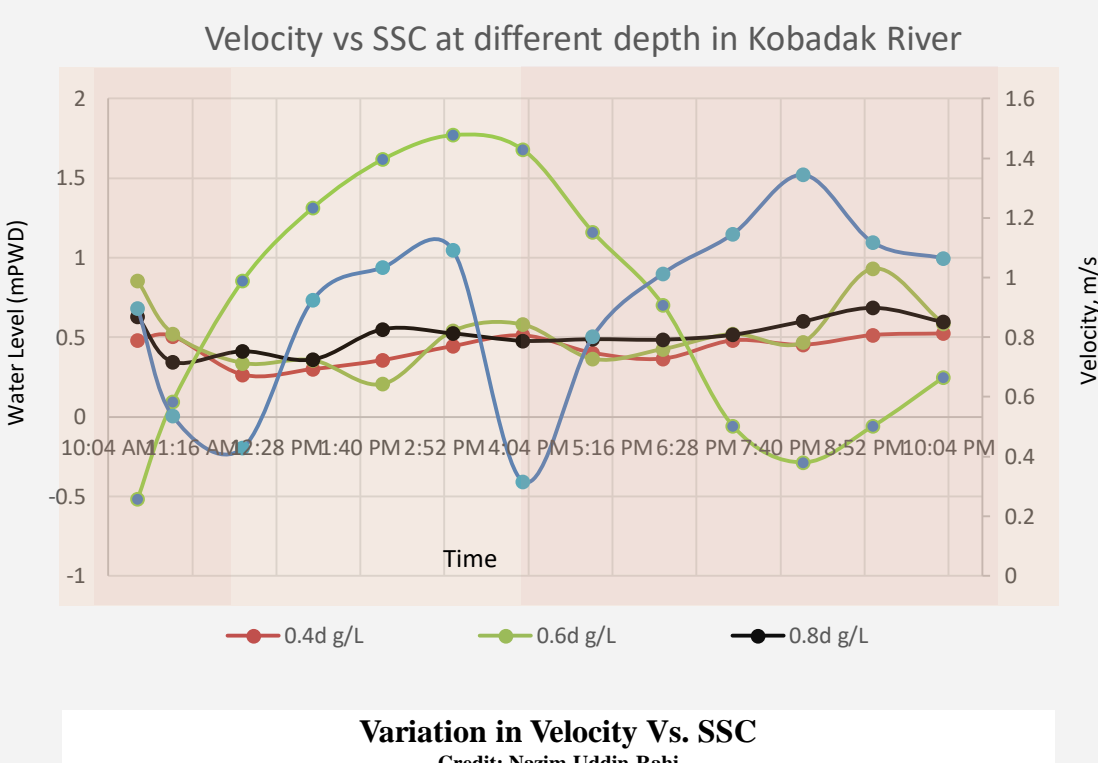
- **Post Doctoral Fellow** (Dr. Sanchayan Nath) is working on socio-hydrological system and polder governance.
- **PhD Fellow** (Md. Feroz Islam) is designing hydro-morphological models at polder and delta scale.
- Both the physical and institutional part will be combined to design the DSS tool.



Deposited Sediment Sample Collection
Credit: Nazim Uddin Rahi



Variation in Deposited Sediment Nutrients
Credit: Nureza Hafiz



Variation in Velocity Vs. SSC
Credit: Nazim Uddin Rahi



Measuring amount of sediment deposition
Credit: Syed Hash Ali

- **MSc. Student-1** (Nazim Uddin Rahi) is working on the topic "Assessment of Sediment Flow and Deposition Processes in a Selected Coastal Polder of Bangladesh". The work focuses on sediment dynamics in a coastal polder, the interaction between a river and flood plain. A hydrodynamic model will be designed to understand different scenario conditions for sediment deposition.

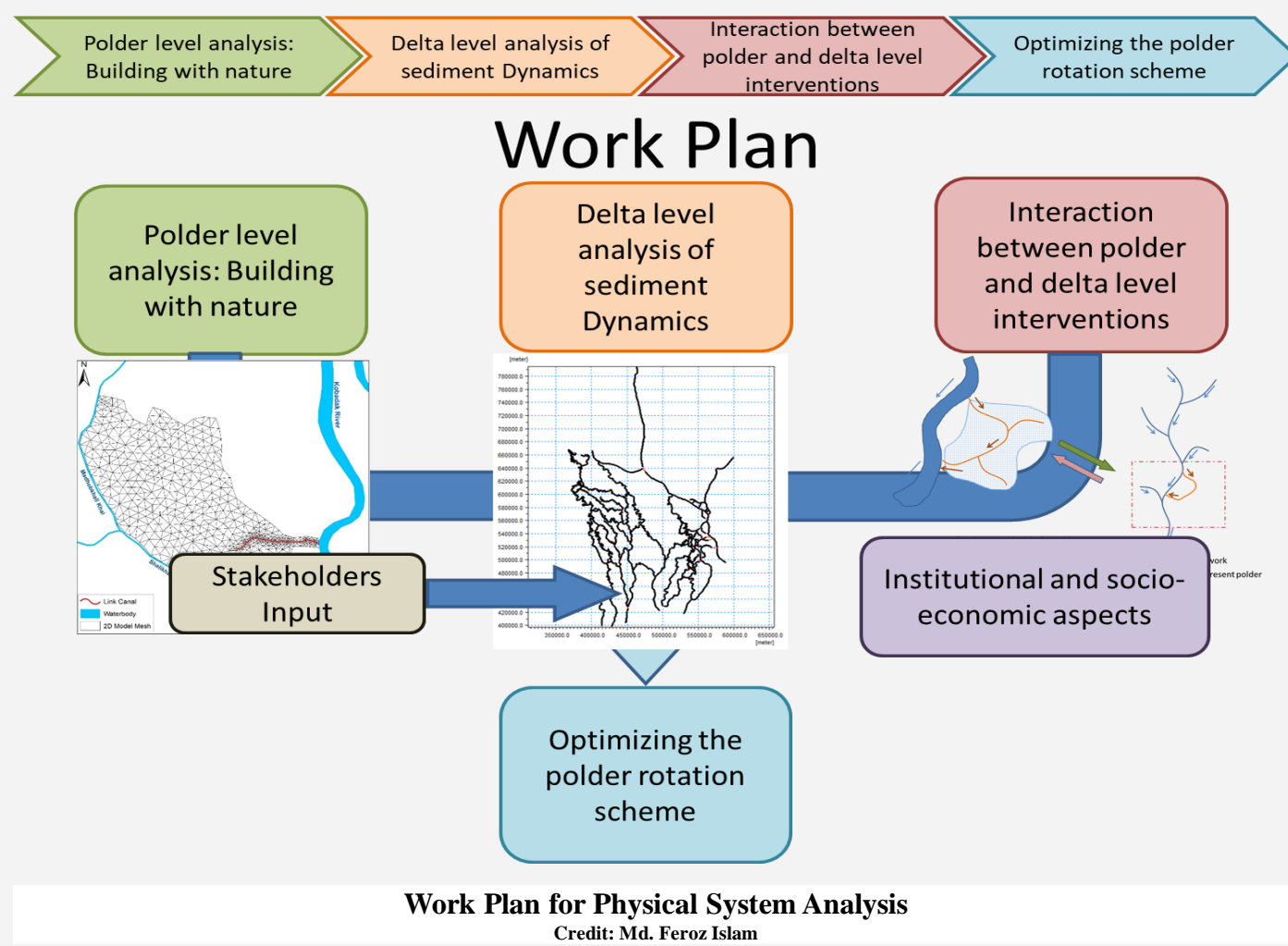
- **MSc. Student-2** (Nureza Hafiz) is working on "Assessment of the Variability in Nutrient Content of Water and Deposited Sediment in Selected Tidal Basins of Bangladesh". Laboratory analysis is done to measure different parameters, also Focus Group Discussion (FGD), Informal Interviews, Key Informant Interviews was conducted overall situation in the study areas.

Physical System Analysis

- **Delta-scale:** - 1D hydro-morphodynamic model is partially designed to investigate sediment movement at different scenarios
 - Feeding the developed 1D regional model with measured data and calibration is yet to be done
- **Polder-scale:** - 2D morphodynamic model has been developed and calibrated to understand the sedimentation process after breaching the dike
- **Planned Activities:** - developing and simulating the scenarios developed
 - Examining the response of the river network to sediment trapping inside the tidal basin/polder on the river
 - Up scaling the model to include the regional river network and adjacent polders

Institutional Analysis

- Currently developing a large-N dataset for political and institutional analysis of polder governance at the regional coastal level
- Understanding the path dependencies in resilience, vulnerability and governance experiments associated with socio-hydrological systems
- **Planned Activities:** - planning to manage tidal rivers in polders, develop innovation systems and understand sustainability transitions in social-hydrological systems
 - Integration of hydrology and governance segments



Work Plan for Physical System Analysis
Credit: Md. Feroz Islam

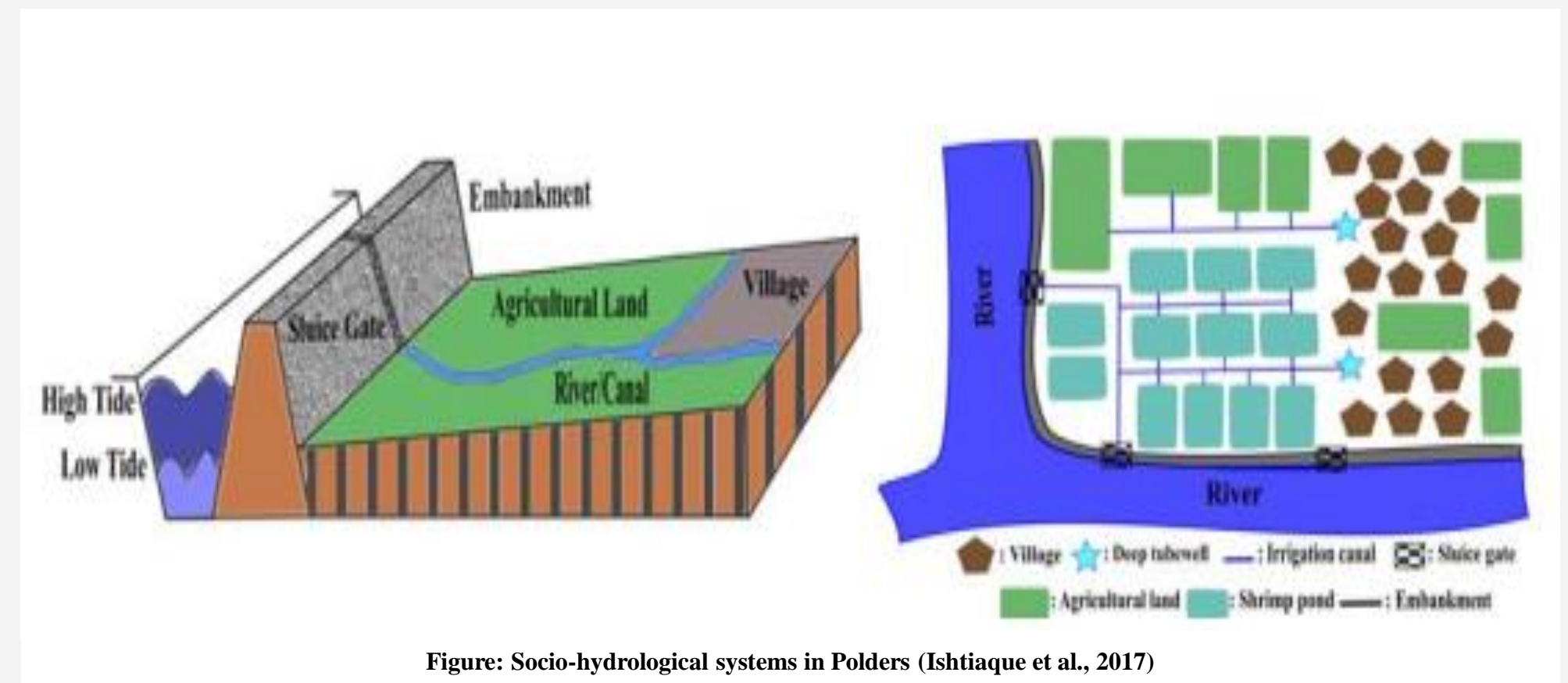
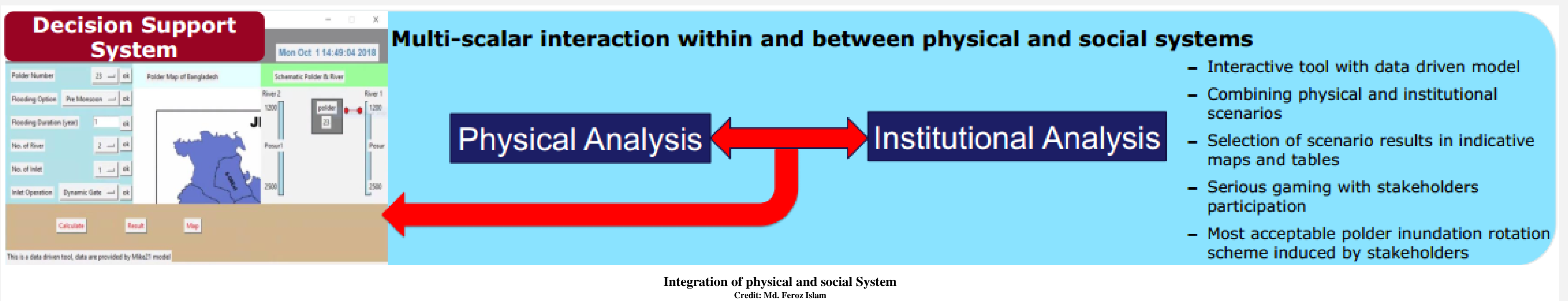


Figure: Socio-hydrological systems in Polders (Istaitique et al., 2017)

Decision Support System

- The tool for decision support system is being developed for the coastal region of Bangladesh.
- It is a data driven model, which will
 - integrate the physical and institutional aspects
 - explore the rotation of flooding the polders
 - assist the stakeholders to visualize the effect of different scenario
 - optimize the polder flood rotation scheme
- The tool is being feed with results of different scenarios
- Optimization of the polder flood rotation scheme and identification of the most suitable rotation scheme is yet to be done.



Integration of physical and social System
Credit: Md. Feroz Islam



Sediment Sampling in the Kobadak River
Credit: Syed Hash Ali



Variation in Deposited Sediment Nutrients
Credit: Nureza Hafiz



Sampling for Deposited Sediment Nutrients
Credit: Nazim Uddin Rahi

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Funded by: Netherlands Organisation for Scientific Research
Duration: 2016-2021



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