Kingdom of the Netherlands

Support to the Implementation of the Bangladesh Delta Plan 2100 (SIBDP 2100)

"Bangladesh in the 21st Century"

North-West Basin Management Plan: Implementation Programme

General Economics Division
Bangladesh Planning Commission
Ministry of Planning
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Preamble

The Bangladesh Delta Plan 2100 (BDP2100) was approved at the National Economic Council (NEC) meeting, presided over by the Prime Minister and Chairperson of the NEC, on 4 September 2018. Bangladesh is the first country in the world to develop such a comprehensive delta plan including an investment plan for an entire delta using Adaptive Delta Management (ADM).

BDP2100 seeks to integrate the medium- to long-term aspirations of Bangladesh to achieve upper middle income (UMIC) status, eliminate extreme poverty by 2030 and being a prosperous country beyond 2041 with longer term challenges of sustainable management of water, ecology, environment and land resources in the context of their interaction with natural disasters and climate change. To facilitate the achievement of the mentioned aspirations, BDP2100 is designed and formulated as a long-term, holistic, techno-economic, water centric, integrated strategic plan.

BDP2100 is framed to face huge challenges related to rapid population growth, urbanization and rapid industrial development. These challenges coincide with more extreme climate events and decreasing dry season flows as a result of developments in upstream countries. Salinity intrusion in the coastal belt and competing water demands for agriculture, industry and drinking water compound these natural and, in some cases, human-induced challenges.

The Government has assigned the General Economics Division (GED) of the Planning Commission the responsibility of the overall coordination, facilitation, monitoring and evaluation of the BDP 2100 implementation. The Government of the Kingdom of the Netherlands has extended the financial support to operationalize BDP2100 in the form of a Technical Assistance (TA) project, entitled "Support to the Implementation of the Bangladesh Delta Plan 2100 (SIBDP2100)"[1].

For the implementation of the BDP2100, a basin approach is followed, considering the principles of Integrated Water Resource Management (IWRM), a principle adopted by Bangladesh in the Water Act 2013 and BDP 2100. Adopting a basin approach entails that the analysis of key issues and opportunities as well as implementation, consider the interaction and integration of delta and water management inside the basin, and between the basin and adjacent rivers, sea or estuary. By adopting the basin approach, Bangladesh hopes to overcome some of the challenges to implementation discussed in the BDP2100; summarized here as: 1) weak capacity of water and water related institutions; 2) absence of water management organizations throughout the country; 3) lack of integration of water issues.

This document presents the Implementation Programme of the BDP2100 for the North-West (NW) basin region[2] of Bangladesh. The North-West region includes the Rajshahi and Rangpur Divisions and coincides with the North-West hydrological region, as included in the National Water Management Plan (NWMP, 2004). In this implementation programme, the principles and strategies outlined in the BDP2100 are matched with the conditions and needs of the NW region, resulting in an implementation programme for the short-, medium- and long- term. This document refers to the characterization of the basin and the analysis of the needs and development priorities as presented separately in the State of the Basin report.

Moreover, the key issues identified in the State of the Basin report were discussed extensively in a 2-day expert consultation workshop in Dhaka as well as in the two ateliers, one at Rajshahi and another one at Chatmohor.

[1] The TA team is led by Twynstra Gudde with consortium partners Deltares and Euroconsult Mott MacDonald and with sub-contractors IWM, CEGIS and the Climate Adaptation Foundation.

[2] In this report, the terms region and basin are used side by side and refer to the same area.

The overall implementation programme is composed of four sub-programmes: 1) Flood risk management – rural urabn and industrial area – economic zone included in this part; 2) Water for agriculture, which includes irrigation, surface water (SW) and groundwater (GR) management; 3) Ecosystems and environment; and 4) Water supply and sanitation, addressing quantity and quality. In the document, references are made to the State of the Basin and Characterization report, BDP2100 Volume 1 Strategy, baseline studies and BDP2100 Volume 2: Investment Plan. In addition, reference is made to the Technical Note describing the results of the Bangladesh Metamodel for the NW region. The Metamodel is currently being developed and applied under the Bangladesh Netherlands Joint Cooperation Programme (JCP).

The NW basin was prioritized in the development of the Bangladesh Metamodel, to facilitate the development of this implementation programme for the NW. A prototype of the Metamodel was developed as part of the formulation of the BDP2100, with the aim of facilitating integrated assessment, adaptive delta management and decision making.

Chapter 1 explains *the goals and strategies of the BDP2100*, which draws extensively on the BDP2100. The separate State of the Basin and Characterization report is especially interesting for readers that are keen to understand the *existing vulnerabilities of the NW water system*. The *actual implementation programs* are included in Chapters 2 to 5 to which the interested readers may directly turn their attention. Two adaptation pathways are elaborated in Chapter 6, to support decision making for i) sustainable groundwater management in the Barind; and ii) restoring Chalan beel as a multifunctional landscape.

A glossary is included to guide the reader for the main definitions on Adaptive Delta Management and the Annexes include a summary of the Metamodel analysis carried out for selected projects in the BDP2100 Investment Plan for the NW; and an overview of the concept notes developed for the BDP Investment Plan, as well as newly developed concept notes developed as part of SIBDP as a result of gap analysis carried out between the proposed Investment Plan projects and the Implementation Programme Objectives and Performance Targets (below table). The latter are derived from the six delta Plan Goals and the indicators in the BDP2100 Results Development Framework.

List of Projects/ Programmes for the North-West Basin Management Plan:

Sl	Project Code	Project Name	Lead Ministry	Lead Agency
Flood Risk Management Program (FRM)				
1	**DP 1.21**	Rationalised water-related interventions in Hurasagar Basin	MoWR	BWDB
2	**DP 1.3**	Revitalization and Restoration of the Hurasagar and the Atrai rivers	MoWR	BWDB
3	**DP 1.2**	Revitalization and restoration of Beel Halti (Chalan Beel)	MoWR	BWDB
4	**NW_FRM1**	Rationalization program of Water Sector Projects in Hurasagar Basin (incl. perennial river system-approach)	MoWR	BWDB
5	**NW_FRM2**	Revitalization and Restoration of Chalan Beel	MoWR	BWDB
6	**NW_FRM3**	Revitalization and Restoration of Chalan Beel – Climate Resilient Roads	MoLGRD&Co.	LGED
7	**NW_FRM4**	Vulnerability assessment of Economic Zones in the NW Region and Option Analysis	MoLGRD&Co.	LGED
8	**NW_FRM5**	A stress-test to design climate resilient road infrastructure	MoRTB	RHD
9	**NW_FRM6**	Flood Insurance Scheme for flood vulnerable underprivileged people of Hurasagar Basin	MoDMR	DDM
Environment and Ecosystem Programme (EE)				

Sl	Project Code	Project Name	Lead Ministry	Lead Agency
10	CC 1.43	Revitalization of Khals all over the country.	MoWR	BWDB (Co-lead-BMDA)
11	DP 15.3	Barind Area Fisheries Development Project	MoFL	DoF
12	NW_EE1	Pilot application of simplified environmental flow method for the Atrai river and Chalan Beel	MoEF&CC	DoE
13	NW_EE2	Strengthening monitoring capacity of the DoE in NW basin	MoEF&CC	DoE
14	NW_EE3	Program for developing register of pressures and emissions on water bodies in the Northwest Basin	MoEF&CC	DoE
15	NW_EE4	Financing mechanism for local governments to invest in (domestic) wastewater treatment.	MoLGRD&Co.	DPHE
16	NW_EE5	Revitalization and restoration of Chalan Beel – Green Beels	MoWR	BWDB
17	NW_EE6	Integrated Development and Restoration Programme for Chalan Beel	MoWR	BWDB
Agricultural Development Programme (AD)				
18	DP 1.1	North Rajshahi Irrigation project	MoWR	BWDB
19	DP 1.4/ 1.5	Kurigram Irrigation Project	MoWR	BWDB
20	DP 25.1	Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M under the North Rajshahi Irrigation with Ganges Barrage	MoWR	BWDB
21	DP 25.2	Development of Scheme WMOs and Agreement with Individual LLP Owners/Operators for Cost Recovery for O&M for the Mahananda Irrigation Scheme	MoWR	BWDB
22	DP 25.3	Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M for the Kurigram Irrigation Schemes (I & II)	MoWR	BWDB
23	CC 1.46	Managed Aquifer Recharge for Artificial Storage (MARAS) of Water to Improve Groundwater Table and Quality Conditions in Vulnerable Areas of Bangladesh.	MoWR	BWDB
24	CC 1.45	Expansion and Modernization of Monitoring Network and Tools for Sustainable Development, Management and Governance of Groundwater in Bangladesh.	MoWR	BWDB
25	NW_AD1	Sustainable groundwater management	MoA	BMDA
26	NW_AD2	Development of NW-Agriculture Database and Management System	MoA	DAE
27	NW_AD3	Water Retention in the northwest to lessen pressure on groundwater resources	MoA	BADC
28	NW_AD4	Research for upgradation of existing irrigation system for increasing water use efficiency	MoA	BMDA
29	NW_AD5	Crop Diversification, Production and Marketing for Nutrition and Food Security Project	MoA	DAE
Water Supply and Sanitation Programme (WSS)				
30	CC 9.10	Piped Water Supply project in 100 Pourasavas.	MoLGRD&Co	DPHE
31	CC 9.11	Water Supply project in the Urban areas of Bangladesh (secondary towns).	MoLGRD&Co	DPHE

Sl	Project Code	Project Name	Lead Ministry	Lead Agency
32	**CC 9.12**	Improvement of sanitation system in urban areas of Bangladesh.	MoLGRD&Co	LGED
33	**CC 9.13**	Village Piped Water Supply project(Phase I and II).	MoLGRD&Co	DPHE (Co-lead agency BMDA)
34	**CC 9.18**	Project for improvement of storm water drainage facilities in pourasava (Phase I).	MoLGRD&Co/ MoWR	LGED
35	**NW_WS1**	Sanitation system development project in 37 district towns.	MoLGRD&Co	DPHE
36	**NW_WS2**	Integrated waste management Project in 25 priority towns in Bangladesh.	MoLGRD&Co	DPHE
37	**NW_WS3**	Water Supply, Sanitation, Drainage, Solid Waste and Faecal Sludge Management for Small Size Pourashavas (Municipalities) in Bangladesh.	MoLGRD&Co	DPHE
38	**NW_WS4**	Surface Water Based Water Supply System in 18 District Towns of Bangladesh.	MoLGRD&Co	DPHE
39	**NW_WS5**	Groundwater aquifer recharge with rain/storm and pond water at coastal belt and drought areas of the country.	MoLGRD&Co	DPHE (Co-lead-BMDA)

Table of Contents

List of Tables

List of Figures

Annex Figure

Annex Table

Abbreviations

ADM	Adaptive Delta Management
BADC	Bangladesh Agricultural Development Corporation
BDP2100	Bangladesh Delta Plan 2100
BEZA	Bangladesh Economic Zones Authority
BMDA	Barind Multipurpose Development Authority
BGP	Blue Gold Programme
BWDB	Bangladesh Water Development Board
CDSP	Char Development and Settlement Project
CEGIS	Center for Environmental and Geographic Information Services (CEGIS)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAE	Department of Agriculture Extension
DoE	Department of Environment
DoF	Department of Fisheries

DP	Drought Prone
DPHE	Department of Public Health Engineering
DPP	Development Project Proforma
DRF	Development Results Framework
DTW	Deep Tubewell
EEP	Environment and Ecosystems Programme
EKN	Embassy of the Kingdom of the Netherlands
EZ	Economic Zone
FCD(I)	Flood Control, Drainage (and Irrigation)
FEWS	Flood Early Warning System
FRM	Flood Risk Management
FYP	Five Year Plan
GED	General Economics Division
GMIS	Groundwater Management Information System
GoB	Government of Bangladesh
IDRP	Integrated Development and Restoration Programme
IWM	Institute of Water Modeling
IWMFM	Institute of Water Modeling and Flood Management
IWRM	Integrated Water Resources Management
IWT	Inland Water Transport
JCP	Joint Cooperation Programme Bangladesh - the Netherlands
LGED	Local Government Engineering Department
MCA	Multi Criteria Analysis
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoL	Ministry of Land
MoWR	Ministry of Water Resources
NEC	National Economic Council
NGO	Non-Governmental Organization
NW	North-West
NWMP	National Water Management Plan
NWPo	National Water Policy
O&M	Operation and Maintenance
PEZ	Priority Economic Zones
PIC	Project Implementation Committee
PIU	Project Implementation Unit
PMU	Programme Management Unit
PWM	Participatory Water Management
RBE	Right bank Embankment
RDE	Results Development Framework
RHD	Roads and Highways Department
SDGs	Sustainable Development Goals
SE	Superintending Engineer
SIBDP	Support to Implementation of Bangladesh Delta Plan
SSWRDP	Small Scale Water Resources Development Programme
STW	Shallow Tubewell
TA	Technical Assistance

WARPO	Water Resources Planning Organization
WASA	Water Supply and Sewerage Authority
WMO	Water Management Organization
WSS	Water Supply and Sanitation
W4A	Water for Agriculture

Glossary

Adaptation Tipping Point: Threshold conditions under which an action or strategy will no longer meet a set of predefined policy or strategic goals or standards

Adaptation Pathway: A sequence of measures to achieve a set of predefined goals under changing external conditions, such as climate, socio-economic factors or other developments

Adaptation (pathways) Map: Visualization of a set of adaptation pathways showing options for transferring from one pathway to another, and the timing and/or conditions under which an adaptation tipping point of a policy action occurs.

Delta: A delta is a geo-morphological area, largely defined by its low-lying surface form and location in landscape and coastal area that forms at the mouth of a river. Deltas form from deposition of sediment carried by a river as the flow leaves its mouth. Over long periods, this deposition builds a dynamic and characteristic geographic, ecological and social pattern of the delta and its features

Delta Atelier: Delta Ateliers are one or two-day workshops in which the issues at stake are discussed, ideas and views are generated and presented while interests of the stakeholders are identified and linked with the discussed issues and are elaborated in visualized and supported results These results have a certain status as building blocks in de BDP 2100 formulation process. The Delta Ateliers form an interactive strategy making concept which will be used for important issues to the BDP2100 formulation process

Flexible or Adaptive Actions: Actions can be adapted (e.g. intensification of the action), abandoned (switch to a different action) or extended (add an action) at low cost or having small societal impact. Flexible actions do not result in lock-ins and have little influence on potential future options (i.o. have less path-dependencies).

Holistic: 'Holistic' refers to viewing and understanding a system and its properties as they happen as whole, not as a collection of elements. This includes the view that systems cannot be fully understood solely in terms of their component elements. A delta forms an interesting application of holism; as a whole it includes e.g. social, biological, physical, chemical, and economic aspects in a given area. The complexity grows with the area, so that it is necessary to reduce the characteristic of the view by studying a) events in the behaviour of the delta, b) behaviour of elements, their emergence and interconnectedness and c) in other ways, for example studying the system during a specific episode

Holistic planning: This is a type of planning to address problems of a system in a comprehensive way, viewing the system in relation with its interdependent elements. Multiple policy domains may be involved requiring coherent governance and budget allocation

Integrated approach: Combination of relevant elements in a comprehending approach to understand more of the total system

Learning cycle: A learning cycle is a concept of how people learn from experience. A learning cycle will have several stages or phases, the last of which can be followed by the first: 1. Doing something, having an experience; 2. Reflecting on the experience; 3. Concluding from the experience, developing a suitable approach; 4. Planning the next steps, to apply or test this approach

Lock-in: Situation where future action in a pathway can only be implemented against high costs or high societal impact because of earlier choices and investments.

Measure or action: Individual intervention, which may be infrastructure but also institutional, legal, economic, knowledge / capacity development and may be at specific spatial, sector- or national-general level. Measures can be part of one strategy but can also fit in multiple strategies

No regret and win-win actions: No-regret actions are useful and cost-effective on the short term and under a range of future conditions and do not involve hard trade-offs with other policy objectives. Win-win actions contribute to a central objective whilst also having other, e.g. social, economic and environmental, policy impacts and benefits

Path-dependency: Extent to which a policy action (in a pathway) is limited by actions implemented in the past or by actions planned anterior in the pathway.

Plan: A coherent framework of targets (expected results), approach, methods and resources as well as actions and time schedule to be worked out beforehand for the accomplishment of one (or more) objective(s)

Robust actions: Actions that result in acceptable indicator values under a wide variety of futures.

Scenario: Coherent descriptions of alternative hypothetical futures that reflect different perspectives on past, present and future developments, which can serve as a basis for action (Van Notten, 2005). In this study, scenario is used for 'external context' scenarios that describe developments that cannot be influenced and are thus policy-free.

Sector: A sub-division within the government, focused on a policy domain with its discourse and instruments

Sectoral planning: Planning to address problems within a sector or policy domain, e.g. by a ministry mandated to act on it

Sell-by year of an action or strategy: Point in time, in a given external scenario, when an action or strategy will no longer meet a set of predefined policy or strategic goals or standards

Showcase: A showcase is an illustrative local scale design exercise. In these exercises the Delta Ateliers' participants apply the more conceptual design principles and adaptation measures on the local scale, which is more tangible

Signposts: Information that should be tracked in order to determine whether implementation of action or reassessment of the plan is needed.

Strategy: A from Delta Vision point of view coherent combination of measures that contributes to reaching the Delta Goals

1 Introduction

1.1 The North-West (NW) region of the Delta

1.1.1 Bangladesh-Land of rivers

On the face of it, Bangladesh is richly endowed with water resources. Some 405 rivers cross the country, 57 of which are transboundary (Bangladesher Nod Nodi, BWDB, August 2011). In NW, total 115 rivers out of which 19 are transboundary. The country is located the Delta of three great rivers, each of them providing substantial freshwater supplies to the country. 93% of the available water resources are generated outside Bangladesh which makes the country highly dependent on its upstream neighbors for its water resources. Being a sub-humid and humid country, ample rainfall contributes to this water resource base, allowing it to be ahead of many more developed countries in terms of per capita freshwater availability. The crux is however in the distribution. In short, there is too much water in the rainy period, contributing to occasional disastrous floods, and scarcity of water in the dry period. If anything, the country is characterized by a highly variable hydrology, regarding the onset of the monsoon season and the amount of rainfall. Rainfall, particularly in the North-West, varies up to 50% between years. In addition, upstream withdrawal/diversion in two major rives, the Gangs and Teesta entered in Bangladesh through this region.

The development of groundwater (GW) irrigation, which has enabled the cultivation of flood-free (boro) rice along with vegetables and other cash crops and contributed to achieving food security, has also had its drawbacks, especially in the North-West. City, Metropolitan and Urban areas also fully dependent on GW for drinking, industrial, domestic and other usages. Due to over extraction of GW for irrigation and other usages, GW levels are declining steadily, threatening GW supplies. Due to upstream diversion of the Ganges and Teesta, the dry season and as the lowest annual rainfall area of the country, water scarcity is severe in NW.

Water quality is a growing area of concern, due to large environmental pressures from industries and urban areas, many of which do not have any form of effluent treatment. For many Divisional and District Headquarters, home to almost 50% of the country's' population, the absence of domestic and industrial wastewater treatment, in combination with reduced flows in the peripheral rivers, has led to a heavily polluted water system, unable to sustain aquatic life. Water quality from the transboundary rivers is also a concern.

1.1.2 The Delta plan as response; preparing for a prosperous future

Bangladesh is on the road to development, driven by an upcoming industrial sector, the resilience of its population and labor force active working population in the country and abroad and a broad, diverse and innovative agricultural development. Food insecurity, which long threw back the population into poverty, has largely been overcome, and the country is now keen to take the next step. Economic sectors such as agricultural sector, industries, agro-industries, fisheries, livestock and transport depend on the availability of enough, clean and reliable fresh water supplies if they want to continue to grow. For that reason, water management is key.

The country has achieved much in securing its water. Building on an age-old tradition of resilience and adaptation, flood and irrigation management has been developed significantly and supporting the development of the country to a prosperous nation. Over 30 years of data gathering, studies and modelling has led to a valuable knowledge base upon which to plan and allocate scarce fresh water resources. In addition, the country has adopted a comprehensive policy framework, laid down in the Bangladesh Water and Flood Management Strategy (WFMS, 1995), the National Water Policy (1999, NWPo), the National

Water Management Plan (2004, NWMP) and the National Water Act (2013, MoWR). In the National Water Act, the principles of integrated water resource management as well as stakeholder participation have been laid down[3]. Planning, research and implementation organizations are in place.

A comprehensive and holistic plan based on the principles of adaptive delta management has now been developed in the form of the Bangladesh Delta Plan 2100 (2018, BDP2100), building on the various sectoral plans and feeding into the country's' regular Five-Year Planning (FYP) process. With the adoption of the BDP2100, integrated water resources management has become part of the core of the country's' long-term policy and drive to become a higher income, prosperous nation. *The plan comes at just the right time*. On the horizon, climate change and upstream diversions loom. Upstream diversions started with operation of the Farakka Barrage on the Ganges, about 88 km upstream from Bangladesh boarder, in the 1975 and barrages on the Teesta river at Gazaldoba about 75 km upstream from Bangladesh Boarder, in the1990's. Further development is anticipated as part of the India River Linking Project (IRLP). In short: Bangladesh has started to feel the water crunch and needs to anticipate these potentially serious external conditions. Nowhere is that 'water crunch' felt more than in the North-West (NW), the driest region of the country, with least annual rainfall. For that reason, first the Barind area and later the whole NW, were selected as Hotspot in the BDP2100, to serve as case for adaptive delta management (ADM) in relation to drought-prone areas.

1.1.3 The Delta plan-moving from planning to implementation

The plan is a comprehensive document, consisting of Volume 1: Strategy, and Volume 2: Investment Plan. In Volume 1, the principles of ADM are expounded, applied to strategy development and elaborated in two national, seven hotspots and nine thematic strategies. Each strategy is detailed into short-, medium- and long-term actions, several of which are included as investment projects in Volume 2: Investment Plan.

Having a plan, resources and investment ambitions, are however not enough to come to effective implementation in line with the principles of ADM and IWRM, as Bangladesh has noticed over the years. For that reason, as a further collaboration between the Governments of Bangladesh and the Netherlands, the SIBDP project started in 2018. In the TA project, five capacities are targeted to support the implementation of the BDP2100 and develop the capacity for implementation within Bangladesh's institutions[4]. These are illustrated below.

[3] Much of this development has been documented in the BDP2100 publication "Lessons learnt: Sixty Years of Water Resources Development in Bangladesh", with lead author Dr. Giasuddin Ahmed Choudhury (2016).

[4] The TA project is aimed particularly at the General Economics Division of the Planning Commission of the GoB.

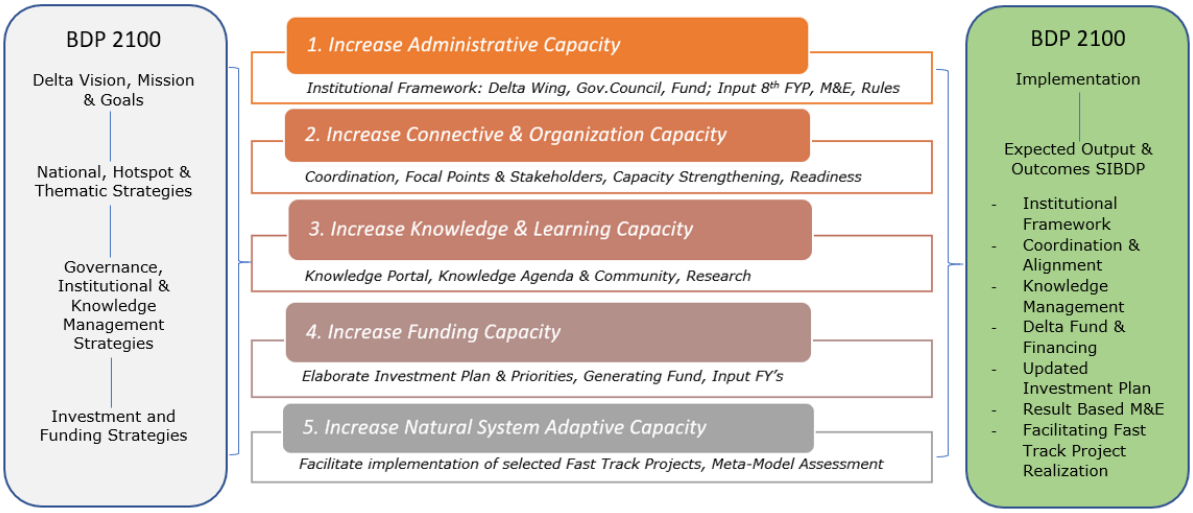


Figure 1.1: Five Capacities to support implementation of BDP2100 .

Source: SIBDP Inception Report, 2019

As part of the fifth step of the Fig 1.1 increase natural system adaptive capacity, and with evident linkages to the other four capacities, basin or regional implementation programmes are being developed. These implementation programmes bring together the knowledge and strategies developed in the BDP2100, with a focus on one area. This approach does justice to the diversity of Bangladesh and the need to anchor the comprehensive and multisectoral plans to local and institutional conditions. As can be seen in this implementation programme document, much of the analysis draws on the BDP2100 documents, and makes these specific for the circumstances, ambitions and development potential of the North-West. Similar implementation programmes are being developed, as part of SIBDP, for all the hotspots of the BDP2100.

In the BDP2100, several implementation challenges were identified, based on the analysis of 60 years of history in water resource management (BDP2100 Volume 1: Strategy, Executive Summary):

"Despite this rich history, (…), effectiveness of implementation of integrated water management is weak." The reasons are (pg. vii): 1) weak capacity of water and water related institutions; 2) absence of water management organizations throughout the country; and 3) lack of integration of water issues with climate change, environment, land management and other delta-related challenges owing to inadequate institutional coordination. The monitoring and evaluation of policies is also weak. In relation to this and with respect to substantial new investments and adequate financing arrangements, "a substantial overhaul of the Delta Governance and the institutional arrangements is needed to implement the Delta Plan." (Executive Summary BDP2100, page. vii).

The implementation programmes are developed to address these challenges in each of the regions (or basins) of the country.

1.2 BDP 2100 Goals and Strategies, in Context of North-West programme

As introduced above, the BDP2100 is a water-centric and holistic plan, developed to prepare for the immediate and long-term challenges for the country. In this section, the BDP2100 goals as well as the national and thematic strategies will be highlighted at first. Thereafter, with a focus on the North-West, the Barind hotspot strategy will also be discussed, which forms the basis for this NW implementation programme.

1.2.1 BDP vision, mission and goals

A long-term delta vision and mission were formulated as part of the Delta Plan. To achieve this vision and realize the mission, three higher-level national goals were derived, in relation to national level plans, and six Delta Plan Specific Goals were defined, focusing on water, ecology and land use that contribute to these higher-level goals, as described in the figure below.

Here, the six goals are described in more detail (GED, 2018)[5].

Goal 1: Ensure Safety from Floods and Climate Change related Disasters

This first goal focuses on managing the risks of floods in the wet season and other climate change related disasters in the Delta at a well-defined and acceptable level. This level is set to facilitate: i) a safe living environment for all, in urban and rural environments; ii) reliable water system conditions for long term economic development; and iii) the performance of key societal and economic functions. The risks of floods and climate change induced disaster are managed according to local knowledge base and spatially differentiated safety levels and include the combined approach of climate proofing, early warning and prediction, prevention, evacuation and disaster relief. The goal considers ensuring safety of lives and livelihood against floods, flash floods, droughts, salinity intrusion, river bank erosion, cyclones, storm surge etc. through introducing improved adaptation and mitigation options.

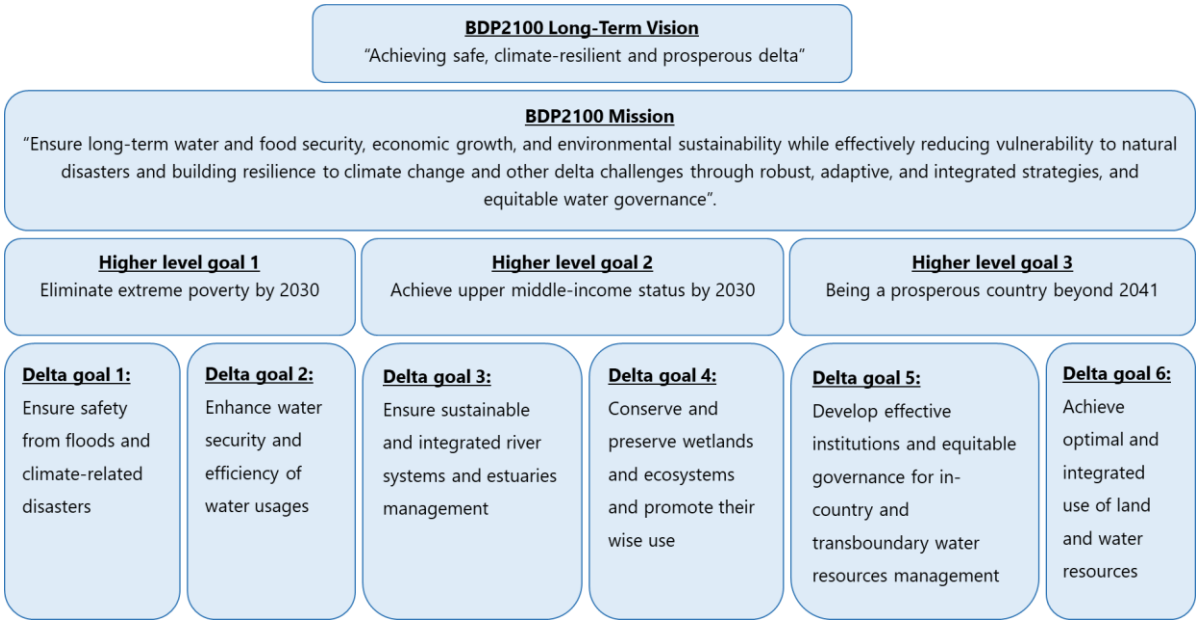


Figure 1.2: BDP 2100 vision, mission, and goals (adapted from BDP2100 Volume 1: Strategy, 2018)

Goal 2: Enhance water security and efficiency of water usages

This goal relates to water resources management especially during the dry season as well as water shortage during dry spells. Maintaining a balance between the economic developments, expanding population and the need to secure water for multifaceted uses is the core of the second goal of the Delta plan. The goal aims to ensure reliable and adequate provision of freshwater to support equitable and sustainable economic development, environmental sustainability and livelihood security. This includes: i) sufficient and timely provision of safe surface and groundwater for drinking, agriculture, fisheries, environment, navigation, industry etc.; and ii) controlling pollution, ensuring water quality and providing sanitation at

[5] Page 182 and further, BDP2100, Volume 1. Strategy, GED, 2018.

acceptable levels in relation to defined standards as well as environmental, health, agricultural and industrial needs.

Goal 3: Ensure sustainable and integrated river systems and estuaries management

This goal considers sustainable management of river systems and estuaries as one of the cornerstones of the Bangladesh Delta. The river systems of the country offer key development ingredients for the economy, society and the environment. Sustainable river and estuaries management contributes to i) long term solutions for navigation; ii) sufficient sediment supply to floodplains; iii) land reclamation in support of community development and economic growth; and iv) an inter-connected major and minor river system for environmental and economic development. This goal seeks to foster sustainable river system management by coping with its morphological dynamics and results in cost-effective, environment friendly and socially viable options for reclamation and developments of lands.

Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use

The goal realizes the term 'conservation' as a more generic target to achieve to safeguard and maintain the wetlands, whereas 'preservation' as a more converging approach, to protect sensitive ecosystem areas. Some of the components to be safeguarded under the goal are mangrove forests, water and riverine ecosystems, the coastal greenbelt, seasonal and perennial wetlands, tidal freshwater frontier etc.

Goal 5: Develop Effective Institutions and Equitable Governance for In-Country and Trans-Boundary Water Resources Management

The goal aims to improve the existing water governance for tackling both the endogenous and exogenous challenges of water resources management. At the same time, the community level functioning of local institutions would also be rejuvenated. Key elements include: i) ensuring adequate financing for investment, operation and maintenance; ii) capacity building and institutional strengthening; iii) stakeholder and private sector participation at appropriate levels; iv) minimizing the gaps between planning and implementation; v) supporting integrated water resource management at regional and local levels, taking into account the interests of all prominent water users; vi) knowledge development for integrated decision-making though modelling, data and information sharing and management; and vii) trans-boundary negotiations on water resource management and building joint basin-wide cross-border platforms for cooperation initiatives.

Goal 6: Achieve Optimal and Integrated Use of Land and Water Resources

The primary quest of this goal is to ensure efficient integration and proper interaction between land and water use aspects. The goal would mainstream the inter-connected resources functions (drainage, navigation etc.) as well. The key topics covered by the goal are land use, water use, and river transport network. Establishment of connectivity of watercourses and inducing integration between different modes of resources interactions are emphasized under this goal.

1.2.2 BDP national strategies

To achieve the goals outlined above, two main national level strategies, nine thematic strategies and hotspot level strategies for 7 hotspots have been elaborated in the BDP2100. A complex delta system calls for well thought out strategies, which support development and productive water use but manage to keep viable options open for future development. By focusing on both the short-, medium- and the long-term, the Delta Plan aims to overcome the well know pitfall that 'the solutions of today become the problems of tomorrow'. Such strategies are based on learning from experience and increasing the understanding of the delta system. A phased implementation of infrastructure and institutional interventions – each time leading to refinement and improvement – is part and parcel of each strategy.

The two National Strategies are the *freshwater strategy* and the *flood risk management strategy*. Both strategies apply to the whole country, whilst addressing the specific conditions and potentials of each basin or region through sub-strategies and preferred measures or actions.

The *freshwater strategy* contributes to the delta goals 2 and 4 by directly addressing:

1) Sufficient and timely provision of safe surface and groundwater for drinking, agriculture, fisheries, navigation and industry;
2) Preservation and restoration of the riverine and wetland ecosystems;
3) Ensuring water quality and sanitation in relation to defined standards, as well as environmental, health, agriculture, and industrial needs; and
4) Saline intrusion in coastal surface and groundwater.

Specific objectives of the freshwater strategy are:

OBJECTIVE 1. WATER AVAILABILITY: *Balancing water supply and demand for sustainable growth*

OBJECTIVE 2. WATER QUALITY: *Maintaining water quality for health, livelihoods and ecosystems*

An overview of the strategies, sub-strategies and measures for the short and medium term is elaborated in the Delta Plan (Volume 1: Strategy) and presented in summary below. The Hydrological Region[6] where the measure is applicable is also indicated in the Summary matrix below.

[6] Hydrological Regions are defined in the NWMP (2004) for the whole country. The abbreviations used are: NW: North West; SW: South-West; RE: Rivers and Estuaries; EH: Eastern Hills; NE: North-East; ECAs: Ecologically Critical Areas; NC: North-Central

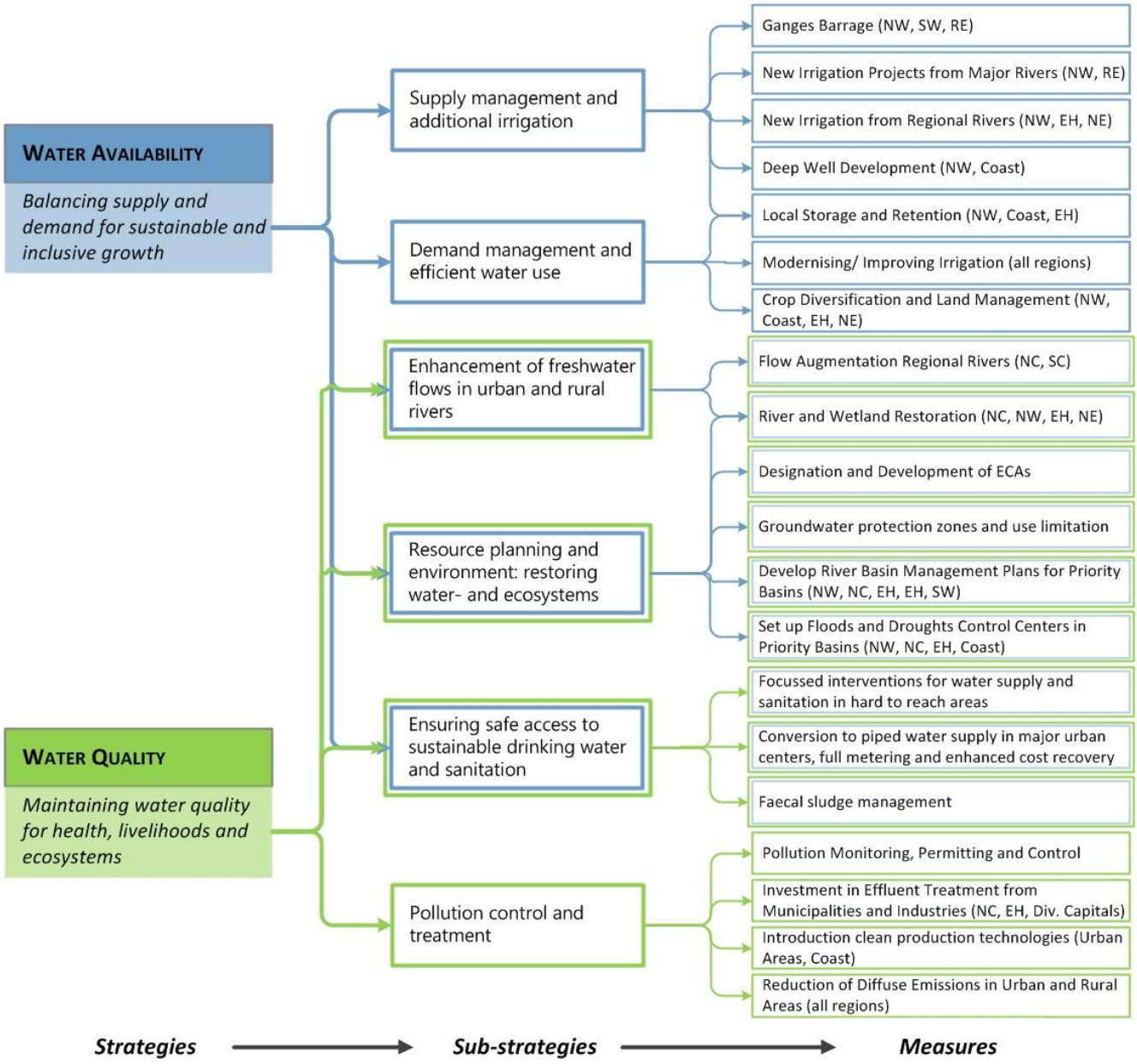


Figure 1.3: Strategies, sub-strategies and measures of the FW strategy for the short and medium term

Source: BDP2100 Volume 1: Strategy, 2018

.Key indicators relating to the freshwater strategy include: i) drought occurrence for various functions; ii) economic productivity; iii) ecosystem (services) quality; iv) groundwater levels in critical areas; v) water quality for selected functions and parameters (salinity, bio-chemical); and vi) food security and health.

The flood risk management strategy contributes directly to delta goal 1: Ensure safety from floods and climate change related disasters. Key elements of this goal, as elaborated in the 8th Five Year Plan, are: "to facilitate: i) a safe living environment for all, in urban and rural environments; ii) reliable water system conditions for long term economic development; and iii) the performance of key societal and economic functions."

Specific objectives of the flood risk management strategy are:

OBJECTIVE 1: PRIORITY ECONOMIC ZONES; protecting economic strongholds and critical infrastructure

OBJECTIVE 2: FCD RATIONALIZATION; updating FCD schemes for the future

OBJECTIVE 3: VULNERABLE COMMUNITIES; safeguarding livelihoods and leaving no-one behind

An overview of the strategies, sub-strategies and measures for the short and medium term, is elaborated in the Delta Plan (Volume 1) and presented in summary form on the next page.

Key indicators relating to the flood risk management strategy include: i) fatalities or loss of human life; ii) flood damage impact on livelihoods, sanitation, health, water supply, homesteads and poverty; iii) flood damage in terms of crop and livestock loss, soil salinization; iv) loss of transport, energy and other critical infrastructure; and v) deferred investment due to the absence of protection.

Both national strategies contribute indirectly to the delta goals 5 and 6 through promoting I) effective governance at national, regional and local level; and ii) supporting and stimulating knowledge development and innovation.

Together, the freshwater strategy and the flood risk management strategy address the core of the country's' water security, addressing both axes as defined by the Global Water Partnership (GWP)[7], through:

1) "Enhancing Productive Use", entailing investing in the water system in direct support of economic growth and social well-being. Growth enables investment in institutions, information systems, innovation and infrastructure; and
2) "Protection Against Destructive Impacts"; entailing focussing on protecting people and assets that are threatened as water-related risks (such as scarcity, floods, access, and resource degradation) grow due to population and economic growth.

As will be discussed in the next sections and chapters, both national strategies are highly relevant for the NW, as drought prone area but also as basin where regular disastrous floods have wreaked havoc upon the population and its economy.

[7] Sadoff, C.W., Hall, J.W., Grey, D., Aerts, J.C.J.H., Ait-Kadi, M., Brown, C., Cox, A., Dadson, S., Garrick, D., Kelman, J., McCornick, P., Ringler, C., Rosegrant, M., Whittington, D. and Wiberg, D. (2015) Securing Water, Sustaining Growth: Report of the GWP/OECD Task Force on Water Security and Sustainable Growth, University of Oxford, UK

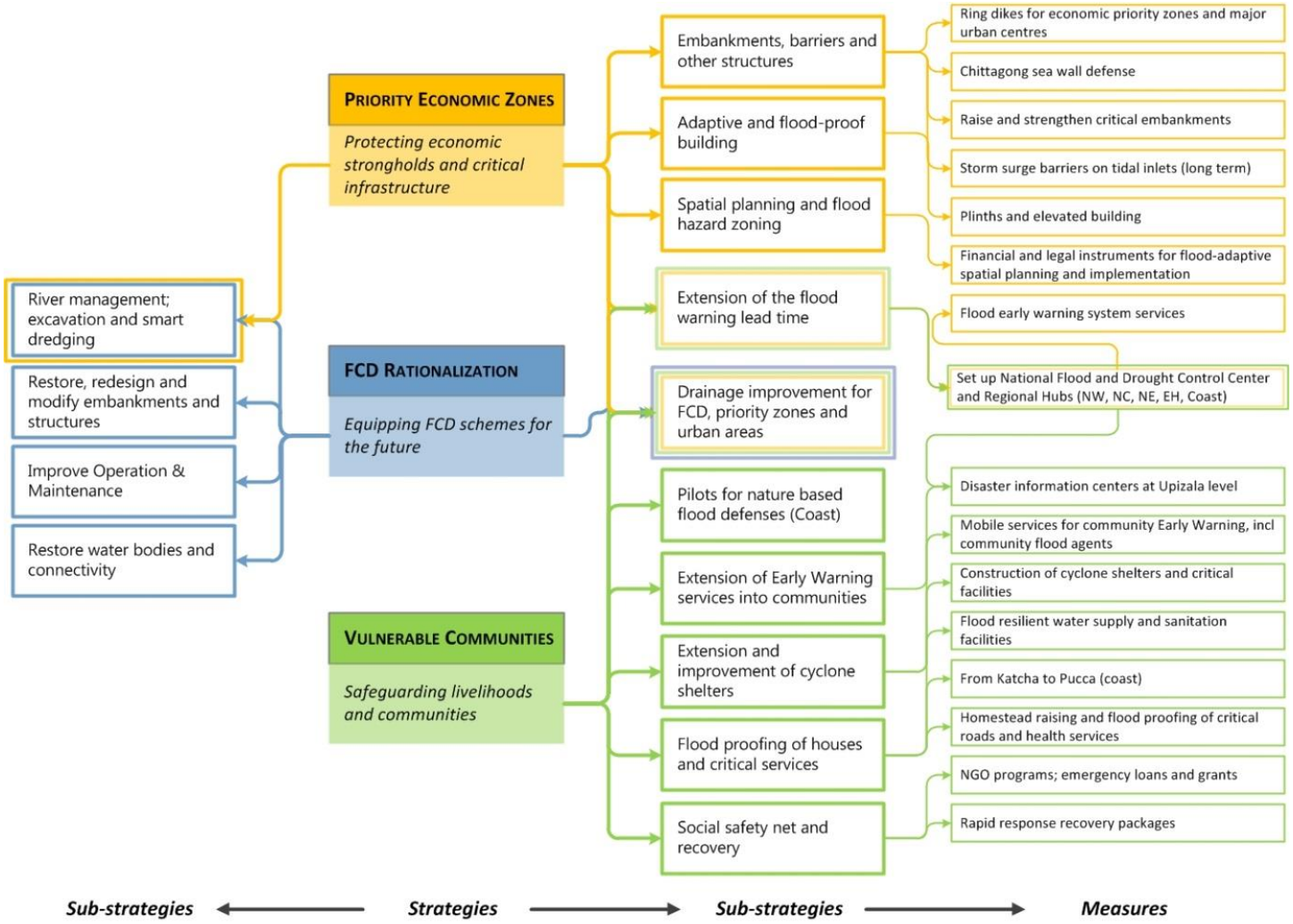


Figure 1.4: Strategies, sub-strategies and measures of the FRM strategy for the short and medium term

Source: BDP2100, Volume 1: Strategy, 2018

1.2.3 Thematic BDP2100 strategies

A further nine thematic strategies have been developed in the delta plan and described in detail in BDP2100 Volume 1: Strategy. In the table below, first, the relevance of the strategies for the NW basin is indicated. Thereafter, a concise assessment is provided of the relevance of each strategy for the NW basin.

Table 1.1: BDP2100 them.atic strategies and the NW basin

Thematic strategy	Relevance NW		
	H	M	L
Agriculture, Food Security, Nutrition and Livelihoods			
Transboundary Water Management			
Water Supply, Sanitation & Waste Management			
Environment, Ecology & Biodiversity			
Dynamizing Inland Water Transport System			
Sustainable Land Use and Spatial Planning			
Advancing the Blue Economy			
Renewable Energy			
Earthquakes			

Thematic strategies on Agriculture, Food Security, Nutrition and Livelihoods

This strategy is highly relevant for the NW as core rice producing region of the country along with vegetables, cash crops, fruits (mango and lichi) etc. growing areas. Important challenges such as consistent and gradual groundwater decline, and surface water pollution are directly related to the agriculture sector. In addition, the sector is vulnerable to both floods and droughts in the NW. Key actions that are relevant for the NW include: i) improving crop varieties, enhancing irrigation and soil husbandry practices for climate resilience; ii) improving fish and livestock breeds and culture practices; iii) crop and diet diversification; iv) developing peri-urban food systems; v) enhancing agro-processing and value addition; and vi) water retention including rainwater harvest/preservation.

Thematic strategies on Transboundary Water Management

The NW is bounded by the Indian border, total 115 rivers out of which 19 are transboundary, and two major transboundary rivers: the Ganges and the Brahmaputra. Dry-season upstream water diversion/withdrawal of three rivers, the Ganges and the Teesta are flowing through NW, make this region high water stressed during dry season. The Ganges water sharing treaty of 1996 is due to be renewed in 2026. An agreement is also foreseen for the Teesta river. Of the six 'other' prioritized rivers to be addressed in the Joint Working Group between Bangladesh and India, two rivers located in the NW are: Dharla and Dudhkumar (BDP2100, Volume 1, p170). In addition, the aquifers that underlie the basin are (partially) fed from upstream, transboundary surface and groundwater sources. In short, transboundary water management is highly relevant for the NW.

Thematic strategies on Water Supply, Sanitation & Waste Management

Much of the strategy is driven by the SDGs, principally SDG 6, 'access to water and sanitation for all', to which the Government has committed through the Delta Plan and other policies. All aspects of thisstrategy are highly relevant for the NW: i) water supply and moving up the service ladder towards piped water supply for all; ii) sanitation and sludge management; iii) urban drainage; iv) wastewater treatment and solid waste management; and v) improving the operational service level and financial durability of service

delivery and enforcement, in urban and rural areas. All the Urban and City areas of the NW , entirely dependent on the GW for municipal and industrial use, need to gradual shifting from GW to Surface Water.

Thematic strategies on Environment, Ecology & Biodiversity

The beels, khals, rivers and floodplains (categorised as wetlands in the BDP2100) of the NW provide important ecosystem services to the region's population. Formally, protected areas have not been designated in the NW, nevertheless, Delta Goal 4 focusses entirely on the conservation and wise use of wetlands. The region has several areas with important biodiversity. Moreover, water pollution is an increasing problem in the NW, from agriculture, municipal and industrial sources.

Thematic strategies on Dynamizing Inland Water Transport System

Inland water transport is not of major importance for the NW. A total of three (3) rivers are categorised by BIWTA as Class 3 and 4 waterways. The strategy has limited relevance for the NW.

Thematic strategies on Sustainable Land Use and Spatial Planning

Land zoning and land use planning are key elements of flood risk management, wetland conservation and ensuring environmental sustainability in the broadest sense. Moreover, land management and acquisition play an important part in planning and implementation of large infrastructure projects. With a growing population, expanding economy and increasing pressure from industrialization and urbanization, the strategy is highly relevant for the NW.

Thematic strategies on Advancing the Blue Economy

The blue economy is not relevant for the NW, as there is no sea border or industry that depends on the blue economy in this region.

Thematic strategies on Renewable Energy

The renewable energy strategy is moderately relevant for the NW. There is potential for further solar energy generation whilst the potential for hydropower and wind energy is very low.

Thematic strategies on Earthquakes

The NW is the least earthquake prone zone in the country, nevertheless, major earthquakes may lead to river avulsions which could affect the NW.

1.2.4 The barind and drought prone hotspot strategy

The Barind Hotspot Strategy, as described in the BDP2100, forms the basis for this NW basin implementation programme. As indicated in Chapter 1, the Barind was selected as representative for the drought prone areas of the country.However, the Hotspot was expanded to cover the whole NW region. The Barind strategy strongly informed the national freshwater strategy, particularly with respect to drought and groundwater management.

The Barind hotspot was expanded to the whole NW as a result of reorientation of the hotspot boundaries during the formulation of the BDP2100. Subsequently, the GED, with support through the SIBDP, adopted NW basin approach for the implementation of the BDP2100, covering Rangpur and Rajshahi divisions and bounded by the Brahmaputra/Jamuna rivers in the East and the Ganges in the South.

The key delta and water management issues addressed in the Barind Hotspot Strategy were:

- Key issue 1: Drought
- Key issue 2: Groundwater decline
- Key issue 3: Floods and drainage congestion

- Key issue 4: Floodplain connectivity and degradation of wetland ecosystems
- Key issue 5: Water supply and sanitation

Subsequent analysis for the NW State of the Basin report (SIBDP, 2020), led to the identification of 2 additional key issues:

- Key issue 6: Sustainable water governance
- Key issue 7: Pollution and water quality

To address these issues, the Barind Hotspot strategies and supporting measures, were developed, reproduced here below from the BDP2100 (Volume 1: Strategy), and detailed thereafter.

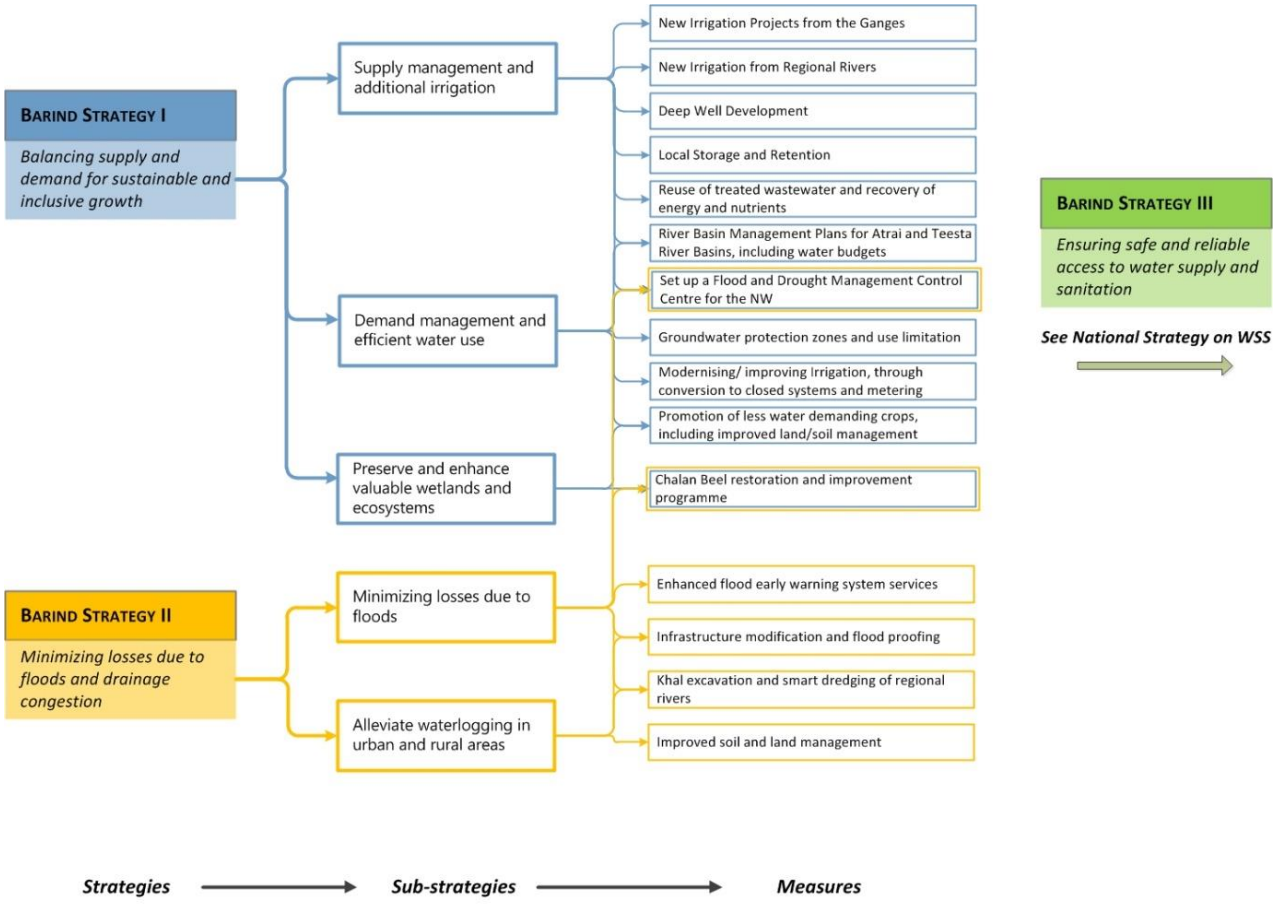


Figure 1.5: Barind hotspot strategies

Source: BDP2100, 2018

Barind or NW strategy 1: Balancing Supply and Demand for Sustainable and Inclusive Growth

Ensuring water availability by balancing supply and demand for sustainable and inclusive growth lies at the core of the strategies for northwest region. Increased droughts and water shortages for different socio-economic sectors are expected in the future and, if one continues with the 'business as usual' strategy, these constraints will hamper the sustainable growth as envisaged by Government in the National Sustainable Development Strategy (NSDS, 2013, GED). Three sub-strategies form part of this Strategy.

- Sub-strategy 1.1: Supply management and additional irrigation

Where adequate water resources exist or can be developed, from the Ganges and regional rivers, this sub-strategy is geared towards providing additional irrigation water for sustainable and inclusive growth. The

key beneficiary of this sub-strategy is the agriculture sector and, where valuable groundwater supplies can be substituted by surface water resources, benefitting the environment, and water supply and industry sectors. Sustainable operation & maintenance of irrigation systems is a particularly essential feature of this sub-strategy.

- Sub-strategy 1.2: Demand management and efficient water use

This sub-strategy is aimed at reducing the demand for freshwater, for those areas where additional water resources cannot be (economically) developed or where more urgent socio-economic priorities such as safe water supply, industry, ecology or navigation receive a higher priority. A mix of interventions is included, consisting of less water consuming crops to more efficient irrigation and more effective management and pricing. The substrategy also includes gradual shifting from GW source to surface water(SW).

Barind or NW strategy 3: Ensuring water supply and sanitation

This strategy centers on achieving basic water security and sustainable development goals: ensuring safe and reliable access to water supply and sanitation. There is a strong link with water quality through the development of improved sanitation and wastewater treatment systems in all districts and major settlements, with cost recovery principles advocated for all WSS services. This strategy is elaborated in the National WSS Strategy. Key activities include development of sewage treatment plants in all district headquarters; advanced treatment driven by the desired environmental quality standards of receiving waters; fecal sludge management facilities and practices; conversion of localized systems to piped distribution networks; and securing scarce GW supplies in areas where an over extraction is taking place and ensuring the priority of groundwater use for water supply above other GW use. Gradual shifting from GW source to surface water (SW) for Urban and industrial usages.

The investment projects included in the BDP2100 Investment Plan (BDP2100 Volume 2: Investment Plan) were subsequently mapped and connected to the strategies and sub-strategies for the Barind/NW, visualized here below.

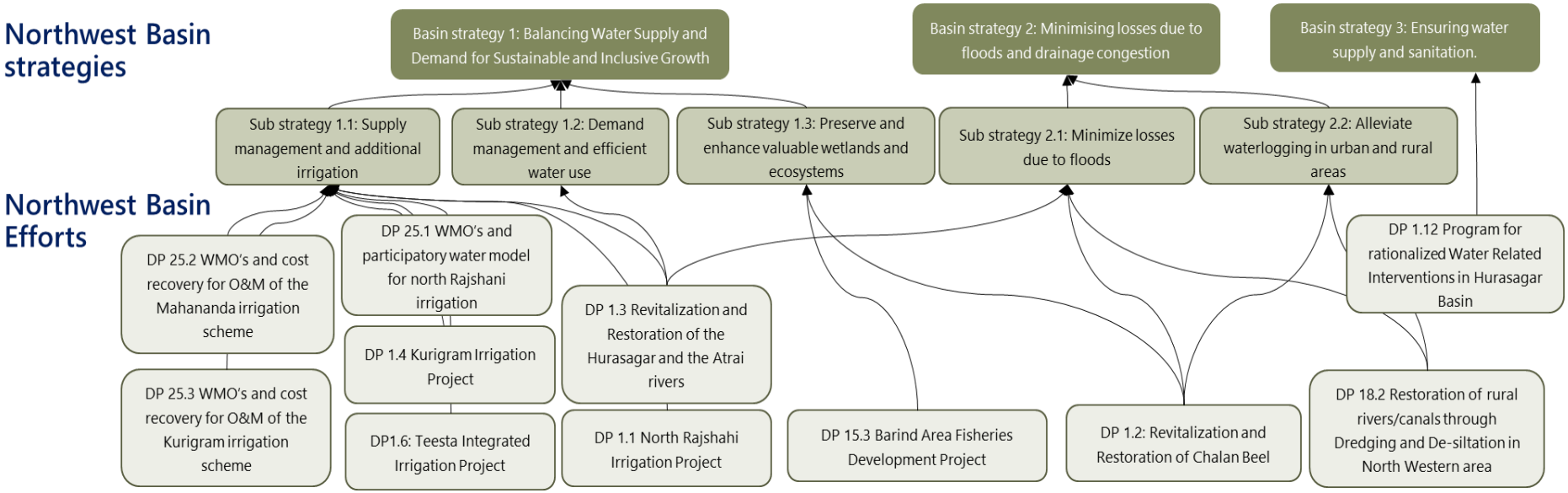


Figure 1.6: Relation between approved investment projects and the NW basin strategies

Source: BDP Volume 2: Investment Plan

1.2.5 The basin approaches

After being approved by the Government of Bangladesh end of 2018, the implementation of the BDP2100 is being structured in distinct implementation programmes at National and Basin level. Integration and coherence between programme are needed to achieve the BDP's goals whilst cooperation between implementing agencies is key to furthering *holistic, adaptive and integrated water resource management: the hallmarks of the BDP2100*.

In this section, the Implementation programme for the NW Basin is presented. The basin covers the Drought Hotspot of the Bangladesh Delta Plan (BDP2100, 2018) and coincides with the North-West Hydrological Region as identified in the National Water Management Plan (NWMP, 2004).

For the implementation of the BDP2100, a basin approach is followed, considering the principles of Integrated Water Resource Management (IWRM)[8], a principle adopted by Bangladesh in the 2013 Water Act and BDP2100. Adopting a basin approach entails that the analysis of key issues and opportunities as well as implementation, consider the interaction and integration of delta and water management inside the basin, and between the basin and adjacent rivers, sea or estuary. By adopting the basin approach, Bangladesh hopes to overcome some of the challenges to implementation discussed in the BDP2100; summarized here as: 1) weak capacity of water and water related institutions; 2) absence of water management organizations throughout the country; 3) lack of integration of water issues.

For the NW basin, four distinct programmes have been developed, to contribute to the six BDP Delta Goals and BDP2100 national and thematic strategies. The NW programmes specifically address the key delta and water management issues identified in the State of the Basin (SOTB) report: Key issue 1: Drought; Key issue 2: Groundwater decline; Key issue 3: Floods and drainage congestion; Key issue 4: Floodplain connectivity and degradation of wetland ecosystems; Key issue 5: Water supply and sanitation; and Key issue 6: Sustainable water governance; and Key issue 7: Pollution and water quality. The NW SOTB is the baseline for the NW Implementation Programme. The content of the Implementation Programme has been developed making use of a gap analysis carried out between the proposed Investment Plan projects and the Implementation Programme Objectives and Performance Targets. The latter are derived from the six delta Plan Goals and the indicators in the BDP2100 Results Development Framework.

The steps of the basin approach in relation to the BDP2100 are visualized here below:

[8] https://www.gwp.org/en/gwp-SAS/ABOUT-GWP-SAS/WHY/About-IWRM/

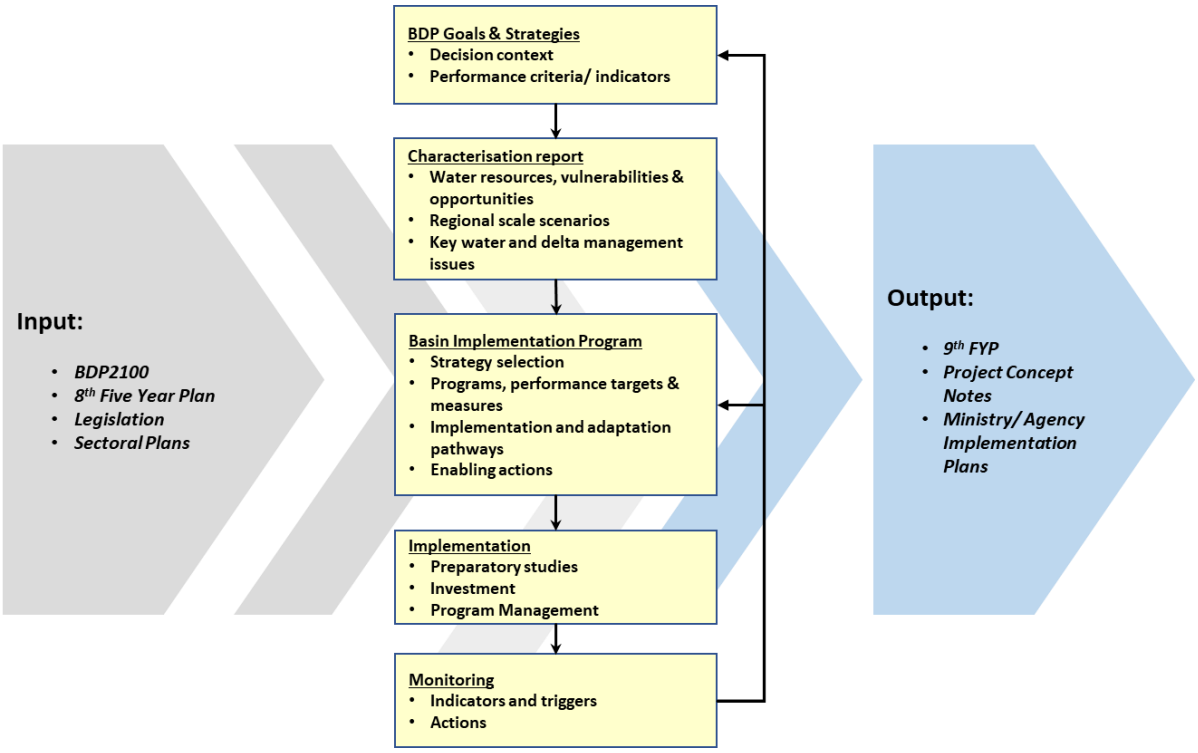


Figure 1.7: The steps in developing the BDP2100 basin implementation programmes (input 8th five year, output 9th FY)

Concept notes of projects and programmes are included in the Annex of this document, including concept notes developed for the BDP Investment Plan, as well as newly developed concept notes that address the identified gaps.

1.2.6 Programme management

In the BDP2100, important governance challenges to holistic, integrated and adaptive planning and implementation are mentioned. These include (BDP2100 NW State of the Basin report, 2021):

i) Closing the gap between planning and implementation and ensuring the coordinated and integrated development of water resources. This includes developing water management plans at regional and catchment level to ensure adequate supply and water quality for the priorities in the area.
ii) Coordinated and well-planned river management taking into account river morphology, the different river functions and the interaction between the main rivers and regional river/floodplain systems.
iii) Securing O&M financing at local, regional and national level, including the development of public-private management models, for irrigation in particular.
iv) Application of the IWRM concept at catchment and sub-catchment level, based on reliable and up to date data and models, taking into consideration all IWRM aspects and ensuring a good access to information by all stakeholders in the area.
v) Sustainable development of decentralised, user-led and self-financing water management organisations (WMOs), be they grassroots community-based organisations, private sector led service organisations or hybrid models. These organisations should i.e. ensure effective and efficient O&M and take into account the different interests of water users and stakeholders at local and regional level in day-to-day and long-term water resource management.
vi) Implementation, monitoring and enforcement of regulations in both water quantity (surface and groundwater) and water quality.

Programme management is a proven tool to support the integrated and holistic implementation of complex and multi-stakeholder plans like the BDP2100. It is an approach to structure vision, understanding, clarity and improve adaptiveness of the suggested approach and efforts to reach predefined goals. Programme management is designed as an approach of managing and directing a multitude of goals and projects in a rational and holistic way. A programme differs from projects, a difference that is important to understand. A programme is a temporary form of collaboration, aimed at achieving goals that contribute to the strategy of an organization. A project is a temporary form of collaboration aimed at realizing a result that contributes to a certain goal.

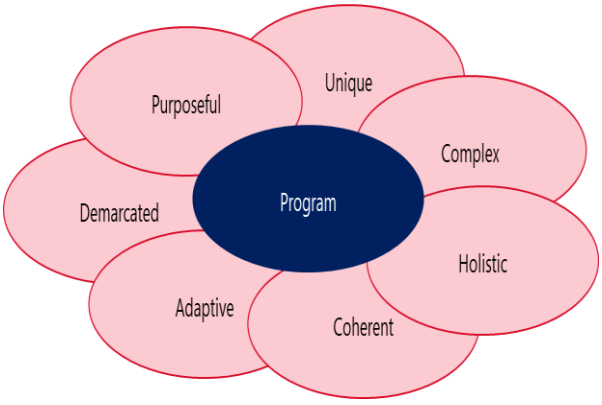


Figure 1.8: Key characteristics of a program

Programs can be developed top-down and bottom-up: Programs can be developed using top-down and bottom-up approaches, illustrated below the benefit of working both ways are the resulting insight gained in coherence and interdependence of efforts and goals.

For each programme, ***objectives*** are formulated, derived from the BDP goals and strategies and tailored to the conditions of the basin. For each objective, ***performance targets*** are defined, which allow for basin-specific planning and assessment. Where needed, these performance targets are further explained, related to established norms or, where these norms do not exist, proposed anew. They may therefore be subject to adjustment as a result of further consultation with key public authorities.

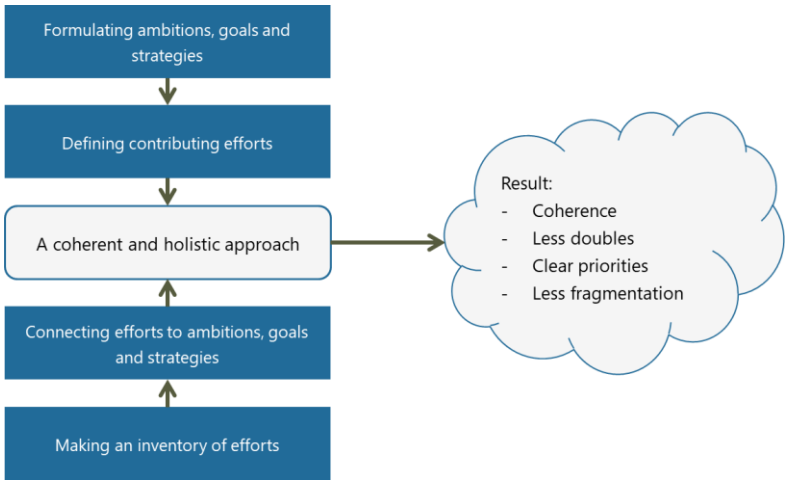


Figure 1.9: Developing a program bottom-up and/or top-down

Each programme is further comprised of individual investment projects as well as enabling activities and studies, with a lead agency responsible for its implementation, a list of cooperating agencies, and a linkage to the **BDP Results Development Framework**. A guiding principle of all programmes is the strong collaboration between relevant agencies and stakeholders, to further the overall BDP approach of integrated, adaptive and holistic planning and implementation.

1.3 Integrated Assessment and Screening

1.3.1 Scenarios for adaptive planning

The BDP2100 makes use of external scenarios to assess the range potential future change in drivers, pressures and impacts on flood risk, water resources and population, to name a few of the main parameters. These scenarios are then applied to assess the change for the main issues in the basin and

assess the robustness and effectiveness of the proposed projects and programmes. Where possible, making use of the Bangladesh Metamodel, these potential changes are quantified, to support assessment and decision-making. Reference is made to the BDP2100 main document for a detailed description of the BDP2100 scenarios, including the scenario parameters as well as the *JCP Technical Note North-West Region results Bangladesh Metamodel*, published under the Bangladesh Netherlands Joint Cooperation Programme (JCP).

The scenarios are visualized here below for completeness sake and easy reference. Thereafter, the main climate parameters for each of the four scenarios are summarized in a table, for the 2015 'base case' and the 2030- and 2050-time horizons. As part of the formulation of the BDP2100, a dedicated report was drafted on the delta scenarios[9].

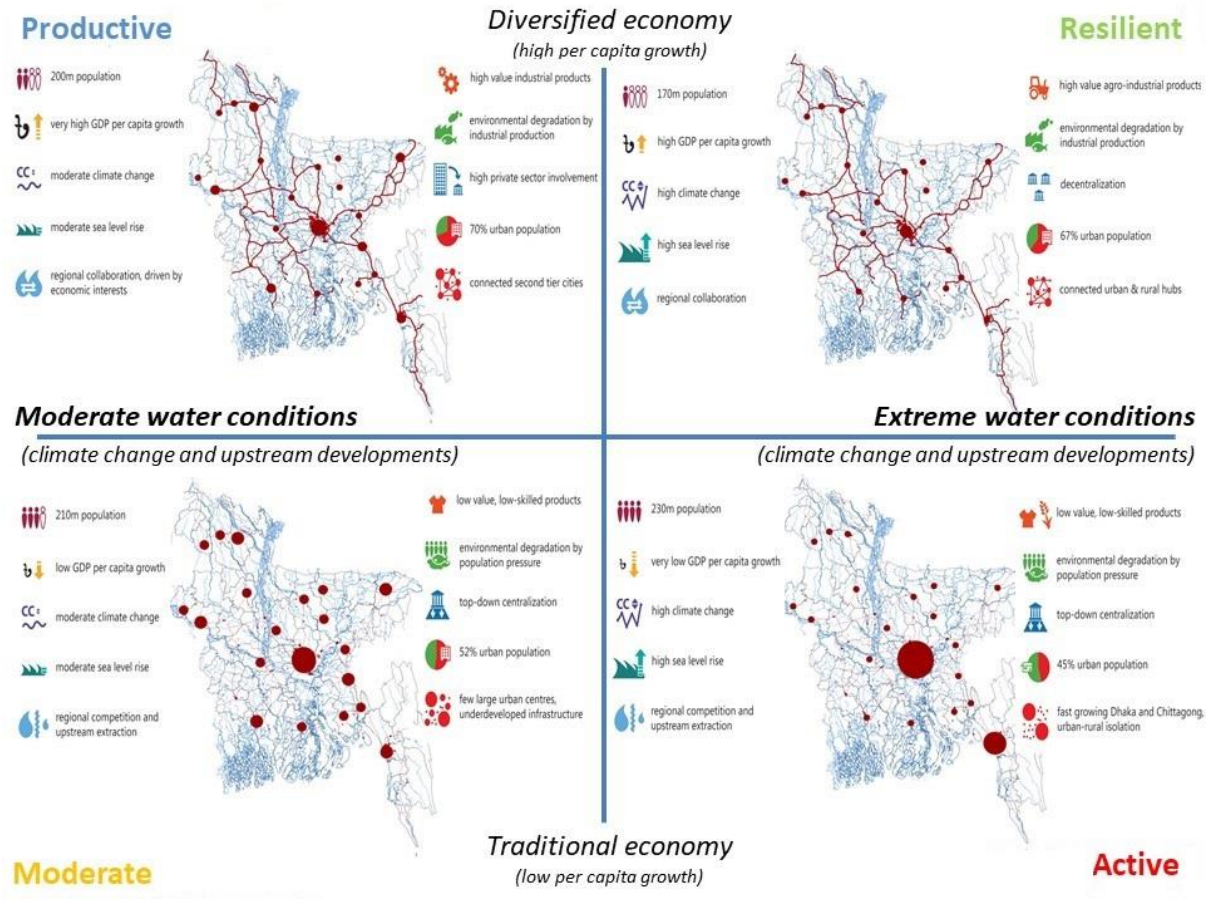


Figure 1.10: BDP2100 integrated scenarios

Table 1.2: BDP2100 climate change scenario characteristics

[9] Bangladesh Delta Scenarios, BDP2100, Maaike van Aalst, William Oliemans, Fulco Ludwig, Leo Beumer, Catharien Terwisscha van Scheltinga, Kymo Slager (2016)

Scenario		Base	Productive		Resilient		Moderate		Active	
Climate situation		2020	2030	2050	2030	2050	2030	2050	2030	2050
Climate characteristics										
Sea level rise	cm	n/a	10 - 20	20 - 30	15 - 30	40 - 60	10 - 20	20 - 30	15 - 30	40 - 60
Temperature rise*	˚C	n/a	0.5	1	1.5	2	0.5	1	1.5	2
Monsoon rainfall change	%	n/a	0	10	15	20	0	10	15	20
Dry season rainfall change	%	n/a	0	0	-10	-10	0	0	-10	-10
Peak discharge change	%	n/a	5 - 15	10 -20	15 - 30	20 - 40	5 - 15	10 - 20	15 - 30	20 - 40
Low flow discharge change	%	n/a	-5	-15	-15	-30	-10	-25	-20	-40

The BDP2100 climate scenarios are uniform for the whole country, do not provide details on the regional differentiation of changing rainfall and discharge patterns and provide an indication of changes to current averages and extremes. The effect of the scenario characteristics is presented in Figure 1.11 where not only the average rainfall profile is adapted by an increase of 20% of monsoon rainfall - in case of a high climate change scenario for 2050 – but that this increase also applies to an extreme wet year (e.g. plus 100 mm in July) with a probability of 10%.

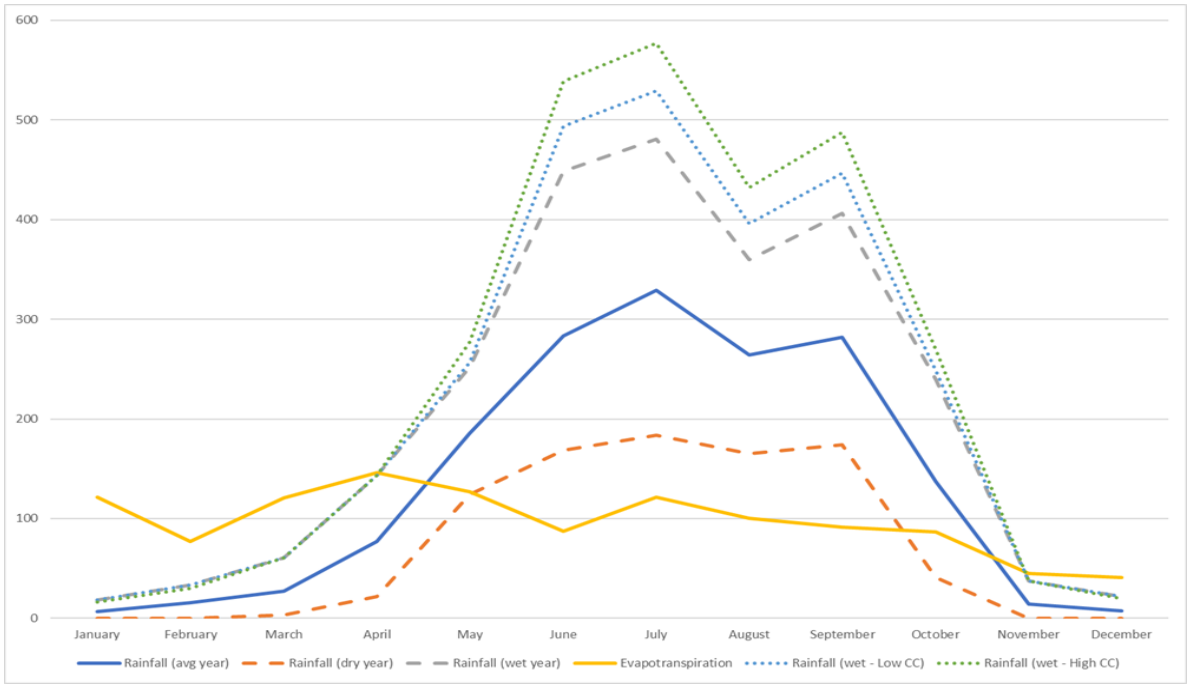


Figure 1.11: Potential impact of climate change to average rainfall for the North-West region

Source: Bangladesh Metamodel, 2021

The BDP climate change scenarios do not include information on potential changes in timing of rainfall, shifting of the monsoon period, regionalized information and co-incidence of rainfall and high discharges. These aspects of climate change are possibly more relevant for adaptive policy making, as they for example directly influence crop production and provide more action perspective to develop regionalized strategies. The projected *average* changes fall within the inter-annual variability, discussed in the SOTB (BDP2100 NW SOTB, 2021).

Textbox: The use of climate change scenarios in the Bangladesh Metamodel

The BDP2100 climate change scenarios are used as input for the exploration on the potential impacts of climate change on the water system and society. We have transformed the historical timeseries - used for describing the current water resources - to reflect the variation of the meteorology under the future climate. We can compare in this way the outcome for each meteorological year in the timeseries for the

different scenarios.

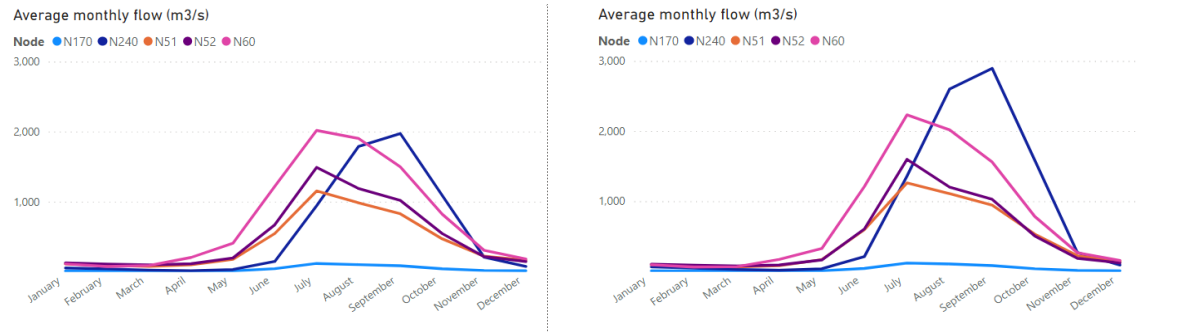


Figure 1.12: Transboundary average flows for regional rivers in the NW region: under current climate conditions (left), under future extreme climate scenario 2030 conditions (right)

Source: Bangladesh Metamodel, based on data from the NWRD

1.3.2 The MCA and indicator selection

The implementation programme includes both 'implementation-ready' projects, and new project ideas and proposals developed as a result of gap analysis carried out in SIBDP. To support integrated assessment of the projects, in line with the BDP2100 integrated, holistic and adaptive approach, and with a view to developing coherent and adaptive implementation programmes that contribute to meeting the BDP2100 Delta Goals, both quantitative and qualitative assessment have been used. These two methods complement each other, based on the principle of *'quantitative assessment, if possible, qualitative if not'*.

To support quantitative assessment, a prototype Metamodel was developed as part of the formulation of the BDP2100 in 2017. With support from the Embassy of the Kingdom of the Netherlands (EKN), as a component of the Joint Cooperation Programme (JCP), this prototype was then redeveloped into a functioning decision-support tool: the Bangladesh Metamodel. The application of the metamodel to the NW basin is discussed in a separate JCP Technical Note.

The Metamodel results for the projects are input to a Multi Criteria Analysis (MCA), a methodology designed to combine quantitative and model-based assessment results with qualitative expert judgment to arrive at an integrated and holistic assessment. An MCA was developed for the BDP implementation programmes to facilitate decision-making by the GOB. The criteria in the MCA were drawn and where needed, adapted, from the BDP2100 Development Result Framework (DRF, BDP2100 Volume 1: Strategy, p631-633), the 8th Five Year Plan and the Vision 2041. To facilitate decision-making and comparison, the longlist of decision criteria drawn up from these documents, was screened to arrive at a concise shortlist containing key decision support indicators. The criteria used to develop the short list included: i) adequate reflection of the BDP2100 goals; ii) relation to the specific objectives and performance targets for the North-West; iii) not or less open to multiple interpretations.

The outputs of any MCA are highly sensitive to the weights or importance given to a particular indicator. This depends on the background of the person assigning the weights, their interests and expertise. For this reason, in this Implementation Programme, the MCA results are presented without any weighting. The scoring was carried out by a multidisciplinary team of experts from the SIBDP TA team. An MCA scoring tool was developed by the JCP Metamodel team to facilitate MCA scoring and assigning weights by selected stakeholders at a later stage. An overview of the indicators, 13 in total, and their relation to the BDP2100 goals is visualized in the figure below. A detailed description of the assessment, indicator choice, screening and scoring is provided in a separate SIBDP Technical Note, from which key parts are drawn for this Implementation Programme report.

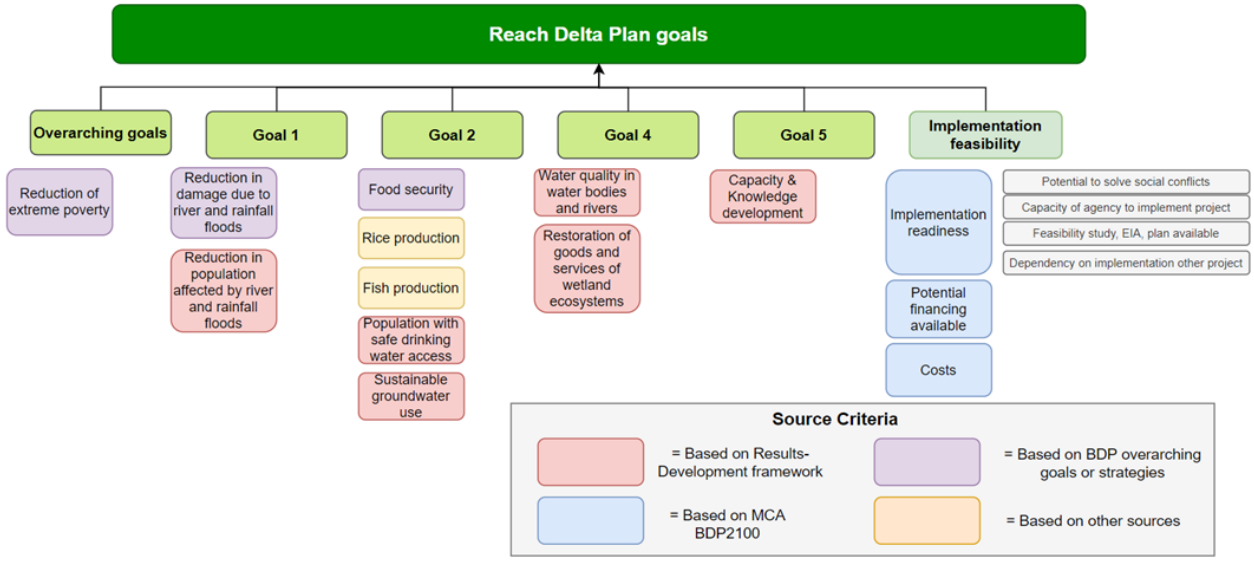


Figure 1.13: Key parts for the Implementation Programme

1.3.3 Project screening for inclusion in the BDP2100 NW Implementation Programme

The investment plan of the BDP2100 contains 80 projects, of which 13 projects are related to the NW, classified either as Barind and Drought Prone (DP) area (9 projects) or as Cross Cutting (CC) project (4 projects). As part of SIBDP and in preparation for the 9th FYP, additional project proposals were submitted, which together constituted the longlist, or first screening step. A summary of the screening, selection and programme development process is provided here below:

- STEP 1: Drawing up the Longlist; from the BDP Investment Plan, and additional projects received from different agencies.ls
- STEP 2: First shortlist based on the availability of a Concept Note
- STEP 3: Assigning shortlisted projects to one of the four NW Implementation Programmes, each of which includes programme objectives and performance targets
- STEP 4: Gap analysis, using expert judgement of multidisciplinary SIBDP TA experts, of the project shortlist with the programme performance targets and the BDP2100 principles: holistic, adaptive and integrated approach
- STEP 5: Formulation of proposed reorientation of existing projects to address shortcomings, inclusion of existing adequate Concept Notes which were not included in the BDP Investment Plan and development of new Concept Notes
- STEP 6: MCA scoring by a multidisciplinary team
- STEP 7: Inclusion of Bangladesh Metamodel outputs for selected (6) indicators

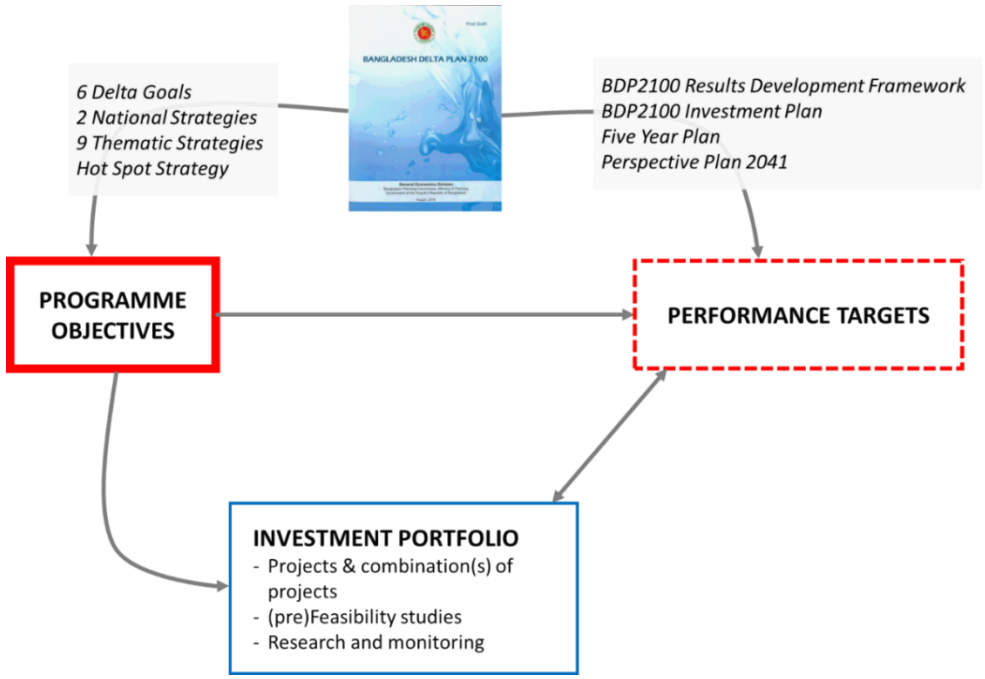


Figure 1.14: The relationship between programme objectives, performance targets and the investment portfolio

Gap analysis was carried out by comparing the performance targets for specific programmes with the project investments foreseen in the BDP2100 investment plan. This was done through quantitative assessment, using the Bangladesh Metamodel, developed specifically for the BDP2100 and qualitative expert judgement by multidisciplinary assessment teams. Multi Criteria Analysis was then used to compare and carry out integrated assessment, laid down in scorecards for each programme and objective. The same multidisciplinary project teams subsequently developed project concept notes to fill the identified gaps, which were also assessed using the quantitative and qualitative assessment techniques mentioned before.

This process is visualized here below.

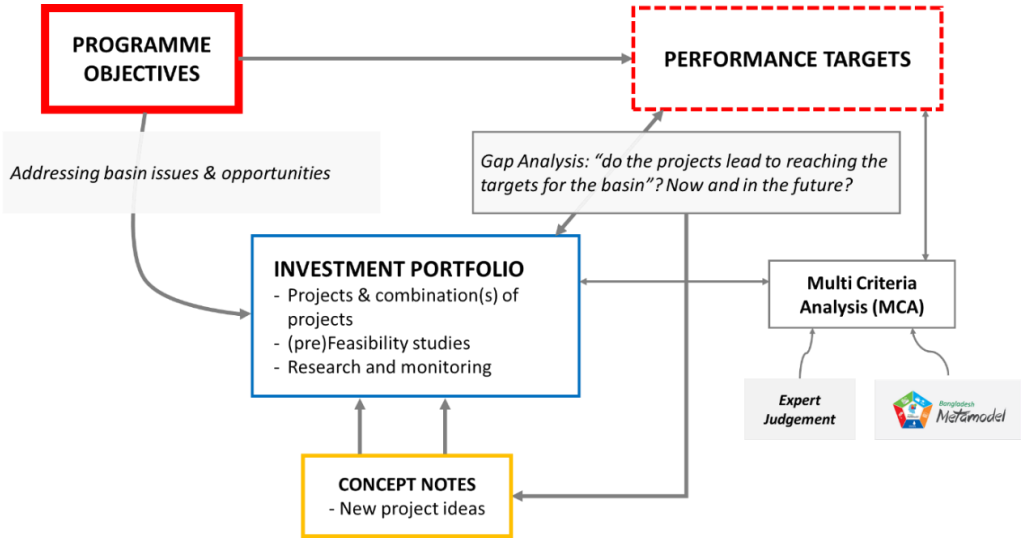


Figure 1.15: Developing concept notes based on gap analysis

In the next chapter, each programme is presented, including the projects identified as part of those programmes. These projects include both the already approved projects in the 7th and 8th five-year plans and the additional projects needed to reach the BDP goals in relation to the NW basin in 2030 and 2050.

In a next step, the MCA will include three additional criteria to assess the fit between the measures, projects and programme on the one and the principles of adaptive delta management on the other: i) flexibility, or the possibility to adapt a measure, project or programme to changing climate and socio-economic conditions; ii) robustness, or the performance of the measure/project or programme in different scenarios; and iii) resilience, or the contribution of the measure to the ability to recover from climate and socio-economic shocks. These shocks include both man-made and natural disasters.

1.4 Stakeholder Consultation in North-West Basin

The stakeholder consultation is vital and one of the preconditions for successful outcomes of these projects implementation in line with the Bangladesh Delta Plan 2100. Therefore, SIBDP has been conducting stakeholder consultation with related water management agencies/organizations and other stakeholders that including officials from verious related agencies, practitioners and researchers from the Department of Disaster Management (DDM), Department of Livestock Services(DLS), Department of Fisheries (DoF), Soil Research Development Institute (SRDI), BWDB, IWM, BARC, IUCN, DPHE, Barandra Multiurpose Development Authority (BMDA), Bangladesh Agricultural Development Corporation (BADC), Bangladesh Agricultural University (BAU), Dhaka University (DU), Local Governmaent Engineering Department (LGED), BUET, Rajshahi University (RU), City Corporation/Pouroshova representatives, WARPO, CEGIS, IWM, GED-Planning Commission,. related NGOs, Local Government Institutions, local elites and WMG/WMS representatives.

On 26-29 January 2020, day long two Ateliers were organized by the GED and SIBDP in the North-West region of Bangladesh. The first atelier was held at Rajshahi on 27 January 2020 and the second one was held at Chatmohar upazila under Pabna district on 28 January 2020. Both the workshops were participatory and interactive with approximately 100 participants/representatives per delta atelier of the region, followed by a field visit and interviews with representatives of local government agencies, Rajshahi University, NGOs, villagers and farmers. During the ateliers, the people from the region were invited to share their knowledge on the projects proposed by BDP 2100 for North West region.

The main objectives of these stakeholders consultation are to explain stakeholders, incuding local community and LGIs, better understanding of the proposed/planned investment projects part of the Bangladesh Delta Plan 2100, solicit the opinion of different and often diverse stakeholders on the current investment plans and to include those in the project planning for future implementation, try to integrate all the related stakeholders to make comprehensive water management/development projects for the area, try to remove/minimise the existing problems of the different projects/intervantions on the wtare resources in the area and few other from connection, road network, culvarts, bridges etc having advarse impact on water flow or hydrology of the area, collect recommendations on current projects and gather indeas on potential new projects. The expectation is that this will enrich the BDP2100 and enhance commitment and ownership of stakeholders all over the country. As a next step, the relevant comments, experience, suggestions and feedback have been integrated in the NW Implementation Plan.

1.4.1 Consultation steps:

The consultation meetings build upon the principles of a participatory and systematic approach to gain an increasing degree of involvement and trust between parties and ownership on problem identification, problem definition and finding solutions or preparing interventions. The following steps have been taken:

- Identification, mapping and invitation of stakeholders
- Preparation of the program and materials
- Preparation and training of the group facilitators for each of the groups
- Consultation/discussions/interaction among the group members and answer to questions and quarries by the group facilitator during the workshop for preparation of recommendations/ suggestions and sharing of experiences on the water resources development.
- Reportpresentation on the experiences/results/suggestions/recommendations by each of the groups. After presentation by all the groups a brief question answer session was conducted.
- Integrate results in NW Implementation Plan

Stakeholder Identification, Selection and Invitation: Based on the reconnaissance field visit by CEGIS team, the stakeholders from different public and private sectors, civil societies, academia and NGOs etc were identified, selected and invited for the North West (NW) consultation program. During reconnassinace field visit, CEGIS team made several meetings with different agencies like BWDB, BMD, BMDA, DAE, LGED, DPHE, BADC, water user group etc and collected several proposed list of potential stakeholders. This list included all those are being affected by policies, decisions or actions within a particular system. Participation of women were also ensured to make it more participatory and enhance gender equity under this phase of work.

Primarily, the stakeholders included the people who are the water users. Eventually all people are the water users but more precisely emphasis was given to those who use water for production purposes like agricultural production. Apart from these, fishing community were identified as another potential primary userbecuase they are solely dependant on the basin in North-West region for their livelihood.

Moreover, the stakeholders included local government institutions (LGI) like City Corporation, Pouroshova, Upzilla Parishad, Union Parishad, Bangladesh Water Development Board (BWDB), Local Government Engineering Department (LGED), Bangladesh Meteriological Department (BMD), Department of Publice Health Engineering (DPHE), Bangladesh Agriculture Development Corporation (BADC), Department of Agriculutural Extension (DAE), Barandra Multipurpose Development Authority(BMDA), Department of Fisheries(DoF), Representatives form Water Management Organisations(WMOs), Teacher from Rajshahi Univrsity, civil society representatives, Local elected representatives, NGOs and general public at large. Effort has been made to include representatives from all the relevent agencies, organisations and institutions.

After finalisation the list of stakeholders from various agencies and sectors, the invitation letter was sent to them all to attend the meeting as per schedule Fromal letter were also sent to relevant govenrment officials requesting them to attend the workshop.

Preparation of the program and materials: The preparation of the program and materials have been done in collaboration with different members of the SIBDP team, GED-Planning Commission, Deltares-the Netherlands, CEGIS and IWM. The prepared materials provided relevant information to the participants. Information of the approved projects were translated in Bangla language. Other information supporting the discussion are (detailed) maps of the area.

Prepare/train the group facilitators: The participants were divided in different groups according to similarities in background and profession, to provide the opportunity to all participants to express their opinion and share experiences and provide suggestions for planning for future projects. For each of the group facilitator led the group discussions and answered the questions on the investment projects and planning of these projects. Necessary preparation and training of the group facilitators were key to answer all the relevant questions and quarries of the participants on the projects.

Consultation Program: The consultation program was organized both in Rajshahi and Chatmohar, Pabna district of the NW basin. There were two sessions in each atelier/workshop. The first session was about a short description of projects proposed in BDP 2100 for the North-west region. The second session was about the recommendations/suggestions on the projects and future proposals for the NW basin provided by the participants. This program was supported by 2 touch tables and relevant maps.

Nearly 100 local experts and stakeholders worked in groups with close and interactive discussion/ consultation, shared knowledge, ideas and experience and provided suggestions or recommendations, for the development of the water resources management in their respective areas. The participants were from BWDB, BADC, DPHE, LGED, water management group or organizations, Universities, LGIs, WMOs, and NGO's and Argi processing and fisheries related companies, media, entrepreneurs of the irrigation providing by the local people through Deep tube well and Shallow tube well, etc. There was significant participation of women in this atelier of North West region.

There was a session on Meta Model at the Delta Atelier which focused on explaining the goal and functionalities of this innovative Model, as well as demonstrating the program manager, which is a tool to easily combine different projects into a program. Most of the participants could provide little input on the functionality and use of the Meta Model, as they were not usually involved in decision-making using Meta model. For example, local farmers and representatives of the civil society have little to do with a support tool to prioritize projects. The relevant professionals of the BWDB could envisage a role of the Meta Model in their decision-making process. The participants suggested to develop a user Manual for the Meta Model and translate the Meta Model theory and literature in Bengali. Furthermore, the project descriptions should be easily approachable from the dashboard.

Aside of the presentation of the Metamodel in the Delta Atelier, the MM team visited the office of BMDA, where they presented and explained the Meta Model to the BMDA officials. The BMDA was interested in the functionalities of the Meta Model. However, the BMDA is not an actor that prioritizes projects from the list of all projects under different agencies like BWDB, LGED etc. Typically, the BMDA prepared the proposals to be implemented under their mandate and sends project proposals to the Ministry of Agriculture (MoA), for further processing for approval and officials of the MoA decides which projects will be considered for implementation and approval. If the MoA agreed to include it in the Development Program, forwarded it to the Planning Commission for approval. The project is included in the Annual Development Programme (ADP) with allocation after approval of the competent authority of the government and implementation of the project then takes place.

1.4.2 Feedback and suggestions:

The overall observations(below Box), priorities of the projects (Figure 1.16) and new projects ideas (Table 1.3 and Table 1.4) suggested and presented by the Atelier groups are given below:

Text Box: Overall general observations at Rajshahi and Pabna

General Observations

- Ensure environmental impact assessment (EIA) and work on regular basis for environmental management (EMP) plan for every project.
- Capital dredging in Baral river is necessary to increase the flow of fresh water, to reduce the flood, to increase flow capacity, to increase water retention for use during dry season, to facilitate the surface water irrigation in the area, to facilitate local navigation, to improve the environment, to increase ground water recharge specially during dry season, to facilitate better wet-land management. This is a connecting river of Ganges/Padma (western side) and Jamuna river (in the eastern side). It will also recharge the groundwater of this region. Eviction of illegal occupants, encroachment and illegal structures from the river is highly recommended
- Ensure water flow and improve water retention/preservation capacity by dredging of Chiknai River, Atria River, Nondokuja River of Chalan Beel areas, this will facilitate the local navigation, ground water recharge and potentials for increase fish production (capture fisheries)
- Taking necessary initiatives to reduce river, Kahl, Beel, common water body etc encroachment, illegal occupation, construction of structures on the River, Kahl, Beel and common water body and pollution of these water bodies. Motivation/awareness building in this regard is needed.
- Stop new Deep Tube Well (DTW) construction by different agencies to stop gradual declination of Ground Water Table and create/increase water reservoir/retention capacity so that use of DTW could be compensated, reduced gradually by using more and more surface water.
- Revitalize Rivers, Khals, Beel, Pond, common water bodies by re-excavation, that could effectively use for water retention/preservation to facilitate navigation by local country boat and the retained water to be used during the dry period for irrigation and other purposes. This also facilitate the ground water recharge round the year that improving the ground water situation.
- Control/minimize use of chemical fertilizers and pesticides in agriculture, promote use of organic fertilizer and nature based solution for pest control.
- Develop and restore natural fish sanctuary for increasing fish production.
- Ensure planned irrigation instead of unplanned irrigation, expedite the use of surface water for irrigation.
- Remove all unplanned sluice gates, box culverts, inappropriate size bridge those creating drainage

General Observations

congestions and obstructing flood flow and irrigation water availability in different khal, Beel to increase freshwater flow and inland water transport/navigation facility.

- Remove all unplanned water control/water management structures constructed in Chalan Beel areas.
- Taking necessary steps for increasing ecological balance and wet-land preservation.
- Local community demanding removal of Charghat Regulator (3-V) regulator on Baral River and Atgharia Regulator (5-V, number of Vents are more, but size might not be appropriate at this site) on Bagatipara and constructing bridge over them. The BWDB informed that removal of the two regulators will not in harmony with the proper Water Management, say flood control and water retention of the area. Steps has been taken to updating or improving the capacity by increasing the number of vents and size of the vents for both the regulators, study has been conducted by the IWM in this regard so that water management of the area could be improved, and existing water management problems would be removed.
- Need for rationalization or updating of the embankments and need proper maintenance for flood control or flood management infrastructures.
- Ensure free flow of freshwater in Khals and Beels of Baral Basin, need re-excavation.
- Save Narod River from industrial pollution and unplanned urbanization, river encroachment, eviction of illegal structures and occupation.
- Ensure proper/appropriate water retention and preservation for saving Baral and Chalan Beel and all water reservoir or pond or water bodies in the area.
- Need due attention on Ground Water use for irrigation in Chalan Beel areas and need strategies for reduction on Ground Water exploration for irrigation and increase Surface Water use in irrigation and other usages like domestic and environmental purposes.
- Develop fish sanctuary, facilitate capture and culture fisheries.
- Afforestation/Plantation.
- Tourism, recreation, specially eco-tourism be an essential element/component. Attention and development are needed in this respect
- Expand Irrigation and drainage systems by pipeline
- Promote Low Lift Pump (LLP) with Solar Power/ renewable green energy arrangement

Rajshahi

CODE	PROJECT NAME	RANKING
DP 1.1	North Rajshahi Irrigation project	1
DP 1.2	Revitalization and restoration of Beel Halti (Chalan Beel)	2
DP 25.1	Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M under the North Rajshahi Irrigation with Ganges Barrage	3
DP 25.2	Development of Scheme WMOs and Agreement with Individual LLP Owners/Operators for Cost Recovery for O&M for the Mahananda Irrigation Scheme	4
DP 15.3	Barind Area Fisheries Development Project	5
CC 1.46	Managed Aquifer Recharge for Artificial Storage (MARAS) of Water to Improve Groundwater Table and Quality Conditions in Vulnerable Areas of Bangladesh.	6

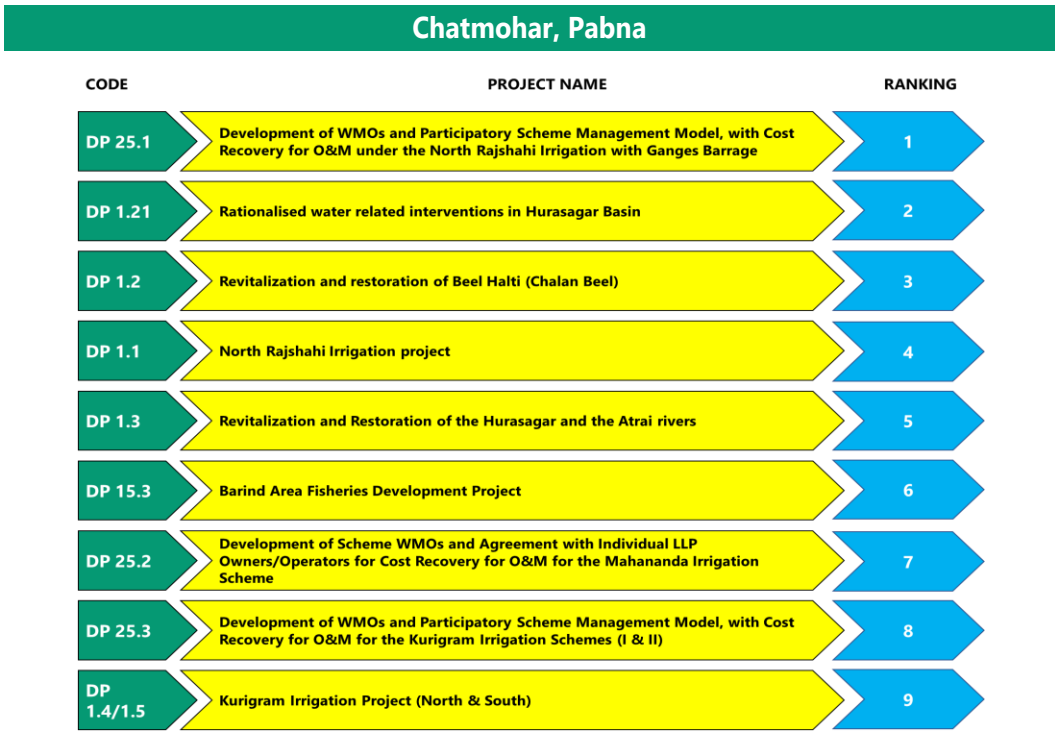


Figure 1.16: Priority of Delta Projects for the implementation in NW basin prepared by the stakeholders at Rajshahi and Chatmohar, Pabna

Table 1.3: New Project ideas developed by stakeholders at Rajshahi

Sl.	Project Name	Location	Duration	Impact
1	Provide water from Ganges/ Padma River to Barind areas for drinking, domestic use as well as irrigation purpose	Godagari, Tanore and Poba upazila of Rajshahi district	2020-2025	• Round the year irrigation using surface water • Even in the dry spell during monsoon, irrigation opportunity using surface water for the area, this area identified as the drought prone area • Much needed irrigation supply for the least rainfall area of the country • Recharge ground water • Single crop land can be increased to triple crop land, more food production • Needed for water security and food security of the area, as it is specially dry/ less rainfall area, drought stressed area of the country • Reduce ground water use with facility of more available surface water for irrigation and other usages like domestic, cattle, wild birds, bathing etc • Less cost for irrigation using surface water
2	Irrigation Project	Godagari Mohishal to	5 years	• Use of surface water for irrigation and other usages

Sl.	Project Name	Location	Duration	Impact
		Tanore Talongo Shib River		• About 60 km dredging • About 250km area covered for irrigation • Increase agricultural production • Afforestation • Ground water recharge • More opportunity for fisheries • Navigation boat transportation • Improve rural livelihood, more job opportunity at local level and more business/ trade facilities. • Improver water security and food security
3	Construction of Ganges Barrage (Padma barrage)		5 years	• Increase Use of surface water for irrigation and other purposes • Flood control • River erosion control • Improved availability of fresh water during dry season • Create facility/availability of higher water level in the Ganges/ Padma river during post monsoon and dry season, facilitate significantly increased amount of water with higher water level, more flow during dry season in the connecting rivers, distributaries. • More agricultural and fisheries production and more work generation at local level • Improve rural livelihood. • Improve food security for the region • Improve agro-fisheries industry development • Reduce use of ground water for Irrigation using surface water, much cheap alternate for irrigation • Improve Ground Water recharge in large area, entire north west and part of south west of Bangladesh • Secured dry season irrigation in the GK project and all other irrigation projects of the region. • Improve navigation • Increase fisheries, aquatic bio-diversity and wet-land conservation • Create facility of road/rail connectivity with bridge on the Barrage
4	Dredging of Joakhali River	Poba, Godagari,	3 years capital	• Increase agricultural production • Use surface water for irrigation and other

Sl.	Project Name	Location	Duration	Impact
		Tanore, and Chanduria	dredging, afterwords maintenance dredging 3/ 5years interval	usages • More crop production and more work generation at local level • Less use of ground water, more use of surface water • 300ha of agricultural land will be covered for Irrigation using surface water, less cost for irrigation • More opportunity for fisheries, aquatic bio-diversity and wet-land conservation • Navigation, boat transportation by local country boat

Table 1.4: Project ideas developed by stakeholders at Chatmohar, Pabna

Sl.	Project Name	Location	Duration	Impact
1	Development of agriculture, irrigation, ecological conservation and socioeconomic development by re-excavation of Jamuna river and protection of river bank project.	Jamuna river	In different phases, each phase 5 years, foure phases total 20 years	• Increase agricultural production • Use surface water for irrigation and other usages • More crop production and more work generation at local level • More opportunity for fisheries, aquatic bio-diversity and wet-land conservation • Navigation
2	Automation of data of rainfall, evaporation, river water level and discharge.		3 years for installation and after that, 5 years for maintenance and capacity improvement	• Improve water and flood management with more accurate and continuous data • Improve flood forecasting and warning • Improve weather forecasting and early warning • Improve accurate water resources data availability for water resources project planning (irrigation, flood control, drainage, erosion protection etc) • Improve more accurate/ realistic planning for other development projects like roads, bridges, industries, navigation etc with Max and Min water availability data, accurate rainfall and other weather related data.
3	Projects for ensuring free flow of freshwater in all the river systems of Chalan Beel.	Chalan Beel.	5 years with sustainalble maintenence plan	• Reduce flood problem • Transportation and navigation, cheap way of transportation of goods and products • Livelihood increase • Eco tourism

Sl.	Project Name	Location	Duration	Impact
				• Increase fresh water availability round the year • Increase ground water recharge round the year • Increase fisheries • Stop the ground water declination and reduce irrigation cost in the dry period
4	Project for ensuring conservation of surface water by creating reservoir on Beel, Pond, common water body.	Chalan Beel.	5 years with sustainalble maintenence plan	• Biodiversity Restoration • Transportation and navigation, cheap way transport goods and products • Livelihood increase • Eco tourism • Increase fresh water availability round • Increase ground water recharge round the year • Increase fisheries • Improve water security
5	Baral River Revitalization & Restoration project	Rajshahi-Chargat through Natore to Chatmohar, Bera, Shahjadpur.	5 years for implementation and after sustainable maintenance plan	• Water flow increase to Chalan Beel • Biodiversity Restoration • Transportation • Livelihood increase • Eco tourism • Increase fresh water availability round • Increase ground water recharge round the year • Increase fisheries • Improve water security • Eco forest
6	Barnai River Revitalization and Restoration Project	Rajshahi-Natore District	3 years for implementation and after sustainable maintenance plan	• Increase water flow, reduce flood problem • Transportation and navigation by local boats • Reduce flood problem • Biodiversity and wet-land conservation • Availability of fresh water / surface water round the year • Increase ground water recharge • More Livelihood opportunity • Eco-tourism and travel for recreation
7	Vodai River re-excavation & restoration project	Korotoya under Bogura district to Chalan Beel.	5 years for implementation and after sustainable maintenance plan	• Increase water flow • Transportation and navigation by local boats • Reduce flood problem, quick flow pass • Improve Biodiversity • Availability of fresh water / surface water round the year, specially during the dry season

Sl.	Project Name	Location	Duration	Impact
				• Increase ground water recharge • Increase agricultural and fish production • Improve food security in the area • More Livelihood opportunity with more agricultural and fish production • Eco-tourism and travel for recreation
8	Surface water retention by reservoir for Agricultural, Fisheries and livelihood increase and facilitate eco-tourism.	Chalan Beel	3 years each phas, total 5 phases	• Increase irrigation facility using surface water • To increase agricultural and fish production • More livelihood improvement opportunity, more work opportunity and more business opportunity for increased agricultural and fish production • Improve food security and water security • Improve/development of agricultural and fisheries industry, cottage industry • Improve Biodiversity • Socio economic development • Increase soil moisture in the dry season • Tourism and recreation facility development • Transportation, navigation, cheap way of goods carry • Trade hub with more business opportunity • Increase ground water recharge round the year • Stop/protect declination of ground water table and more water available for irrigation and other usages during dry season
9	Dredging of Baral, Atrai, Chiknai, and Nondokuja river	Chalan Beel Area	Capital dredging 5yrs and after maintenance dredging 3/5 years interval	• Increase water flow during flood period • Flood control and drainage improvement of the area, giving quick flow pass • Improve Transportation and navigation by local boats • Improve Biodiversity, wet-land and environmental conservation • Availability of fresh water / surface water round the year, specially during the dry season • Increase ground water recharge, help to protect and stop Ground Water declination/ scarcity during dry season • Increase agricultural and fish production • More Livelihood opportunity • Increase water security and food security • Eco-tourism and travel for recreation
10	Construction of an	Chatmohar,	Implementation	• Improve and conservation of environment

Sl.	Project Name	Location	Duration	Impact
	Eco-park at Promoth Choudhury's area in Haripur	Pabna	5yrs and sustainable maintenance plan	and bio-diversity • Improvement of livelihood of the local community from tourism • Eco-tourism and travel for recreation • Recognition and preservation of a famous writer/Laureate

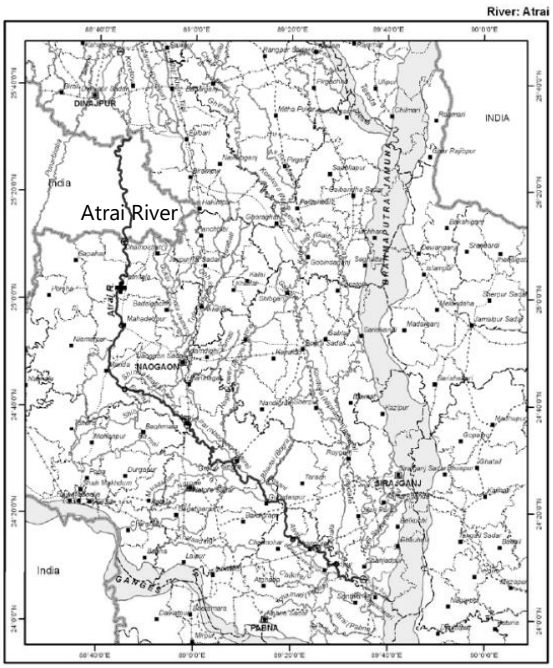
1.4.3 Field visit to Chalan Beel areas

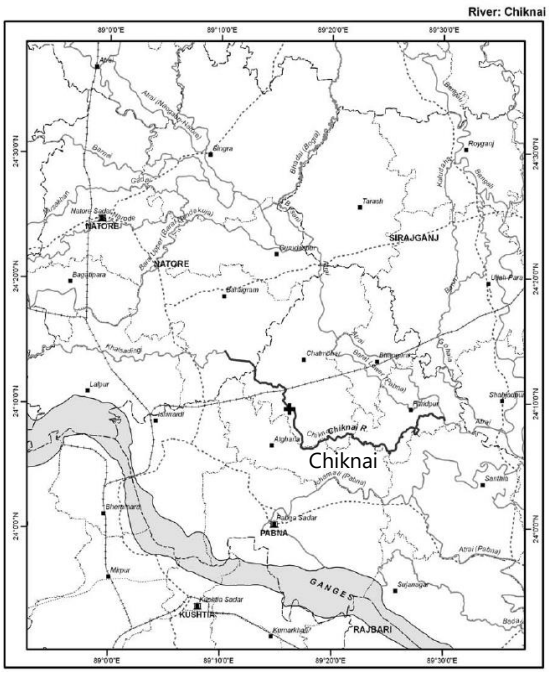
The field visits were hosted by local experts and stakeholders after workshop. The visits gave insight in the lives and livelihood of the people of the Barind area, specially in Chalan Beel areas, their unprecedented adaptive capacity to cope with floods and natural disasters. Some of the suggestion or observations made by the local people at Chalan Beel are summarized below:

- Dredging Baral river from Charghat to Hurasagor to increase the surface water flow, reduce flood problems or improve flood management, increase water retention, rain water harvesting, facilitate local navigation by local country boat, facilitate ground water recharge, increase surface water availability for irrigation, reduce ground water use for irrigation, facilitate fish sanctuary etc.
- Improve reservoir capacity, water retention capacity, in Chalan Beel areas, rationalize the flood control embankment
- Forestation/plantation
- Develop fish and bird sanctuary
- Develop Agricultural and Fishery products processing industry in Chalan Beel areas
- Giving priority for new Inland Waterways instead of constructing road.
- Establishment of small and medium cottage and weaving industries to improve the quality of life of the indigenous people
- Recover encroached land of the Chalan Beel areas

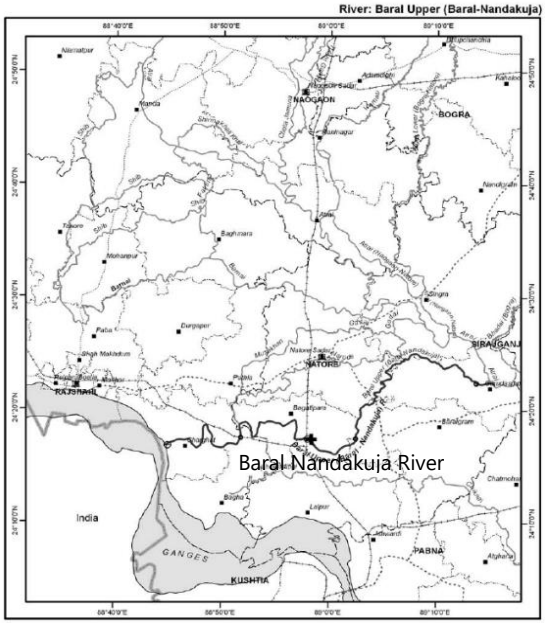
- Facilitate and awareness building for environmental preservation and protection. Administrative and punitive measures for pollution control, illegal occupation of kahla/river, water body, beel etc.
- Protect/stop garbage dumping on the river, khals.
- Facilitate use of green/solar energy for domestic and irrigation use
- Conservation of biodiversity and better wet-land management
- Increase use of surface water instead of ground water for irrigation and other usages
- Develop master plan for conservation and restoration of Chalan Beel
- Promote tourism in Chalan Beel areas
- Increase cultivated land, increase cropping intensity
- Establish fisheries research center in Chalan Beel areas
- Improve water security and food security

- Ensure Easy excess to information on water related data and information
- Improve flood and weather early warning system and improve warning dissemination for the local community, farmers.
- Enhance/strengthen the capacity of local water community or water management organisations and ensure the information sharing from the related development projects
- Participation of local stakeholders/community in the planning process
- Effective integration and coordination among the agencies working for the development of the area, specially the water related agencies and NGOs, other institutions, research and education institutions
- Develop fish bazar in Mohishluti
- Arrange alternative employment opportunity for small fisherman
- Facilitate eco-tourism and recreational tours
- Establish Chalan Beel museum development and research center
- Establish Chalan Beel research and technical university
- Declare Challan Beel as RAMSAR site
- Develop IT center/improvement of Union Digital Centers

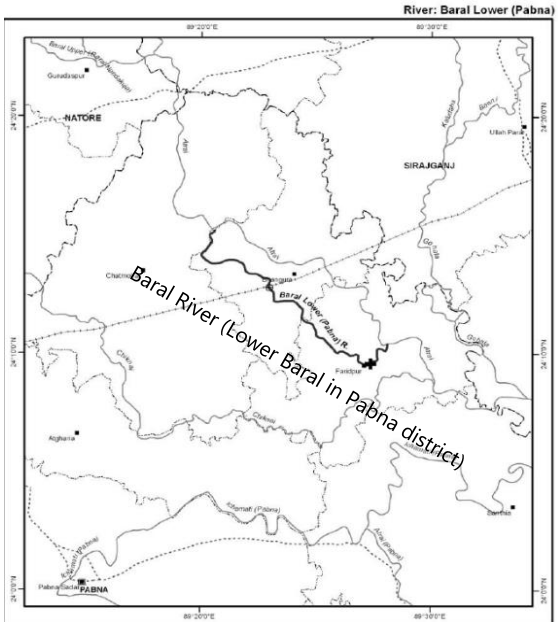




- Promote health care service by Boat.



Map – Baral Nandakuja River



Map – Baral River (lower Baral)

2 NW Flood Risk Management Programme

2.1 Floods and Drainage Congestion in the NW basin

2.1.1 Characteristics and challenges

The NW Flood Risk Management Programme (FRM) is based on the National FRM Strategy developed in the BDP2100 (Volume 1: Strategy) and builds on the analysis carried out in the NW State of the Basin Report (NW SOTB, 2021). Whereas the national FRM strategy provides general guidelines and priorities, the basin FRM programme addresses the specific needs and challenges of the basin. In a nutshell, it addresses the 3 types of flooding that exist in the NW: i) river floods, from the major (transboundary) and internal rivers; ii) rainfall floods; and iii) flash floods. Tidal floods do not occur in the basin.

The NW FRM programme is aimed at protecting existing assets, lives and livelihoods and providing the conditions for continued investment, development and prosperity. A balance is needed between safe and productive living and economic conditions, free from disruptive floods and drainage congestion, and long-term provision of key ecosystem services such as groundwater recharge, water quality and ecological connectivity. The FRM programme is therefore closely linked to wetland and beel restoration and the aim is to minimize the negative impacts of floods whilst not jeopardizing the positive impacts. The programme includes FCD infrastructure modification, redesign and flood proofing so that this infrastructure can continue to fulfil valuable socio-economic objectives. Non-structural measures like Flood Early Warning Systems (FEWS), Draught early warning, Long range (may be upto 60 days) stream flow or discharge prediction, Ground Water Table fluctuation prediction etc are crucial for better DRR. FEWS is praacting in Bangladesh, other prection or warning, multi hazard early warning system need to be introduced/initiated. Key aspects of redesign and remodeling of the existing structures are considering the multiple functions and interests and appreciating the positive impacts of flooding: crop production, replenishment of beels and wetlands, fish migration and spawning, groundwater recharge and flushing of nutrients and pollutants from the water system.

The floods are a natural feature of the low-lying delta landscape and tropical monsoon climates. The lower, south eastern part of the basin is typically most affected by floods during the monsoon when prolonged and intense rainfall coincides with high water levels in the main rivers, impeding drainage. The annual floods during the monsoon season from June to October, cover some 30% of the NW basin and land use and settlements are well adapted to this.

Abnormal or extreme floods can submerge more than 50% of the land area, damaging crops and property, disrupting economic activities and causing loss of life. Extreme floods also have cascading effects; and may plunge sharecroppers and small farmers into debt and poverty. The main causes of these, extreme floods, in the NW basin are local intense rainfall in combination with impeded drainage, breaches in the Teesta and Brahmaputra right bank embankments, breaches in internal polder embankments and drainage congestion caused by high water levels in – primarily – the Jamuna.

Extreme floods generate little benefits in the flooded area itself, especially where these coincide with breaches in e.g. the Teesta and Brahmaputra right bank embankments or breaches in internal polder embankments. Positive impacts can exist however, for farmers outside the flooded area as crop prices will increase and sales will increase. The 1998 flood is considered the most disastrous river and rainfall flood of the recent past period (1953 – 2013), flooding 68% of the country. However, for the NW, the 1987 flood is considered more disastrous, caused primarily by successive periods of exceptionally heavy rainfall over North-Western Bangladesh and adjoining parts of India. At the national level, about 50% of the flood damage of the 1998 flood was related to agriculture and nearly 40% to infrastructure. Extreme floods,

however, have little positive impacts. Extreme floods have cascading effects, plunge sharecroppers and small farmers into debt and poverty. The most recent disastrous floods in the basin (in 1987/8, 1998, and to a lesser extent 2016 and 2020) have typically been the result of the coincidence of events mentioned above. Flood peak at Bahadurabad exceeded the previous value in 2017 and 5-times flood peaks in Brahmaputra/ Jamuna in 2020 was unprecedented. Also the very late flood, 3rd week of October with extra high water level at Teesta, never happened before considering time and high water level.

In the NW, urban and rural area drainage congestion also prevails. This is caused by the combined effect of: i) decreased infiltration and increased run-off due to increased built up areas; ii) inadequate maintenance of urban and rural drainage networks; iii) siltation, waste accumulation and encroachment; and iv) insufficient drainage capacity, due to the construction of roads, embankments and other infrastructure on the floodplains without adequate provision for drainage. In addition to economic disruption, health and environmental hazards are impacts of waterlogging.

2.1.2 The impact of climate change and socio-economic development

Future developments, as described in BDP2100 scenarios, will change future flood risk in 2 main ways: i) due to population growth, urbanization and economic growth, the value and exposure in flood-prone areas will increase; ii) due to climate change, extreme rainfall and increased peak river discharges within Bangladesh and India, leading to more frequent, extensive and deeper floods and during dry season reduce flow availability in the rivers.

More specifically, events like in 1987, 1998 and 2007 are expected to occur more frequently. Such extreme events, in the current climate, occur once in every 20-50 years. In the future, they may occur twice as often due to increased monsoon rainfall. In addition to increased rainfall, changes in timing of rainfall events (in the pre-and post-monsoon) and coincidence with discharge peaks of the main rivers will have an impact flood depths and duration. As agricultural production is directly related to the flood types, as described above, climate change will have a direct impact on cropping patterns and production.

2.1.3 Application of the Bangladesh Metamodel

An analysis of the potential changes for each scenario was carried out with the Bangladesh Metamodel, presented in the table further below. The impact of economic growth is very apparent from the analysis. A simple calculation can clarify this impact. At 8% annual GDP growth, asset value doubles after 12 years, triples after 25 years and quadruples after 35 years. As flood damage is calculated by multiplying the hazard by the exposure and the vulnerability (as illustrated below), it becomes clear how increased asset value directly leads to increased flood damage.

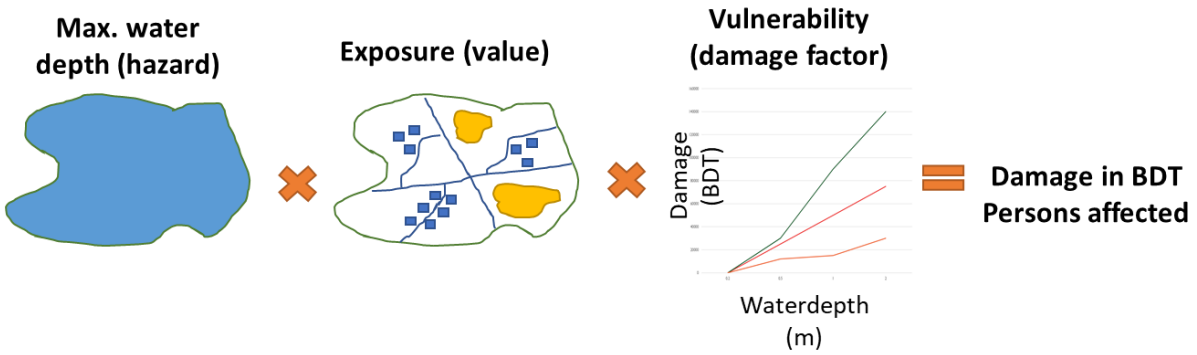


Figure 2.1: Flood damage calculation in the Bangladesh metamodel

As example, in the productive scenario – with (s)low climate change and high economic growth, the damage resulting from rainfall and river floods increases 9-fold or by 899% in 2050. The analysis with the

metamodel reveals that about 70% of that increase is due to increased exposure and vulnerability and 30% due to climate change. In contrast, for the active scenario – with high climate change and low economic growth, the flood damage increases 'only' 7-fold or by 695%.

The values for 2030 show a marked difference, mostly since, in the productive scenario, there are no climate change impacts on rainfall and river discharges yet, in 2030, whilst for the active scenario, climate change has already led to a 10% higher monsoon rainfall and 15-30% higher river peak discharges, in 2030.

These figures demonstrate that, even in the low climate change scenario, the need for enhanced food risk management in the NW basin is paramount.

Table 2.1: Scenario impacts on floods in the NW basin (Bangladesh Metamodel)

Indicator	**Unit**	**Base value***	**High CC / High EC (Resilient)**		**Low CC / Low EC (Moderate)**	
		2018, 2020	**2030**	**2050**	**2030**	**2050**
Rice production	Mtonnes / year	10.5	-9 %	-13 %	-1 %	-6 %
Damage due to river and rainfall floods	Cr. BDT / year	18,613	+237 %	+1162 %	+46 %	+490 %
Agricultural damage due to river and rainfall floods	Cr. BDT / year	28,144	+46 %	+62 %	+5 %	+30 %
Damage due to river floods	Cr. BDT / year	1,697	+804 %	+4040 %	+253 %	+1237 %
Population affected due to river and rainfall floods	People / year	1,950,126	+147 %	+196 %	+26 %	+123 %
River flood extent	ha / year	225,222	+102 %	+143 %	+52 %	+71 %
Rainfall and river flood extent	ha / year	1,550,219	+19 %	+27 %	+1 %	+13 %
Indicator	**Unit**	**Base value***	**High CC / Low EC (Active)**		**Low CC / High EC (Productive)**	
		2020	**2030**	**2050**	**2030**	**2050**
Rice production	Mtonnes / year	10.5	-9 %	-13 %	-1 %	-6 %
Damage due to river and rainfall floods	Cr. BDT / year	18,613	+214 %	+695 %	+59 %	+899 %
Agricultural damage due to river and rainfall floods	Cr. BDT / year	28,144	+46 %	+63 %	+5 %	+30 %
Damage due to river floods	Cr. BDT / year	1,697	+736 %	+2492 %	+283 %	+2185 %
Population affected due to river and rainfall floods	People / year	1,950,126	+179 %	+ 302 %	+24 %	+60 %
River flood extent	ha / year	225,222	+100 %	+141 %	+53 %	+72 %
Rainfall and river flood extent	ha / year	1,550,219	+19 %	+27 %	+1 %	+13 %

*The 'base value' was calculated using 2018 crop data and 2020 price data

2.2 NW FRM Programme Set-up

The FRM programme in the basin can be considered a basin-specific tailoring of the national FRM strategy, included in the BDP2100. Here below, the 3 objectives for the NW, similar to the national FRM strategy objectives, are first introduced. The objectives are then elaborated in an overview table including specific performance targets. Where needed, these performance targets are further explained, related to established norms or, where these norms do not exist, proposed anew. They may therefore be subject to adjustment as a result of further consultation with key public authorities.

Thereafter, the main set up is presented per FRM Objective, linking BDP2100 investment projects to each objective and, identifying additional project investments. In addition, an outline is presented on the programme organisation, key involved agencies and partners.

FRM OBJECTIVE 1: PRIORITY ECONOMIC ZONES; protecting economic strongholds and critical infrastructure, is related to: i) the existing and planned Economic Zones in the basin; ii) key urban growth centres; iii) critical roads and markets; and iv) energy infrastructure.

FRM OBJECTIVE 2: FCD RATIONALIZATION; equipping FCD schemes for the future, covers the FCD schemes in the basin, including: i) embankments along the major rivers Ganges, Jamuna (RBE) and Teesta; ii) embankments along regional rivers; and iii) FCD polders aimed at flood control and drainage.

FRM OBJECTIVE 3: VULNERABLE COMMUNITIES; safeguarding livelihoods and leaving no-one behind, is focussed on vulnerable (poor and extremely poor) communities in the Eastern districts of Kurigram and Sirajganj as well as the urban poor and sharecroppers throughout the basin. Vulnerability is caused by the lack of proper (flood-proof) housing, access to sanitation and safe drinking water, as well as alternative sources of income and timely access to relief resources during the recovery from flood events.

In the table below, the NW FRM programme objectives and performance targets are presented, derived from the BDP goals and Results Development Framework (RDF) and tailored to the specific FRM requirements for the NW basin. As mentioned in Section 1, performance targets are instrumental in basin-specific planning and assessment. Where needed, in the table below, the FRM performance targets are further explained, related to established norms or, where these norms do not exist, proposed by SIBDP. They may therefore be subject to adjustment as a result of further consultation with key public authorities.

Table 2.2: Objectives and Performance Targets Flood Risk Management Programme of NW basin

Objectives	**Performance targets**
OBJECTIVE 1: PRIORITY ECONOMIC ZONES; protecting economic strongholds and critical infrastructure	
The first objective is to minimize economic damage and disruption, at a reasonable cost, and provide a safe and predictable investment environment, now and in the future.	1) District towns (17) and Special Economic Zones (4) with flood protection standards of at least 1:100 year and drainage capacity of at least 1:5-year rainfall event, by 2030 2) Upazila towns with flood protection standards of at least 1:50 year and drainage capacity of at least 1:2-year rainfall event, by 2030 Reference: - BDP2100 Volume 1: Strategy. Flood Risk Management Strategy, page 221 - BWDB design criteria, guidelines and standards on flood protection - Design manual stormwater drainage, WASA, City corporation, Paurashava 3) Flood free access and functioning of main (rail)road network at 1:50 flood return period, by 2030, 1:100 by 2050 4) Flood free access and functioning of secondary road network at 1:50 flood return period, by 2050 Reference: - BDP2100 Volume 1: Strategy. Flood Risk Management Strategy, page 221 - RHD design criteria, guidelines and standards - LGED design criteria, guidelines and standards 5) Flood early warning system, for flood-prone priority economic zones, district towns and special economic zones, by 2025; with flood warning lead time of 7 days for locations adjacent to the major rivers, by 2030 Reference: 6) Floodplain protection zones demarcated according to approved regulations Reference: - BDP2100 Volume 1: Strategy. Flood Risk Management Strategy, page 222; Strategy for Sustainable Land Use and Spatial Planning, page 367

Objectives	Performance targets
OBJECTIVE 2: FCD(I) RATIONALIZATION; equipping FCD(I) schemes for the future (this includes all BWDB projects)	
The second objective is to rehabilitate, redesign and manage FCD(I) schemes to meet the multiple demands of today and the near future.	1) 50% of low-performing priority FCD schemes remodelled by 2030, 100% remodelled by 2050 2) 10% of investment value allocated for O&M annually, on publicly managed FCD(I) infrastructure 3) 50% of urban and economic zone FCD O&M cost contributed by urban centres and economic zones, by 2030 <u>Reference:</u> - BDP2100 Volume 1: Strategy, Flood Risk Management Strategy, page 221 and further
OBJECTIVE 3: VULNERABLE COMMUNITIES; safeguarding livelihoods and leaving no-one behind	
The third objective is to drastically reduce the vulnerability of poor households and communities to regular and extreme flooding and to enhance their resilience in recovering from these flood and erosion events.	1) Mortalities per division (# at flood return period): < 10 at 1:10 years return flood; <50 at 1:50 years return flood and <100 at1:100 years return flood, by 2030 2) Displacement of poor population due to floods (% poor and extreme poor population): <10% at 1:5years return flood; <25% at 1:25years return flood; and <50% at 1:100 years return flood, by 2030 <u>Reference:</u> - Bangladesh Vision 2041, page 39 (poverty), page 55 (mortality) 3) Non-functioning water supply and sanitation facilities (% non-functioning at flood return period): <10% at 1:5 years return flood; <25% at 1:25 years return flood; and <50% at 1:100 years return flood, by 2030 <u>Reference:</u> - National Strategy for Water Supply and Sanitation, 2014 4) Flood early warning system, at upazila and union digital centre level, by 2030 5) Rapid response and recovery system in place, for priority upazilas, by 2025, and all upazilas, by 2030 6) Introduction of Flood Preparedness Program (FPP), like CPP, for the flood prone areas for priority upazilas, by 2025, and all upazilas, by 2030. FPP consists of volunteers from the community, city development through training, could effectively reduce the DRR for flood events. 7) Capacity enhancement of Toll free mobile (no 1090) based Disaster Information Dissemination system by 2030.

2.3 NW FRM Objective 1: Priority Economic Zones

The two existing and two planned Economic Zones (EZ), as well as the (agro-) industrial areas, energy infrastructure, road and market network form the infrastructure core of the quickly modernizing economy of the NW basin. The location of the NW on the border with India, another fast-growing powerhouse in the region, creates new investment opportunities, away from the congested mega cities Dhaka and Chottagram. With an economic growth of up 7% annually, the potential flood risk (hazard x effect) therefore also increases, and economic damage doubles every 10 years. Given the importance of these priority economic areas for future development and economic modernization, the first objective is therefore:

"to minimize economic damage and disruption, at a reasonable cost, and provide a safe and predictable investment environment, now and in the future."

2.3.1 Programme organization

The priority economic zones (PEZs) programme addresses multiple sectors of both the public and private sector. The key actors are therefore highly diverse, from industry to city authorities, communication-transport agencies to key public service providers. These sectors experience rapid change and offer important innovation opportunities. Many priority economic areas designed to cope with flood events, following accepted guidelines. A flood protection system is however as strong as its weakest link and the programme aims to address those weak linkages. Moreover, with rapid industrialization and accompanying dependency on reliable energy and communication facilities, cascading effects become increasingly important. It is key to identify which infrastructure is critical and should not be allowed to fail from a social or economic point of view.

Planning, emergency management and spatial development authorities as well as the private sector have an important role to play in this programme. Given the diversity of actors and interests, programme management would be delegated to a dedicated programme management unit falling under the Ministry of Planning/ Economic Affairs/Regional Development Authority Etc.

Key partners for the Priority Economic Zone FRM programme are:

- BEZA
- RHD and LGED
- Local governments institutions, of the 2 Divisional capitals as well as the district capitals
- MPEMR
- BWDB
- DPHE

The programme and projects will be led by the respective agencies, under a coordination of the GED, IMED of the Planning Commission.

2.3.2 Need of Investment

The BDP2100 Investment Plan (Volume 2): does not include specific projects targeting priority economic zones. However, the project **DP1.3 Revitalization & restoration of Hurasagar and Atrai rivers**; includes 30 km river bank protection works along the Atrai River to protect growth-centers against erosion. For this reason, this project has linkages to the PEZ programme.

To reach the performance targets presented in Table 2.2, above, and given the present and expected future flood risks, the PEZ programme needs to address important gaps (see above in section 1 for an explanation

of the gap analysis carried out), in flood preparedness, protection, and recovery and addressing both structural and non-structural measures (holistic approach). To address these gaps, a thorough analysis is needed of the existing and future flood risks for priority economic zones, considering climate change and socio-economic scenarios (adaptive approach). Investments in industry and urban areas are substantial and highly difficult to reverse or modify once they are put in place. As the economy becomes more complex and interlinked, the multi-functional nature of communication and flood protection infrastructure becomes more important (integration), and cascading effects that go beyond the responsibility and mandate of any one agency or industry, need to be seriously considered.

Considering the gap analysis and given the importance of sound planning and the rapidly developing economy, many of the identified investment projects in the short term include (pre-)feasibility studies, climate change analysis and an assessment of the cascading effects of flood events. Putting in a multi-sectoral and local level flood early warning system, up to the level of economic zones, is also included in the short-term investment programme. The detailed technical and economic analysis mentioned here above, is part and parcel of the proposed investment projects, as laid down in newly developed *draft concept notes*, included as Annex.

Short term investment projects (including studies), up to 2030:

1) Flood proofing Priority Economic Zones in the NW region
2) Flood Early Warning System, for economic zones and other priority areas
3) Climate-resilient national roads
4) Climate resilient regional roads
5) Identification of floodplain protection zones, including demarcation zones and regulations
6) Flood proofing urban critical infrastructure and District capitals
7) DP 1.3 Revitalization & restoration of Hurasagar & Atrai rivers

Medium term investment projects, up to 2050:

- Flood proofing energy grid

A preliminary planning has been developed for this FRM Programme Objective, included below. In addition, an MCA was carried out, included as table thereafter. Metamodel analysis has been carried out for the proposed investment project **DP 1.3** Revitalization & restoration of Hurasagar & Atrai rivers, as included in the BDP Investment Plan., the results of which are presented in the Annex, drawn from JCP Technical Report 1: North-West Region results Bangladesh Metamodel (JCP, 2021).

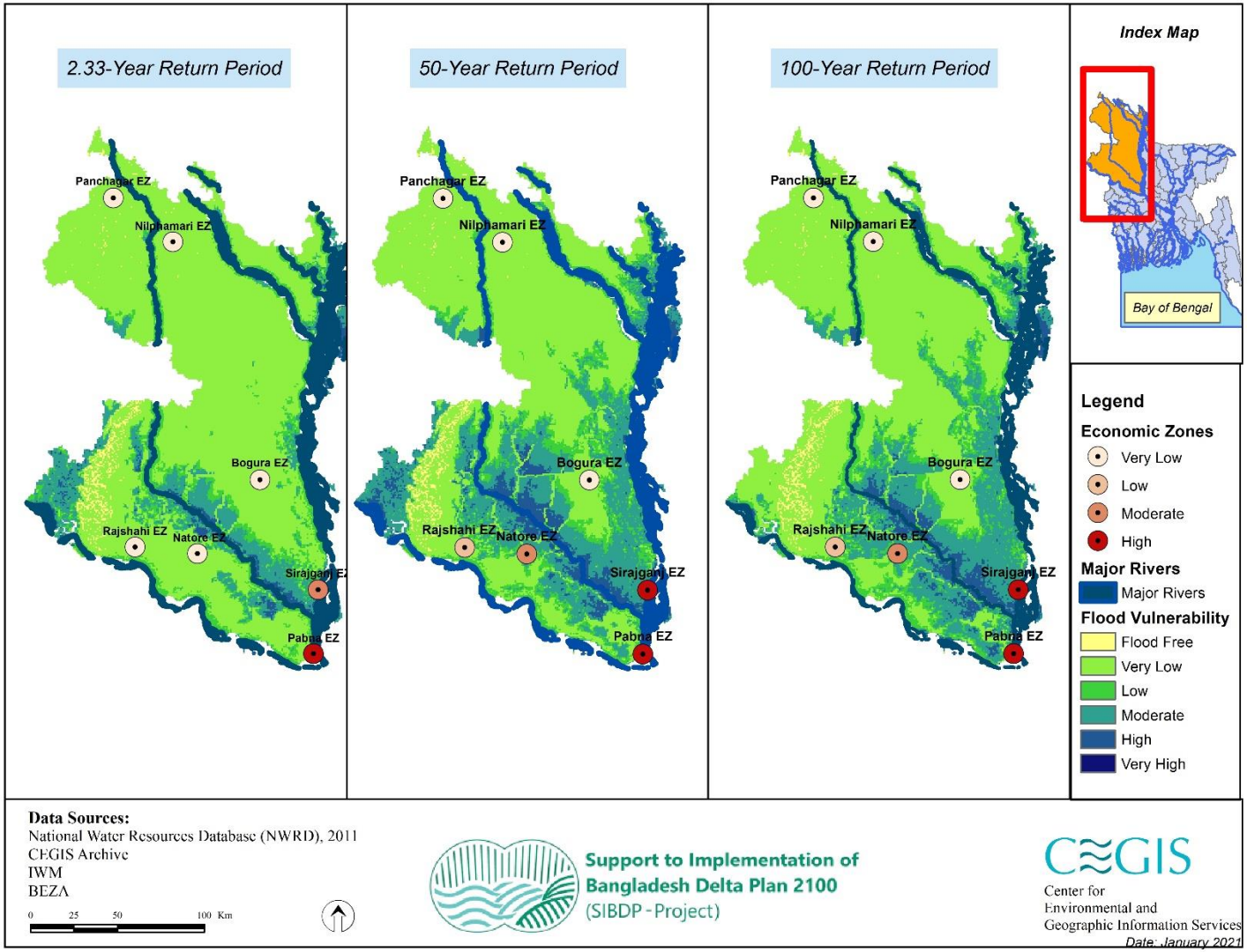


Figure 2.2: Flood vulnerability of economic zone sites in the North-West region

ID	Task Name
1	**NW IP: PRIORITY ECONOMIC ZONES**
2	**1. Flood proofing Priority Economic Zones in the NW region**
3	Hazard analysis of existing and proposed EZ
4	Proritization of flood proofing interventions
5	Draft guideline for FRM and EZ
6	Implementation
7	Monitoring
8	Approved guidelines for FRM and EZ
9	**2. Climate-resilient roads**
10	Hazard analysis for national and main regional roads
11	Proritization of flood proofing interventions
12	Draft guideline for FRM and roads
13	**Implementation**
14	National roads
15	Monitoring
16	Main regional roads
17	Monitoring
18	Approved guidelines for FRM and roads
19	**3. Flood early warning system, for economic zones and other priority areas**
20	Identification pf priority areas
21	FEWS installation and upgrading
22	**4.Floodplain protection zoning, including regulations**
23	Updated flood hazard maps
24	Draft floodplain protection zone designation and regulations
25	Approval designation and regulations
26	Implementation floodplain protection zone controls and measures
27	**5. Flood proofing urban critical infrastructure District capitals**
28	Hazard analysis of urban critical infrastructure District capitals
29	Proritization of flood proofing interventions
30	Draft and final guideline for FRM and urban critical infrastructure
31	Implementation
32	Monitoring
33	**NW IP: FCD RATIONALIZATION**
64	**NW IP: VULNERABLE COMMUNITIES**

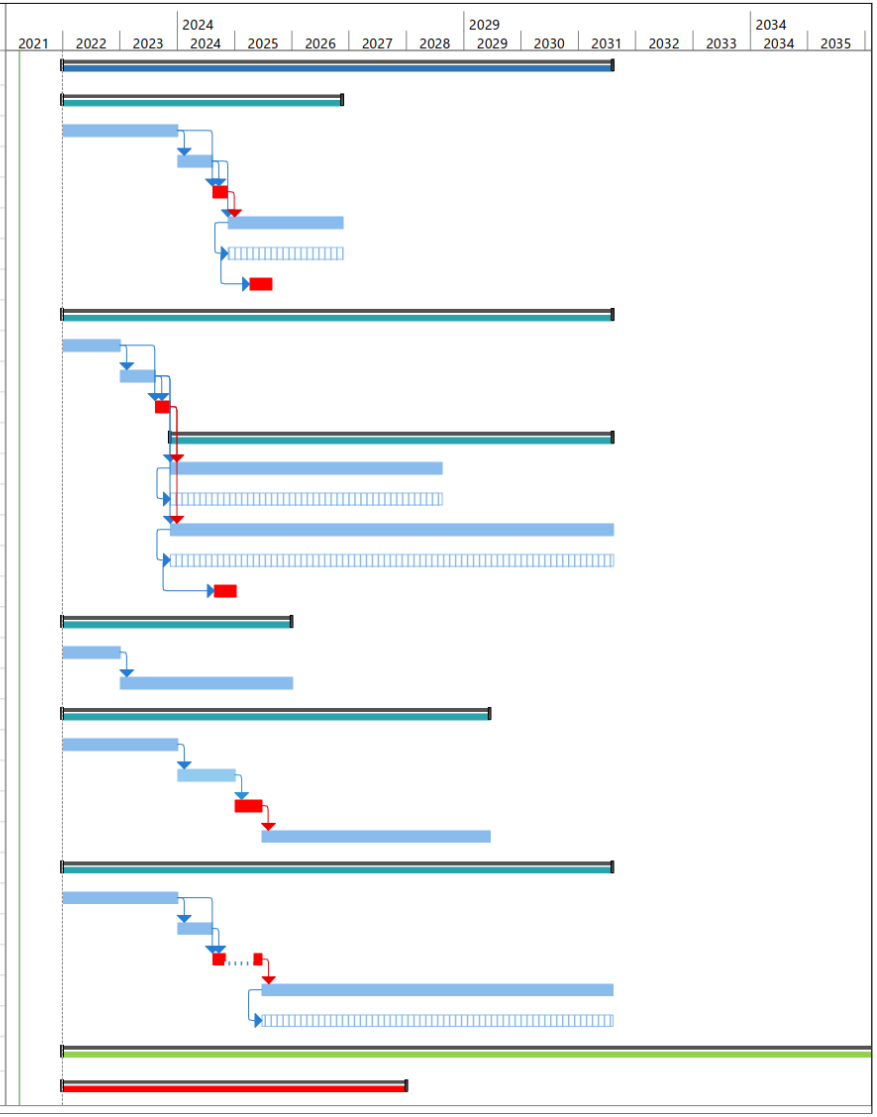


Figure 2.3: Implementation schedule FRM Programme Objective 1: Priority Economic Zones

Table 2.3: MCA FRM Programme Objective 1: Priority Economic Zones

Flood Risk Management Programme Objective 1: Priority Economic Zones

		Criteria												
		Relation to Bangladesh Delta Plan 2100 Goals										Poverty Reduction	Implementation feasibility	
		Goal 1		Goal 2					Goal 4		Goal 5			
Project Code	Project Name	Flood Damage	Affected Population from floods	Food security	Rice production	Fish production	Sustainable groundwater	Access to safe drinking water	Water quality	Ecosystems services	Capacity development	Poverty Reduction	Implementation readiness	Potential financing
NEW	**Flood profing Priority Economic Zones in the NW region**	3	0	0	0	0	0	0	1	1	1	2	1	2
NEW	**Flood early warning system, for economic zones and other priority areas**	1	0	0	0	0	0	0	0	0	1	0	1	2
NEW	**Climate-resilient main roads**	1	2	1	0	0	0	0	1	1	1	2	3	3
NEW	**Climate resilient regional roads**	2	3	1	0	0	0	0	1	1	1	2	1	3
NEW	**Identification of floodplain protection zones, including demarcation zones and regulations**	3	3	-1	-1	2	1	0	1	3	0	-2	-1	-2
NEW	**Flood proofing urban critical infrastructure and District capitals**	3	3	1	0	0	0	1	0	0	0	0	-1	-1
DP 1.3	**Revitalization & restoration of Hurasagar & Atrai rivers**	2	1	0	1	1	0	0	1	1	0	0	1	1

** NEW = Newly Developed*
** EXIST = Existing Concept Note, not included in the BDP2100 Investment Plan*

Legend
-3 Major Negative Impact
-2 Moderate Negative Impact
-1 Minor Negative Impact
0 No Impact
1 Minor Positive Impact
2 Moderate Positive Impact
3 Major Positive Impact

Support to Implementation of Bangladesh Delta Plan 2100 (SIBDP)
Kingdom of the Netherlands

2.4 NW FRM Objective 2: FCD(I) Rationalization

The FCD infrastructure forms the backbone of the (agriculture) flood protection system in the Northwest. This includes the i) Right Bank Embankment (RBE) of the Jamuna river and embankments along regional rivers such as the Teesta, Dharla and Dudhkumar; and ii) FCD(I) polders throughout the basin, developed by BWDB since 1960's and LGED in small projects upto 1000 ha command area from the middle of 1980's onwards. Embankment also provide good means of communication, road. The Brahmaputra Right Embankment (BRE) has several 'weak linkages' with an increased risk of breaching and, in the case of extreme floods, altering of the course of the main Jamuna river. Moreover, important towns are protected by the BRE, of which Bogura Sirajganj, Gaibandha etc. are prominent. The FCD(I) projects and few polders (only four in number in Naogaon) , in general, have not been modified over the last 20-30 years to adapt to the changing socio-economic and physical environment. Many projects have also been adversely affected due to river bank erosion. The most important changes include erosion, river and water body siltation, urbanization and population growth. Updating and rationalization of the projects is also needed due to Urbanization, increase of pved area, new roads/water divides – that changed the catchment boundaries etc.

Moreover, there is an increased realization that environmental aspects such as ecology and water quality need to be included in FCD(I) design and operation, for existing and new schemes. It has also been realized for some time now that governance, participation and a stable financing of FCD(I) scheme O&M are key to improving scheme performance. The Participatory Water Management (PWM) and cost recovery are therefore part and parcel of the FCD(I) rationalization objective. Consequently, to address these challenges, the second objective is:

"to rehabilitate, redesign and manage FCD schemes to meet the multiple demands of today and the near future."

Metrics for FCDI scheme performance

Clear metrics for FCD(I) scheme performance do not yet exist. It is therefore not easy to identify priority actions based on the gap between actual and target performance. Although metrics may differ between FCD(I) scheme due to different needs and conditions, general metrics can be identified, as proposed here below. These include both protected areas – inside the FCDI scheme as well as unprotected areas – outside but affected by the FCDI schemes:

- Flood depths/duration relative to comparable non-FCD(I) areas
- Productivity in kg-BDT / area, relative to comparable unprotected areas, for key economic sectors such as fisheries and agriculture
- Damage to infrastructure and industrial production, relative to comparable unprotected areas
- O&M investment compared to need
- Equitable distribution of benefits
- Change in the above metrics (flood extent, damage and productivity) for unprotected areas affected by FCD(I) schemes

2.4.1 Programme organization

Many of the FCD(I) schemes in the NW were developed by the BWDB and LGED, with the BWDB focusing on schemes > 1000 ha and LGED on schemes < 1000 as per Government of Bangladesh policy. It seems logical that both organisations take the lead on FCD(I) rationalization of their 'own' schemes.

Within the LGED-led Small-Scale Water Resources Development Project (SSWRDP), in different phases, a rationalization / upgrading component is included, with the aim of adapting and upgrading FCD(I) schemes and following PWM principles. Important experience and lessons have been gained from this project.

BWDB activities on FCD(I) development in the NW have been limited in recent years, and mostly focussing on emergency interventions aimed at flood protection, after an intensive development effort before 2000[10].

Given the holistic, adaptive and integrated BDP2100 approach, all BDP implementation programme should address multiple socio-economic sectors (integrated), interests and actors. A medium- and long-time horizon is adopted (adaptive) and the influence of the scheme on the areas outside the scheme should also be considered (holistic). Key partners for the FCD(I) rationalization programme are:

Lead:

- BWDB
- LGED
- Water Management Organizations (WMOs)

Contributing:

- DAE and BADC
- DoF and DoE
- BMDA
- NGOs
- Contractors and engineering consultants, as well as design and implementation consultants
- Knowledge institutes IWM, CEGIS, BARI, BRRI, RRI, SRDI and NW based universities (Rajshahi, Rangpur, Dinajpur etc)

Given that an upgrading component is already in place as part of the LGED-led SSWRDP, the implementation programme under BDP2100 will focus on the BWDB constructed schemes. The programme and projects will be led by the respective agencies, under a coordination of the GED, IMED of the Planning Commission. Separate DPP's will be developed for each of the involved partners, to ensure their sustained involvement.

2.4.2 Investment needs and projects

In the BDP2100, two investment projects were identified that address the FCDI rationalization objective: **DP1.2** Revitalization and restoration of Beel Halti, and **DP1.21** Implementation of rationalized water related interventions in Hurasagar Basin, with the latter being more of an area-based programme including a number of specific projects. With a view to sustainable scheme development, operation and maintenance, investments need to be accompanied by a sound institutional approach, training and capacity development. PWM and cost recovery are therefore part and parcel of all FCDI rationalization projects. Considering the gap analysis and metrics for FCDI performance outlined above, the short term programme includes a prioritization of investment needs and actions, including Cost Benefit Analysis (CBA) for each scheme or set of schemes, based on the performance metrics and with a view to reach the performance targets for the NW.

[10] For an overview of FCD(I) schemes developed by the BWDB in the NW, see the BDP2100 Baseline Study on Water Resources, 2018

In addition to the two investment projects above, there are strong linkages to the investment projects **DP 1.3** Revitalization & restoration of Hurasagar & Atrai rivers; and **CC 1.43** Revitalization of Khals all over the country.

Two additional projects, not included in the BDP Investment Plan, and proposed by the DoF and LGED, were also assessed during the development of this BDP2100 Implementation Programme:

- Fisheries Resource Management and socio-economic development of the Fisher's in Chalan Beel Project, proposed by DoF
- Chalan Beel Infrastructure and Livelihood Improvement Project, proposed by LGED

Short and medium-term investment projects (including studies), up to 2040:

Based on the gap analysis carried out and with a view to integrated, adaptive and holistic development, the above stand-alone projects were integrated into 2 larger and integrated programmes, under this FRM Objective 2: **DP1.21** Implementation of rationalized water related interventions in Hurasagar Basin; and the integrated programme for the development of Chalan Beel. The latter is basically part of Objective 2 of the NW Environment and Ecosystems Programme, in view of the many environment-related aspects. It is also included here in view of the important linkages to the FRM programme.

1) **DP1.21** Implementation of rationalized water related interventions in **Hurasagar Basin**. Although the programme has already been included in the BDP2100 Investment Plan, a preparatory phase is needed to detail and develop the programme further. A detailed classification, prioritization and identification of investment needs for the investment project FCDI schemes in the basin is proposed as starting point, including CBA, institutions, cost recovery, climate adaptation, and performance monitoring, leading to a prioritized list of FCDI rationalization projects for the immediate short term (up to 2025), short-medium term (up to 2035) and long term (up to 2050) along with a portfolio of priority interventions for each scheme.
2) Integrated Development and Restoration Programme **(IDRP)** for **Chalan Beel**, A long term, adaptive, holistic and integrated development programme for Chalan Beel, building on and adapting project proposals already developed on fisheries, flood protection and road development, and without excluding other emerging proposals. A draft Concept Note has been prepared for the programme, included in the Annex. As indicated above, this new programme incorporates and integrates the stand-alone projects: **DP1.2** Revitalization and restoration of Beel Halti; part of the project **DP 1.3** Revitalization & restoration of Hurasagar & Atrai rivers; relevant actions for Chalan beel of the project **CC 1.43** Revitalization of Khals all over the country; as well as 2 projects that were not included in the BDP Investment Plan: Fisheries Resource Management and socio-economic development of the Fisher's in Chalan Beel Project, proposed by DoF, and Chalan Beel Infrastructure and Livelihood Improvement Project, proposed by LGED. Two phases are proposed for IDRP Chalan beel; a first phase until 2030 and a second phased up to 2040.

Concept notes have been prepared for these investment projects, included in the Annex.

To support implementation, a cross-cutting project is the support to the **development of an updated FCDI design manual and guidelines**, considering lessons learnt, technology development, ecosystem impacts, future O&M needs and arrangements and stakeholder participation and management. This update is not necessarily specific for the NW and builds of experience in FCDI development projects such as the Blue Gold Programme (BGP) in the South West-Central coastal region, the Char Development and Settlement Project (CDSP) in Noakhali and the SSWRDP.

In terms of implementation approach, there are important linkages with the new irrigation development investments proposed in the Water for Agriculture (W4A) programme, such as 'Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M', for the North Rajshahi Irrigation Project (**DP 25.1**), the Mahananda Irrigation Scheme (**DP 25.2**) and the Kurigram Irrigation Schemes (I & II) (**DP 25.3**).

ID	Task Name
1	**NW IP: PRIORITY ECONOMIC ZONES**
33	**NW IP: FCD RATIONALIZATION**
34	**1. Revitalization and Restoration of Chalan Beel**
35	**detailed feasibility study**
36	review existing project propsoals BWDB, LGED and DoF
37	draw lessons learnt from past interventions
38	formulate and assess intervention options
39	**develop draft Integrated Development and Restoration Programme (IDRP) for Chalan Beel**
40	define programme objectives and outputs
41	set up progamme governance
42	draw up planning and budget
43	define Terms of Reference for phase 1
44	approval phase 1
45	**IDRP phase 1**
46	inception and detailed planning
47	implementation
48	monitoring and adaptation
49	formulation of phase 2
50	approval phase 2
51	**IDRP phase 2**
52	inception and detailed planning
53	implementation
54	monitoring and adaptation
55	**2. Rationalized water related interventions in Hurasagar Basin**
56	**detailed feasibility study**
57	review existing project propsoals BWDB, LGED and DoF
58	draw lessons learnt from past interventions
59	formulate and assess intervention options
60	**develop intervention programme**
61	define programme objectives and outputs
62	set up progamme governance
63	draw up planning and budget
64	**NW IP: VULNERABLE COMMUNITIES**

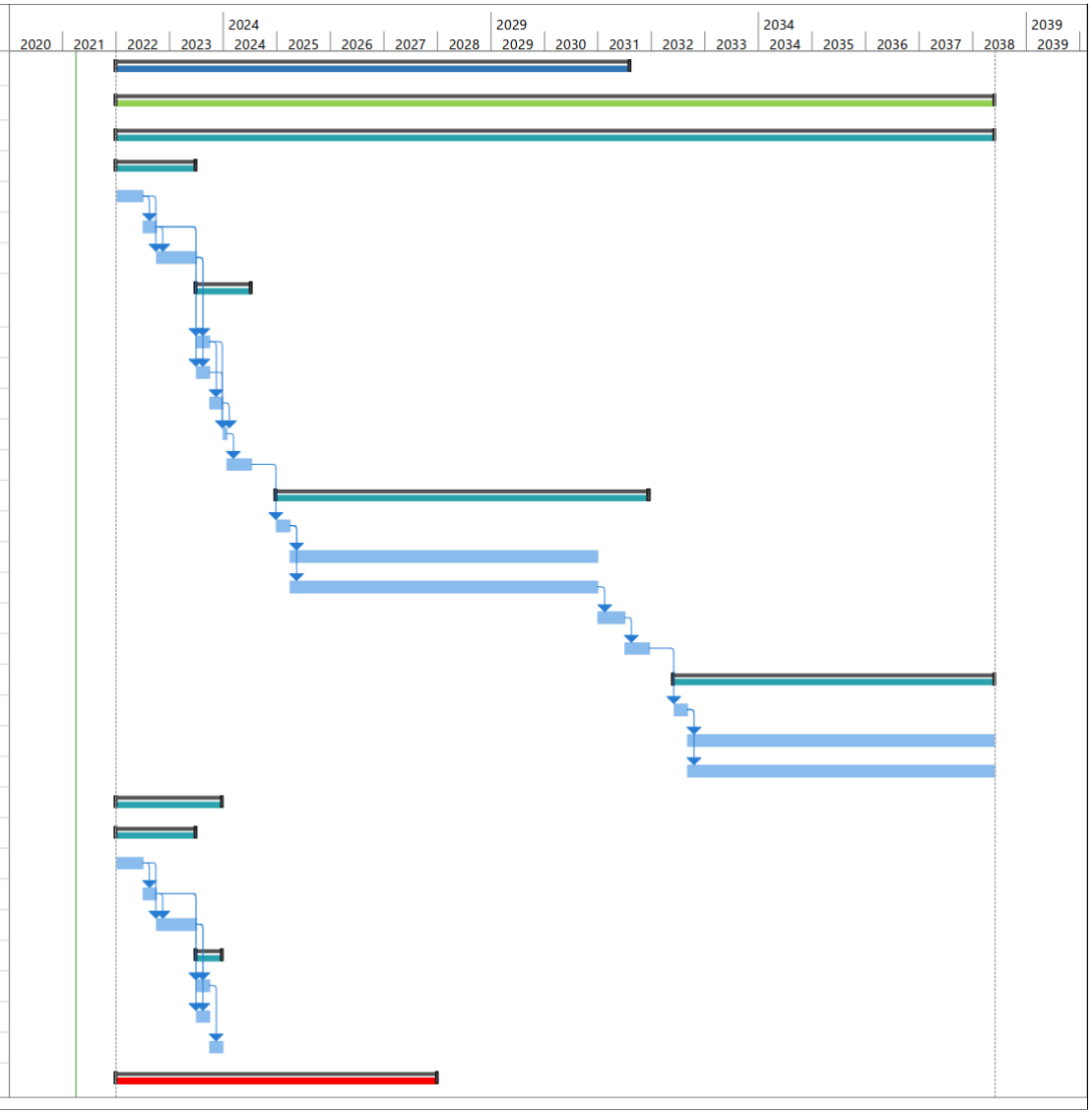


Figure 2.4: Implementation schedule FRM Programme Objective 2: FCD Rationalization

Table 2.4: MCA FRM Programme Objective 2: FCD Rationalization

Flood Risk Management Programme Objective 2: FCD Rationalization

		Criteria												
		Relation to Bangladesh Delta Plan 2100 Goals										Poverty Reduction	Implementation feasibility	
		Goal 1		Goal 2					Goal 4		Goal 5			
Project Code	Project Name	Flood Damage	Affected Population from floods	Food security	Rice production	Fish production	Sustainable groundwater	Access to safe drinking water	Water quality	Ecosystems services	Capacity development	Poverty Reduction	Implementation readiness	Potential financing
DP 1.2	Integrated Development and Restoration Programme Chalan Beel	3	3	2	0	2	0	0	2	3	2	1	1	2
DP 1.21	Rationalized water related interventions in Hurasagar Basin	0	0	0	0	0	0	0	0	0	3	0	2	2

** NEW = Newly Developed*

** EXIST = Existing Concenpt Note, not included in the BDP2100 Investment Plan*

Legend

-3	Major Negative Impact
-2	Moderate Negative Impact
-1	Minor Negative Impact
0	No Impact
1	Minor Positive Impact
2	Moderate Positive Impact
3	Major Positive Impact

2.5 NW FRM Objective 3: Vulnerable Communities

Some of the poorest districts of the country are in the NW basin, in the Eastern districts of Kurigram and Sirajganj. The poor and extreme poor also include the urban poor and sharecroppers throughout the basin. Extreme floods, as well as river erosion, have cascading effects, with land and crop loss plunging sharecroppers and small farmers into debt and poverty. Vulnerability is caused by the lack of proper (flood-proof) housing and transport infrastructure, access to sanitation, health and safe drinking water, as well as the lack of alternative sources of income and timely access to relief resources during the recovery from flood events. As investments in FCD and economic zone development may not reach these poor and vulnerable communities, the third objective of the FRM programme is:

"to drastically reduce the vulnerability of poor households and communities to regular and extreme flooding and to enhance their resilience in recovering from these flood events."

2.5.1 Programme organization

Such a targeted programme needs a focussed and multidisciplinary approach, to ensure that the benefits materialise for the poor, many of which are in the hard to reach areas of the basin. Key agencies include the Department of Public Health Engineering (DPHE), LGED and the Department of Disaster Management (DDM), alog with NGOs and other disaster relief and recovery agencies/communities. Local governments are keenly aware of the conditions in their area and it seems logical that they are closely involved in programming, monitoring and implementation of the Vulnerable Communities programme. Separate DPPs will be developed with implementing agencies for the specific projects.

2.5.2 Investment needs and projects

The BDP2100 Investment Plan does not include specific projects directly benefitting g vulnerable communities or the poor. However, the Water Supply and Sanitation programme for the NW includes important investments which have direct benefits for the poor and extreme poor, including a proposed project on flood proofing water supply and sanitation facilities. The Kurigram Irrigation Project (**DP 1.4** and **1.5**) is another example, included in the Water for Agriculture (W4A) programme. The thrust of this programme is therefore ensuring that pro-poor investments are included in other programmes, rather than developing a large stand-alone programme. DAE and research systems need to introduce dry season improved crops suitable for water stressed areas targeting the poor and ultra-poor living in the char area. DAE and BADC need to concnetra on the irrigation efficiency, say for paddy alternate wet and dry (AWD) method of irrigation. Nevertheless, the following projects have been identified under this programme, for which concept notes were developed, included in the Annex.

1) Multi hazard early warning such as Flood early warning system, drought early warning, ground water table fluctuation prediction etc tailored to vulnerable communities and focussed on upazilas with a high poverty rate. The early warning also nned to be utilised the respective agencies for planning on DRR
2) Expand flood proofing low-cost housing, services (education, health) and evacuation infrastructure
3) Flood insurance schemes for poor communities, for which a concept note has been developed
4) Development of Flood Preparedness Program (FPP) with local/community volunteers, like Cyclone Prepardeness Program (CPP), for better DRR

ID	Task Name
1	**NW IP: PRIORITY ECONOMIC ZONES**
2	**1. Flood proofing Priority Economic Zones in the NW region**
9	**2. Climate-resilient roads**
19	**3. Flood early warning system, for economic zones and other priority areas**
22	**4.Floodplain protection zoning, including regulations**
27	**5. Flood proofing urban critical infrastructure District capitals**
33	**NW IP: FCD RATIONALIZATION**
34	**1. Revitalization and Restoration of Chalan Beel**
55	**2. Rationalized water related interventions in Hurasagar Basin**
64	**NW IP: VULNERABLE COMMUNITIES**
65	**1. Flood insurance scheme for flood vulnerable poor**
66	Needs analysis poor communities
67	Review national and international best practice
68	Develop pilot insurance scheme in selected Upazilas
69	Upscaling plan flood insurance scheme to the NW
70	Upscale flood insurance to the whole NW
71	Monitoring and adjustment
72	**2. Flood early warning system for vulnerable communities**
73	Development and testing of a community based Flood Early Warning System
74	Installation of the FEWS to reach priority/poor communities
75	Training for local authorities and communities
76	Maintenance and repair
77	**3. Investment programme for flood proofing low-cost housing and services in poor communities**
78	Identify priority needs and areas
79	Develop investment programme
80	Implementation and monitoring

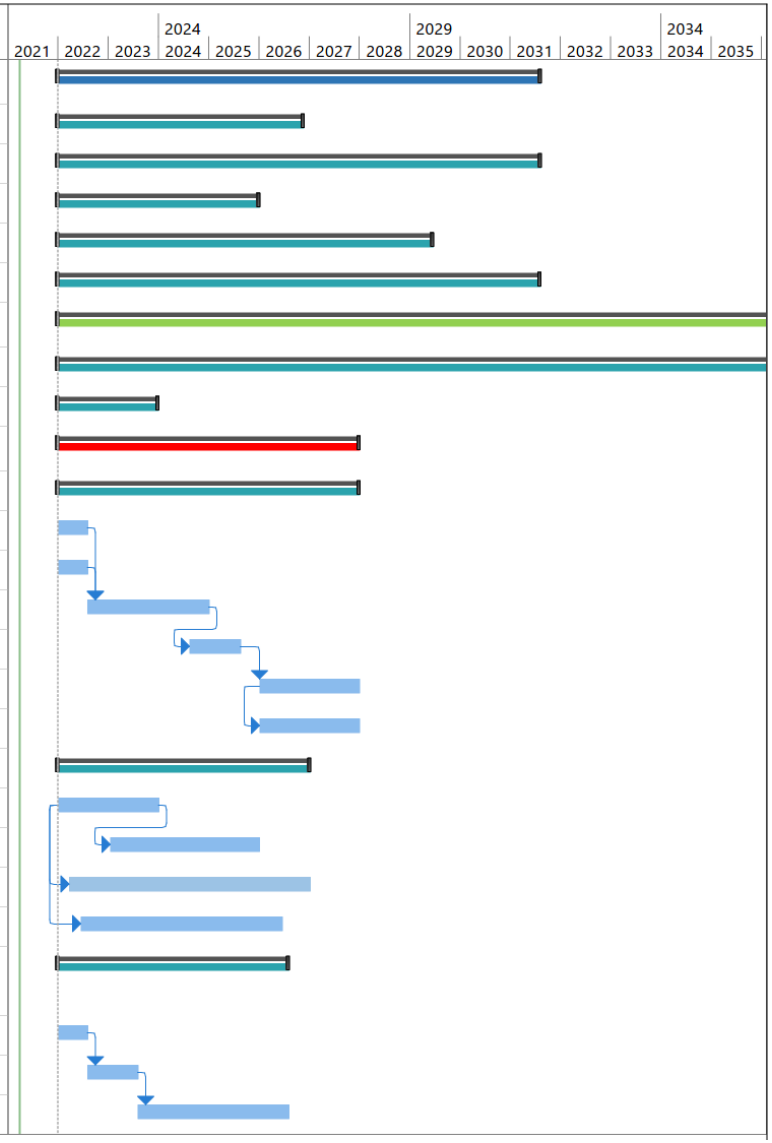


Figure 2.5: Implementation schedule FRM Programme Objective 3: Vulnerable Communities

Table 2.5: MCA FRM Programme Objective 3: Vulnerable Communities

		Relation to Bangladesh Delta Plan 2100 Goals												
		Goal 1		Goal 2					Goal 4		Goal 5	Poverty Reduction	Implementation feasibility	
Project Code	Project Name	Flood Damage	Affected Population from floods	Food security	Rice production	Fish production	Sustainable groundwater	Access to safe drinking water	Water quality	Ecosystems services	Capacity development	Poverty Reduction	Implementation readiness	Potential financing
NEW	**Flood insurance scheme for flood vulnerable poor**	2	2	2	0	0	0	0	0	0	1	-1	0	1
NEW	**Flood early warning system, for vulnerable communities**	1	3	0	0	0	0	0	0	0	1	3	1	2
NEW	**Investment programme for flood proofing low-cost housing and services in poor communities**	1	3	0	0	0	0	0	0	0	1	3	1	1

** NEW = Newly Developed*

** EXIST = Existing Concenpt Note, not included in the BDP2100 Investment Plan*

Legend

-3 Major Negative Impact
-2 Moderate Negative Impact
-1 Minor Negative Impact
0 No Impact
1 Minor Positive Impact
2 Moderate Positive Impact
3 Major Positive Impact

3 NW Water for Agriculture Programme

3.1 Introduction and Objectives

key challenges and opportunities

The NW basin covers the Drought Hotspot of the Bangladesh Delta Plan (BDP2100, 2018) and coincides with the NorthWest Hydrological Region as identified in the National Water Management Plan (NWMP, 2004). In the basin, agriculture is a key economic sector. Optimal growing conditions, proximity to markets and production resources, as well ample availability of irrigation supplies, have all contributed to the basin being considered the 'rice bowl of Bangladesh'. 55% of Boro production originates from the basin. Agriculture is particularly vulnerable to climate variability and change, and the NW basin is a prime example of that vulnerability.

Droughts, more than floods, and subsequent massive crop failure, are a major cause for famine and impoverishment in Bangladesh. The famine in 1974 was was partly caused by the 1973 drought. Since 1960, large scale drought, leading to famines, has occurred in 12 distinct years. Drought is most profound in the North West region (WARPO, 2001), with an average occurrence of once in 2.5 years (Hossain 1990, and Adnan 1993).

For this reason, the Barind area in the NW was defined as the drought prone area Hotspot in the BDP2100, representative of other drought affected areas in Bangladesh such as the South Western Coastal area. Following the definition of drought in Bangladesh, expressed as 10 consecutive days without rainfall and 20 consecutive days without rainfall as severe drought, some 50% of the basin is affected by drought. Severe drought occurs in the high Barind in Rajshahi division, in Natore, Bogra, Thakurgoan Districts, and pockets in the South Western part of Rangpur division.

Three major drought types occur in the NW basin: meteorological, agricultural and hydrological drought. Agricultural drought is observed from decreased production or crop failure whilst hydrological drought is observed in reduced or absent dry season flows and a sharp decrease in the extent of wetlands in the dry season. Perennial river flows are present in the major regional river systems, but many of the minor rivers lack sufficient environmental flows in the dry period. The abstraction of ground- and surface water for agricultural production, a prominent feature in the NW basin in the dry season, has had further impacts on the decrease in stream flows and wetland extent. The case of Chalan beel is exemplary, where the combined effect of decreased dry season flow and the development of embankments and roads inside the beel area, has led to a dramatic decrease of the beel area over the last 30 years.

Although drought occurs particularly in the winter Rabi season, pre-monsoon (pre-Kharif) and monsoon (Kharif) drought can be severely damaging to crops. Although the lack of rainfall is a key cause, the low moisture holding capacity of most of the soils is an additional factor in explaining drought impacts in the Barind. An additional factor is the timing and reliability of the onset of the monsoon or Kharif 1 season. In the case of non-irrigated rice, the dominant crop in the Kharif season, crop failures may occur due to the variability of the early season rainfall, in April and May, where early rainfall can be interrupted by drought. Such a dry spell can also occur during the main growing – monsoon – season and these droughts are typically referred to as 'monsoon droughts'. Drought and food security are not always directly linked.

The agriculture sector is also vulnerable to *the rapid decline of the groundwater table* in the Barind. In the state of the basin report, the causes and impacts of this decline have been analyzed, resulting from decades of intensive groundwater exploitation for irrigation. Groundwater decline has had negative impacts on

environmental flows in regional rivers as well as the obvious direct availability of groundwater resources for water supply and irrigation. The percentage of wells with a declining year-round water table is 81% for the short-term trend (2000 – 2010) and 60% for the long-term trend (1985 – 2010) (CSIRO, 2014). Two important factors contribute to this trend: a relatively low rate of recharge and a very high abstraction rate. A recent questionnaire among farmers also revealed that 73% realizes that the groundwater depth is decreasing in their agricultural fields.

BDP2100 strategies: Agriculture and Freshwater

Against this background, a dedicated implementation programme has been developed for Water for Agriculture (W4A) in the basin within BDP2100.

The W4A implementation programme supports the National Agriculture Strategy in the BDP2100 (Volume 1: Strategy, p379 and further). This strategy is highly relevant for the NW as core rice producing region of the country. Important challenges such as groundwater decline, and surface water pollution are directly related to the agriculture sector. In addition, the sector is vulnerable to both floods and droughts in the NW.

Key actions that are relevant for the NW that are included in the BDP2100 Agriculture Strategy include: i) improving crop varieties, enhancing irrigation and soil husbandry practices for climate resilience; ii) improving fish and livestock breeds and practices; iii) crop and diet diversification; iv) developing peri-urban food systems; and v) enhancing agro-processing and value addition.

Improving water security is also a key part of the national Freshwater Strategy of the BDP2100. Specific objectives of the national freshwater strategy are: i) water availability: balancing water supply and demand for sustainable growth; and ii) water quality: maintaining water quality for health, livelihoods and ecosystems. For the W4A programme of the NW, especially the first objective of the national freshwater strategy is relevant, including two sub-strategies[11].

- Sub-strategy 1.1: Supply management and additional irrigation

Where adequate water resources exist or can be developed, from the Ganges and regional rivers, this sub-strategy is geared towards providing additional irrigation water for sustainable and inclusive growth. The key beneficiary of this sub-strategy is the agriculture sector and, where valuable groundwater supplies can be substituted by surface water resources, benefitting the environment, and water supply and industry sectors. Sustainable operation & maintenance of irrigation systems is a particularly essential feature of this sub-strategy. Additional interventions include locally diversified solutions such as soil and water conservation and small-scale water retention.

- Sub-strategy 1.2: Demand management and efficient water use

This sub-strategy is aimed at reducing the demand for freshwater, for those areas where additional water resources cannot be (economically) developed or where more urgent socio-economic priorities such as safe water supply, industry, ecology or navigation receive a higher priority. A mix of interventions is included, consisting of less water consuming crops, more efficient irrigation and more effective management and pricing. Drought forecast, GW table fluctuation prediction may be introduced.

[11] Objective 2 of the national freshwater strategy is a starting point for the Environment and Ecosystems programme for the NW basin

Objectives of the W4A programme for the North West

Drawing on the national agriculture and the national freshwater strategy, and in response to the challenges identified in the NW basin, three programme objectives have been defined for the Water for Agriculture programme for the NW basin:

OBJECTIVE 1: SUSTAINABLE GROUNDWATER MANAGEMENT; conserving a precious resource

OBJECTIVE 2: ENHANCED IRRIGATION; making technology work

OBJECTIVE 3: AGRICULTURE ADAPTATION; local solutions to local challenges

The objectives of the W4A programme are first summarized in the overview table below including specific performance targets for the basin. Thereafter, the main set up of the programme is described per objective, linking BDP2100 investment projects to each and, identifying additional project investments. In addition, an outline is presented of the programme organization, key involved agencies and partners. A MCA scoresheet is also presented for each objective of this programme.

Table 3.1: Objectives and Performance Targets Water for Agriculture Programme NW basin

Objectives	**Performance targets**
OBJECTIVE 1: SUSTAINABLE GROUNDWATER MANAGEMENT, conserving a precious resource	
The first objective is to ensure sustainable use and management of groundwater resources in the NW basin, and the Barind in particular, considering water use priorities for i) water supply for urban and rural population; ii) environmental flows; iii) agriculture; and iv) industry	1. Recovery of the groundwater level to the long-term average (reference period 1980-1990) before large scale abstraction unless otherwise scientifically justified through monitoring and/or geohydrological modelling Reference: - The reference period is based on the BDP2100 Baseline Study on Water Resources, and identified groundwater decline from 1990 onwards 2. Advanced soil and water conservation and water retention practices applied in 25% of agricultural land, by 2030, and 50%, in 2050 Reference: - BDP2100 Volume 1: Strategy. Barind and drought prone areas strategy, page 259 3. Availability of 80% of the long-term average minimum flow in all regional rivers in the basin, during the dry season, by 2030 Reference: In absence of an established environmental flow parameter, this constitutes an intermediate target, to be adjusted after an integrated and holistic method has been developed 3. Groundwater monitoring and abstraction permitting system in place, by 2025 Reference: Water Act 2013 4. Delineation of groundwater protection zones for 50% in 2030 and 100% in 2050 of groundwater abstraction points at risk of overexploitation or contamination beyond limits for drinking water or irrigation, whichever is relevant Reference: - BDP2100 Volume 1: Strategy. Barind and drought prone areas strategy, page 259

Objectives	Performance targets
OBJECTIVE 2: ENHANCED IRRIGATION, making technology work	
The second objective is to make optimal use of irrigation infrastructure and technology, in support of long-term agricultural production and socio-economic development and underpinned by effective and responsive irrigation management arrangements.	1. Increased water productivity[12] in irrigation areas, by 10% in 2030 and 20% in 2050 Reference: BDP2100 Volume 1: Strategy, Results Development Framework, page 635 2. 10% of capital investment allocated for O&M annually in publicly managed irrigation infrastructure 3. Effective irrigation management system in place in 2030, for all publicly managed irrigation schemes, including functioning WUAs Reference: - BDP2100 Volume 1: Strategy. Barind and drought prone areas strategy, page 258 - Guidelines for PWM - Water Act, 2013 and Water management rules, 2018 4. 50% of low-performing irrigation schemes remodelled by 2030, with 50% cost recovery of O&M cost 5. 100% of low performing irrigation schemes remodelled by 2050, with 75% cost recovery of O&M cost Reference:
OBJECTIVE 3: AGRICULTURE ADAPTATION; local solutions to local challenges	
The third objective is to increase adaptative capacity of the agricultural sector, to support food security, agricultural production and employment for man and woman, exploring the potential of new approaches and technologies.	1. Increased agricultural diversification, by 25% by 2030 Reference: BDP2100 Volume 1 (p 411) 2. Local water retention volume increased by 50% by 2030 3. Increased water productivity of the agricultural sector, by 30% by 2030 Reference: BDP2100 Volume 1 3. Good soil moisture and nutrient management practices applied in 50% of agricultural land, by 2030 Reference: BDP2100 Volume 1 (p 253, 410)

[12] Water productivity is defined here in its broader sense (holistic approach) as the ratio of the net benefits from crop, forestry, fishery, livestock and mixed agricultural systems to the amount of water consumed to produce those benefits. Water productivity is considered a more holistic metric than irrigation efficiency which refers to the ratio of water consumed by crops relative to irrigation water applied or relative to water withdrawn from a source (IWMI, 1999)

3.2 NW W4A Objective 1: Sustainable Groundwater Management

The first objective is formulated in response to the decline of the groundwater table in a large part of Rajshahi division due to the intensive use of groundwater for irrigation. Groundwater is an important source of drinking and irrigation water in the Barind area and throughout the NW. The rapid decline has been analysed extensively by CSIRO, IWM and CEGIS, and documented in the BDP2100 State of the Basin Report for the North West basin as well as the BDP Baseline Study Water Resources.

To ensure that this precious underground resource is not threatened in the short and long run, the first objective is:

"to ensure sustainable use of groundwater resources in the NW basin, and the Barind in particular, considering water use priorities for i) water supply for urban and rural population; ii) environmental flows; iii) agriculture; and iv) industry, in that order."

3.2.1 Programme organization:

Four agencies are particularly involved in groundwater management in the NW: the Barind Multipurpose Development Authority (BMDA), Bangladesh Agricultural Development Corporation (BADC), the BWDB (directorate of groundwater hydrology) and DPHE. These organizations constitute a program management unit, led by MoA. The key functions are monitoring and maintaining an up to date groundwater management database (feeding into a Groundwater Management Information System) and a register of abstractions and permits, as well as more general coordination and planning tasks, communication with partners and reporting to the Delta Wing.

In addition, the PMU supports the development of DPPs for studies and investment projects to further the programme goal. Important partners in the programme (in addition to the directly involved agencies mentioned above) include DAE, LGED, City Corporations (incl. WASA), Municipalities and knowledge institutes such as IWM, CEGIS, RRI, BARI, BRRI, RDA etc and Universities of this region. In addition, the Water Resources Planning Organization (WARPO) is also a programme partner, in view of its roles defined in the 2013 Water Act with respect to GW management.

3.2.2 Investment needs and projects

The BDP2100 Investment Plan includes two investment projects that support the programme goal: Expansion and modernization of network and tools for groundwater monitoring (**CC1.45**), and Managed aquifer recharge for artificial storage of water to improve groundwater table (**CC1.46**).

Besides ensuring sustainable abstraction, under the programme, enhanced groundwater recharge will also be promoted, with specific, often localized benefits. There is a linkage with the Enhanced Irrigation Programme where the use of surface water for irrigation can replace groundwater, thereby conserving precious groundwater resources for water supply and other high value use.

In areas where groundwater use is not sustainable and surface water is not available at a reasonable cost to replace groundwater through irrigation scheme development or local surface water retention, then reduction of groundwater demand should be promoted through crop change, soil and water conservation (rainwater harvesting and storage), advanced irrigation technologies and water reuse. Depending on the suitability of the soils, topography and local level needs, an increased use of soil and water conservation techniques will: i) limit run-off and infiltration to increase water retention for irrigation, ii) stimulate infiltration to recharge the groundwater; and iii) enhance the soil water retention capacity through improved tillage and vegetative practices.

In areas, where the combined impact of the above is not sufficient to ensure sustainable groundwater use, abstractions limitations will have to be introduced and enforced. This may include the demarcation of

groundwater protection zones, depending on the local hydro-geological conditions. For this purpose, a reliable and up to date groundwater monitoring system needs to be put in place, where needed complemented by groundwater modelling for specific vulnerable aquifers and feeding into a publicly accessible Groundwater Management Information System (GMIS).

Resulting from the gap analysis (the degree in which the two foreseen BDP investment projects lead to the reaching of the programme objective and performance targets), the following investment projects are included to reach the goal of sustainable groundwater management in the NW. Concept notes have been developed for each of these projects, except for the project 'promotion of water saving crops', for which the promotion activities under the existing agriculture extension system may be best equipped.

Short term investment projects (including studies), up to 2030:

1. CC1.45 Expansion and modernization of network and tools for groundwater monitoring, *including a regularly updated groundwater management information system (GMIS)*[13]
2. CC1.46 Managed aquifer recharge for artificial storage of water to improve groundwater table
3. Rainwater harvesting/preservation

In addition, to fill the gap identified, three additional projects have been identified, which have been elaborated as concept notes under SIBDP. The first three are proposed for the period 2025-2030:

4. Development of a register of groundwater abstractions and permitting system, based on the GMIS developed
5. Promotion of water saving crops, through other projects and programmes
6. Ground water table fluctuation prediction
7. Disaster information dissemination through Union Digital Centre
8. Development of Flood Preparedness Program (FPP), constituted with local community volunteers.

Medium term investment projects, up to 2050:

Defining longer term investment projects is hampered by the insufficient understanding of the groundwater reserve and use. For that reason, demarcation of groundwater protection zones, in combination with abstraction limitation is therefore identified as long-term project. Such a project will require a high-quality understanding of the groundwater system and impact of abstractions, as well as adaptation measures to mitigate for the loss of productive water use.

1) Demarcation of groundwater protection zones, based on the GMIS developed
2) Enhancing use of Surface water, replacing GW, for municipality Urban and rural areas.

[13] The groundwater management information system is not yet included as project concept note and needs elaboration

Table 3.2: MCA W4A Programme Objective 1: Sustainable Groundwater Management

NW Water for Agriculture Programme Objective 1 Sustainable Groundwater Management

		Criteria												
		Relation to Bangladesh Delta Plan 2100 Goals										Poverty Reduction	Implementation feasibility	
		Goal 1		Goal 2					Goal 4		Goal 5			
Project Code	Project Name	Flood damage	Flood affected population	Food security	Rice production	Fish production	Sustainable groundwater	Access to safe drinking water	Water quality	Ecosystems services	Capacity development	Poverty Reduction	Implementation readiness	Potential financing
CC 1.46	**Managed Aquifer Recharge for Groundwater vulnerable areas**	0	0	1	1	0	2	1	0	1	1	1	-1	0
CC 1.45	**Expansion and modernization of network and tools for groundwater monitoring**	0	0	0	0	0	1	0	0	0	3	0	0	1
NEW*	**Sustainable Groundwater management by establishing a system of monitoring, permitting and groundwater protection zones**	0	0	0	0	0	2	1	0	1	3	0	0	0

Legend

-3	Major Negative Impact
-2	Moderate Negative Impact
-1	Minor Negative Impact
0	No Impact
1	Minor Positive Impact
2	Moderate Positive Impact
3	Major Positive Impact

** NEW = Newly Developed*

** EXIST = Existing Concept Note, not included in BDP2100 Investment Plan*

3.3 NW W4A Objective 2: Enhanced Irrigation

Food self-sufficiency in Bangladesh has been made possible by the introduction and adoption of irrigation technology from the 1980s onwards, much of which in the southern part of the basin, in Rajshahi division and to a large extent driven by private initiative. Especially the groundwater-based systems perform well in terms of cost recovery, timely delivery of irrigation and reliability. The larger surface water-based systems have not yet reached their full potential, with low cost recovery, a general lack of maintenance and a comparatively modest productivity increase. Given the need to conserve groundwater, the demand for more diverse agricultural produce and the availability of new technologies for precision irrigation, there is a need and ample scope to improve irrigation performance in the basin.

To realize this potential, the second objective of the W4A programme is:

"to make optimal use of irrigation infrastructure and technology, in support of long-term agricultural production and socio-economic development and underpinned by effective and responsive management arrangements."

Metrics for irrigation scheme performance

Clear metrics for Irrigation scheme performance do not yet exist, and we can draw a parallel with the FCD schemes in this respect. Again, although metrics may differ between irrigation schemes due to different needs and conditions (e.g. groundwater vs surface water, public vs private), general metrics can be identified, as proposed here below.

- Productivity in kg-BDT / area, relative to unirrigated areas
- Contribution to food security
- Cost benefit ratio
- Cost recovery ratio
- O&M investment compared to need
- Equitable distribution of benefits

3.3.1 Programme organization

Four agencies are particularly involved in irrigation development in the NW: the Barind Multipurpose Development Authority (BMDA), the Bangladesh Agricultural Development Corporation (BADC), the BWDB, LGED, through the SSWRDP, and DAE, as agency under the Ministry of Agriculture. These organizations cooperate through a Program Management Unit (PMU), with each organization retaining its own functions and mandates. Water management organizations (WMO) are obvious and indispensable partners for irrigation scheme development.

The main function of the PMU is exchange experience and where relevant streamline project activities. This could be the case in areas where, as example, i) surface water irrigation is developed to replace groundwater irrigation; ii) where the introduction of irrigation opens up opportunities for more high value crops or generates a need for different soil and fertility management; or iii) where increased surface water abstraction limits environmental flows in the river. These aspects entail integration of disciplines and a holistic approach, superseding the mandates of any one organization.

A systematic approach on PWM and O&M is another area where the organizations coordinate, following the Water Act-2013, Participatory Water Management Rule-2014 and 2018 Water management rules. Sustainable operation & maintenance of irrigation systems is mentioned as a 'particularly essential feature' of the Barind and Drought Prone Areas Strategy in the BDP2100 (page 258, Volume 1: Strategy). Given the challenges in PWM and sustainable O&M, sharing and developing good practices as well as technological and institutional innovations are vital for the success Enhanced Irrigation Programme. For this reason, the

PMU will have focussed monitoring capacity as well as dedicated competency to advise and guide implementing agencies on PWM and irrigation scheme operation, maintenance and financing, including private sector involvement in irrigation scheme O&M.

Key partners in the Enhanced Irrigation Programme are:

Lead:

- BMDA – BADC
- BWDB
- LGED
- DAE
- WMOs

Contributing:

- DoF and DoE
- NGOs
- Contractors and engineering consultants, as well as design and implementation consultants
- Knowledge institutes IWM, CEGIS and NW based universities (Rajshahi and Rangpur Division)

3.3.2 Investment needs and projects

Six investment projects have been included in the BDP2100 Investment Plan for irrigation development. Given the need for a holistic, integrated and adaptive approach, these will become part of the Enhanced Irrigation Programme of the BDP2100 for the Northwest. These projects are the infrastructure investment projects **DP 1.4** Kurigram Irrigation Project (South) and **DP 1.5** Kurigram Irrigation Project (North) and **DP1.1** North Rajshahi irrigation project. These projects are complemented by the institution oriented projects for the 'Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M', for the North Rajshahi Irrigation Project (**DP 25.1**), the Mahananda Irrigation Scheme (**DP 25.2**) and the Kurigram Irrigation Schemes (I & II) (**DP 25.3**). In the EIP, the infrastructure and institutional projects will be integrated in line with the holistic and integrated approach of the BDP2100.

In terms of implementation approach, there are important linkages with the FRM-FCDI rationalization programme in which WMOs play an important part. In the case of the BDP Investment Plan project 'Program for Implementation of Rationalized Water Related Interventions in Hurasagar Basin' (**DP 1.21**), there is a direct link with the irrigation related interventions that are included there. There is also a linkage between the new irrigation projects and the project 'Pilot application of simplified environmental flow method for the Atrai and Dharla rivers', developed as Concept Note under the Environment and Ecosystems Programme (EEP), as the envisaged Kurigram irrigation project will abstract flows from the Dharla river (holistic approach).

Resulting from the gap analysis (the degree in which the three foreseen BDP investment projects lead to the reaching of the programme objective and performance targets), one additional concept note was developed as preparation for a knowledge investment project. In addition, a clear need was identified to develop an irrigation water productivity improvement project, to increase the return on water from a holistic point of view. They are included in the overview here below, including the already developed concept notes in the BDP Investment Plan (Figure 3.1).

Short term investment projects (including studies), up to 2030

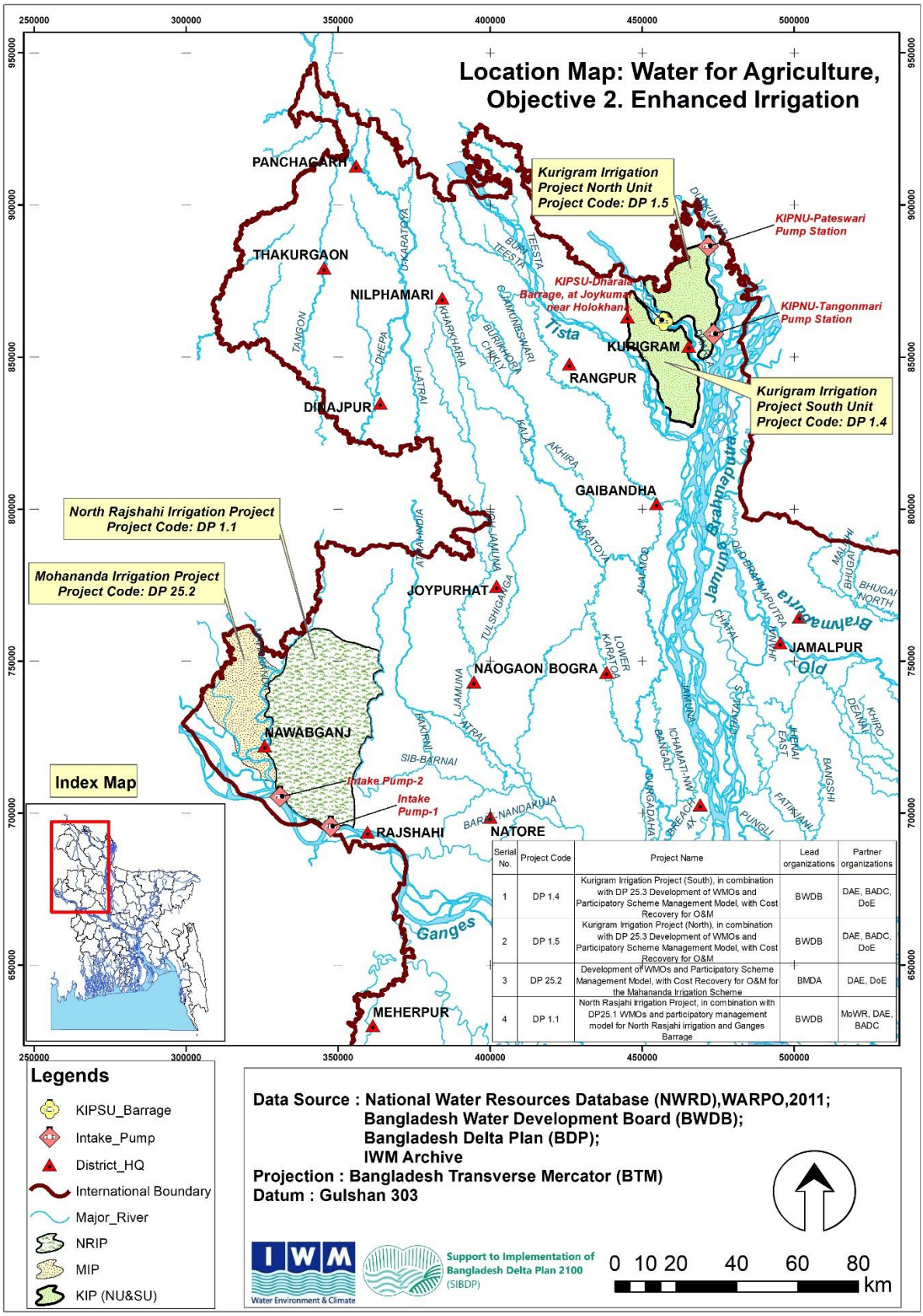
1) **DP 1.4** Kurigram Irrigation Project (South) and **DP 1.5** Kurigram Irrigation Project (North), in combination with **DP 25.3** Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M for the Kurigram Irrigation Schemes (I & II)

2) **DP 25.2** Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M for the Mahananda Irrigation Scheme
3) Agriculture database, developed as Concept Note, and supporting the activities and extension services provided by DAE to enhance agronomic performance in newly developed and existing irrigation schemes
4) Irrigation water productivity improvement project, including but not limited to increased irrigation efficiency (see footnote on water productivity, above), and aimed at existing and new irrigation schemes, to be developed as Concept Note

Medium term investment projects (including studies), up to 2050

The North Rajshahi irrigation project (DP 1.1) depends on the construction of the Ganges Barrage to guarantee adequate dry season flow at the intake of the scheme from the Ganges. For this reason, scheme development is anticipated to not be able to start before 2025

1) **DP1.1** North Rajshahi irrigation project, in combination with **DP 25.1** Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M North Rajshahi Irrigation Project.



Serial No.	Project Code	Project Name	Lead organizations	Partner organizations
1	DP 1.4	Kurigram Irrigation Project (South), in combination with DP 25.3 Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M	BWDB	DAE, BADC, DoE
2	DP 1.5	Kurigram Irrigation Project (North), in combination with DP 25.3 Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M	BWDB	DAE, BADC, DoE
3	DP 25.2	Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M for the Mahananda Irrigation Scheme	BMDA	DAE, DoE
4	DP 1.1	North Rasjahi Irrigation Project, in combination with DP25.1 WMOs and participatory management model for North Rasjahi irrigation and Ganges Barrage	BWDB	MoWR, DAE, BADC

Figure 3.1: Location Map of Objective 2: Enhanced irrigation

Table 3.3: MCA W4A Programme Objective 2: Enhanced Irrigation

NW Water for Agriculture Programme Objective 2 Enhanced Irrigation

		Criteria												
		Relation to Bangladesh Delta Plan 2100 Goals										Poverty Reduction	Implementation feasibility	
		Goal 1		Goal 2					Goal 4		Goal 5			
Project Code	Project Name	Flood damage	Flood affected population	Food security	Rice production	Fish production	Sustainable groundwater	Access to safe drinking water	Water quality	Ecosystems services	Capacity development	Poverty Reduction	Implementation readiness	Potential financing
DP 1.1	**North Rajshahi irrigation project**	0	0	1	1	0	3	1	-1	-1	0	0	-1	1
DP 25.1	**Development of WMOs and PWM Model, with Cost Recovery for O&M for the North Rajshahi Irrigation**	0	0	1	1	0	0	0	0	0	3	1	0	1
DP 1.4	**Kurigram irrigation project (South - Dharla)**	1	1	1	2	0	1	0	-1	-1	0	2	2	1
DP 1.5	**Kurigram irrigation project (North - Dudhkumar)**	0	0	1	2	0	2	0	-1	-1	0	2	2	1
DP 25.3	**Development of WMOs and PWM Model, with Cost Recovery for O&M for the Kurigram Irrigation Schemes**	0	0	1	1	0	0	0	0	0	3	1	1	1
DP 25.2	**Development of WMOs and Cost Recovery for O&M for the Mahananda Irrigation Scheme**	0	0	1	1	0	0	0	0	0	3	1	1	1
DP 1.6	**Teesta integrated irrigation project**	1	1	1	1	0	1	1	-1	-1	0	1	1	1

Legend

-3	Major Negative Impact
-2	Moderate Negative Impact
-1	Minor Negative Impact
0	No Impact
1	Minor Positive Impact
2	Moderate Positive Impact
3	Major Positive Impact

** NEW = Newly Developed*

** EXIST = Existing Concept Note, not included in BDP2100 Investment Plan*

3.4 NW W4A Objective 3: Agriculture Adaptation

The third objective is to increase adaptative capacity of the agricultural sector, to support food security, agricultural production and employment for man and woman, exploring the potential of new approaches and technologies.

In the Bangladesh Delta Plan, agricultural diversification is mentioned as one of the ways to create resilient systems. Diversification suppresses pests and diseases, can increase production and facilitate stable agricultural production. The Bangladesh Delta Plan mentions in the Barind and Drought prone area strategy that water retention and storage should be increase in especially the Barind. The agricultural chapter of the Bangladesh Delta Plan mentions that water productivity is a good measure to evaluate water efficiency of the agricultural sector. The importance of soil fertility, moisture and nutrient management is mentioned, and soil management can entail composting, matching nutrients with plant needs and crop varieties improving soil moisture content. The Bangladesh Delta Plan 2100 mentions the importance of strengthening the capacity to adapt to climate change, also it mentions field trials and dissemination of new techniques to farmers and research. Furthermore, farmers also need the financial capacity to take adaptation measures.

Four investment projects are included to reach Objective 3, with strong linkages to Objectives 1 and 2 of the W4A Programme:

- Rainwater harvesting for domestic water supply and irrigation in the northwest to limit pressure on groundwater resources
- Development of an agricultural database and management system, developed as Concept Note, and supporting the activities and extension services provided by DAE to enhance agronomic performance and enhancing agriculture water productivity
- Crop Diversification, Production and Marketing for Nutrition and Food Security Project
- Climate Smart Agriculture and Water Management Project

Table 3.4: MCA W4A Programme Objective 3: Agriculture Adaptation

NW Water for Agriculture Programme Objective 3 Agriculture Adaptation

		Criteria												
		Relation to Bangladesh Delta Plan 2100 Goals										Poverty Reduction	Implementation feasibility	
		Goal 1		Goal 2					Goal 4		Goal 5			
Project Code	Project Name	Flood damage	Flood affected population	Food security	Rice production	Fish production	Sustainable groundwater	Access to safe drinking water	Water quality	Ecosystems services	Capacity development	Poverty Reduction	Implementation readiness	Potential financing
NEW*	**Rainwater harvesting for domestic water supply and irrigatio**	0	0	1	1	0	1	1	0	1	0	1	1	1
NEW*	**Development of an agricultural database and management system**	0	0	1	1	0	0	0	0	0	3	0	3	1
DP_DAE1	**Crop Diversification, Production and Marketing for Nutrition and Food Security Project**													
DP_DAE2	**Climate Smart Agriculture and Water Management Project**													

Legend

-3	Major Negative Impact
-2	Moderate Negative Impact
-1	Minor Negative Impact
0	No Impact
1	Minor Positive Impact
2	Moderate Positive Impact
3	Major Positive Impact

** NEW = Newly Developed*

** EXIST = Existing Concept Note, not included in BDP2100 Investment Plan*

4 NW Environment and Ecosystems Programme

4.1 Introduction and Objectives

The wetlands, rivers and water bodies of the NW provide a key source of livelihood for many rural poor. The wetland areas have been declining steadily in the last 30 years, by some 25% from 1989 to 2010. In addition, with less quantity of flow (or inflow in the transboundary rivers) the quality of the rivers and beels (wetlands) and habitat condition are also deteriorating, leading to a significant loss of biodiversity and direct risks to health and productivity. The quality of the rivers and wetlands has deteriorated due to the *decreased dry season flows*, area, depth, water quality and decreased connectivity between the rivers, wetlands and floodplains alongwith more anthropogenic interventions. The latter is key for the ecological functioning and biodiversity. Besides fish production, rivers and wetlands in the NW provide a range of ecosystems goods and services, such as groundwater recharge and water purification, but also landscape and tourism values.

The main causes of *river degradation and wetland decline* are i) encroachment and filling; ii) the decrease of dry-season flows due to abstractions and upstream diversion; iii) the development of FCDI infrastructure and roads with inappropriate size bridge/culvart inside the wetland areas; and iv) more anthropogenic interventions. It is increasingly appreciated, but not well documented, that rivers and wetlands provide important ecosystems goods and services, such as groundwater recharge and water purification, but also landscape and tourism values, in addition to fish and other aquatic products, offering quantifiable benefits to communities and society as a whole. Much of the wetland decline has occurred in Chalan beel. Before infrastructure development in the 1980's, Chalan beel consisted of four large beels, and is now characterised by 97 disconnected and dry-falling 'ponds' as well as drastically decreased dry season flow of the Atrai river. A study carried out in Chalan beel in 2005 and 2006, showed that out of the total of 114 species, at least 19 fish species once considered abundant could be classified as threatened, with a possibility of local extinction. In addition, the total production was estimated to be 12,217 tonnes, being less than half of the production observed in 1982. The wetland areas in the NW have been declining steadily, from 1209 km^2 in 1989 to 904 km^2 in 2000 to 867 km^2 in 2010 (-25%). Based on this data, the declining trend would seem to have slowed down, with a 4.0% decrease with 2000 and 2010.

W*ater quality* is an additional and key emerging issue, even if the available data is patchy, at best. However, given the trend observed and the nature and growth of urban areas and industry in the NW basin, it is very plausible that water quality is already a key issue in the basin. Reliable surveys are missing however, particularly of the chemical-biological quality of the wetlands and subsequent habitat suitability.

To halt these developments, the environment and ecosystems programme is focussed on reversing the trend of ecological degradation in the basin, safeguarding the living environment and offering new socio-economic opportunities in the environment and tourism sectors. The Chalan beel restoration programme lies at the heart of the NW-Environment and Ecosystems programme (NW-EEP), including infrastructure modification and restoration of beels for fisheries and ecological purposes. Other important programme elements are systematic monitoring and data management, pollution control and innovation and the safeguarding of environmental flows. In the short term, there is a necessary emphasis on knowledge development and methodology development, after which, from 2025 to 2030 and beyond, investments in pollution control and treatment as well as river and wetland restoration will take off. The Chalan beel programme is the exception to this rule, with a number of sectoral projects having been formulated in the past already. The sectoral projects are now integrated in one programme for the restoration and development of the Chalan beel area (integrated and adaptive approach). The Chalan beel programme will focus on the whole area of influence, rather than single polders or river stretches, and address all key sectors and interests (holistic approach).

The structure and set up of the programme are linked to the BDP2100 national Freshwater Programme as well as the BDP thematic strategy Environment, Ecology & Biodiversity. The programme contributes directly to Delta Goal 4 which focusses entirely on the conservation and wise use of wetlands. There are also strong links with Delta Goal 6, given the need for joint action by the public and private sectors and the need to enhance both productive and ecosystem objectives.

Relevant sub-strategies of the national freshwater strategy include i) enhancement of freshwater flows in urban and rural rivers; ii) restoring water- and ecosystems; and iii) pollution control and treatment. Realizing the conditions of the NW basin, these sub-strategies form the basis for the three objectives of the NW environment and ecosystems programme:

OBJECTIVE 1: ENVIRONMENTAL FLOWS; bringing the rivers back to life

OBJECTIVE 2: RESTORING CHALAN BEEL; a multi-purpose productive ecosystem

OBJECTIVE 3: POLLUTION CONTROL AND TREATMENT; technology for water quality

The objectives of the environment and ecosystems programme are first summarized in the overview table below including specific performance targets for the basin. Thereafter, the main set up of the programme is described per objective, linking BDP2100 investment projects to each and, identifying and assessing additional project investments making use of Multi Criteria Analysis (MCA). In addition, an outline is presented of the programme organization, key involved agencies and partners, per objective.

After presenting each EE Programme objective and proposed investment projects, the implementation schedule and MCA scorecard for each objective are presented.

Table 4.1: Objectives and performance targets environment and ecosystems programme NW basin

Objectives	**Performance targets**
OBJECTIVE 1: ENVIRONMENTAL FLOWS; bringing the rivers back to life	
The first objective is to revive the ecological functions of the regional rivers, by: i) limiting dry season surface water abstraction to allow for ecological flows in line with ecological needs; and ii) restoring biological connectivity and habitat diversity of the river system.	1) Established minimum environmental flow requirements, for selected regional rivers of the NW, by 2030 2) Monitoring system in place for the main regional rivers in place by 2025, including all necessary hydro-biological parameters 3) Permits for surface water abstraction in place that enable timely adjustment of abstraction limits <u>Reference:</u> - Water Act, 2013 - BDP2100 Volume 1: Strategy. National Freshwater Strategy, page …. - Bangladesh Environment Conservation Act, 1995 - Environment conservation rules, 1997 4) Priority interventions for river restoration identified and included in all river related investment projects, by 2025
OBJECTIVE 2: RESTORING CHALAN BEEL; a multi-purpose productive ecosystem	
The second objective is to restore the wetland system of Chalan beel to meet the multiple needs of fisheries, agriculture, tourism and ecology, by: i) restoring dry season flows and year-round connectivity; ii) modifying infrastructure to accommodate multiple interests; iii) provide protection against disastrous floods, and iv) invigorating the local economy through green economic growth.	1) Restored biological connectivity of the river-floodplain-beel system, with signature species, by 2035 2) Enhanced fish productivity of capture and culture fisheries, by 25% and 10% respectively, by 2030 3) Reduced flood damage, by 50% for flood events with a flood return period of 1:5 and 25% for flood events with a return period of > 1:10 or higher 4) Enhanced agricultural productivity, by 10% in economic terms, by 2030 5) Reduced conflicts by 50%, by 2030 6) Positive Economic Rate of Return (ERR) of ..% <u>Reference:</u> - Bangladesh Biodiversity Act, 2017, and Bangladesh Environment Conservation Act, 1995 - Water Act, 2013 - BDP2100 Volume 1: Strategy. National Freshwater Strategy, page ….
OBJECTIVE 3: POLLUTION CONTROL AND TREATMENT; technology for water quality	
The third objective is to minimise chemical and biological pressures on the surface and groundwater system, through: i) the application of clean production	1) Monitoring system, for all rivers and water bodies, and all relevant parameters, by 2025 2) Register of pressures and emissions in place, by 2030 of all industries, urban areas and land use types 3) Permitting and fining system, for all rivers and water bodies, by 2030 4) Financing mechanism for local governments to invest in water treatment, by 2023

Objectives	Performance targets
techniques in industry; ii) treatment of domestic wastewater; iii) good agri-environmental practices; and iv) strict enforcement of environmental regulations.	5) Private sector innovation programme, for clean production techniques, by 2023 6) Agri-environment innovation and investment scheme, by 2030[14] Reference: - Water Act, 2013 - BDP2100 Volume 1: Strategy. National Freshwater Strategy - Bangladesh Environment Conservation Act, 1995 - Environment conservation rules, 1997

[14] This includes the crop, fisheries and livestock sectors

4.2 NW EEP Objective 1: Environmental Flows

The wetlands, rivers and water bodies of the NW provide key ecosystems goods and services to the basin and are a source of livelihood for many rural poor. The quality of the rivers and wetlands has deteriorated however, due to the decreased dry season flows, area, depth, water quality and decreased connectivity between the rivers, wetlands and floodplains. Maintaining a reliable 'environmental flow' for the rivers, is an important way of safeguarding the goods and services these rivers provide, in the long run and contributes directly to BDP goal 4 regarding conservation and preservation of wetlands and ecosystems. Actual flow regimes deviate from natural flow regimes through manmade modifications, such as dams, embankments and abstractions, put in place to protect communities and production systems from floods and increase (mostly) agriculture productivity in both the monsoon and dry seasons. These are important and valuable benefits to society which should be weighed in when determining the environmental flow of a particular river.

Comprehensive environmental flow regimes require a thorough examination of the aims (the ecosystem state, goods and services provision to be achieved) and their relationship with environmental flow parameters, such as the flow and water quality. The BDP2100 identified environmental flows as one of the largest knowledge gaps (BDP2100 Baseline Study on Water Resources, 2018). This objective (OBJECTIVE 1. ENVIRONMENTAL FLOWS) is therefore focused on addressing this knowledge gap in the short term, up to 2025, after which separate project investments proposals will be developed to improve the environmental flow conditions of the rivers of the NW.

Against this background, the first objective of the EEP is to:

"revive the ecological functions of the regional rivers, by: i) limiting dry season surface water abstraction to allow for ecological flows in line with ecological needs; and ii) restoring biological connectivity and habitat diversity of the river system."

There is a strong linkage with the other EEP objectives, on Chalan Beel (OBJECTIVE 2. CHALAN BEEL RESTORATION) and pollution control (OBJECTIVE 3. POLLUTION CONTROL AND TREATMENT). A link also exists with the projects in the NW Water for Agriculture Programme (W4A), focussing on irrigation development from *Dharla* river: **DP 1.4** Kurigram Irrigation Project (South) and **DP 1.5** Kurigram Irrigation Project (North), in combination with **DP 25.3** Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M for the Kurigram Irrigation Schemes (I & II), and the project focussing on irrigation development from *Mahananda* river: **DP 25.2** Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M for the Mahananda Irrigation Scheme.

4.2.1 Programme/ project organization

A number of agencies are involved when it comes to environmental flow management in the NW: the Department of Environment (DoE), as main competent authority, the Bangladesh Water Development Board (BWDB), the Local Government Engineering Department (LGED), the Barind Multipurpose Development Authority (BMDA), the Bangladesh Agricultural Development Corporation (BADC); as implementing agencies, and the Water Resource Planning Organization (WARPO), as planning organization. Given the mandate of DoE and the parent Ministry of Environment (MoE), and the fact that in the short term – until 2025, only one project will be implemented to specifically support this objective, a regular project organisation will be set up. Given the importance of (local) knowledge development, the project will include a knowledge exchange platform in which local universities and recognized knowledge institutes take part and a stakeholder consultationplatform involving NGOs, local government representatives and recognized community leaders. A project implementation unit (PIU) under DoE will take care of integration and

coordination, communication. The PIU will be guided by a strategic consultation committee to ensure the cross-sectoral uptake of project recommendations (integrated approach), e.g. with the irrigation projects mentioned above. A project preparation unit (PPU) will be set up towards 2025 to develop investment projects proposals with the identified agencies for inclusion in the 9th Five Year Plan.

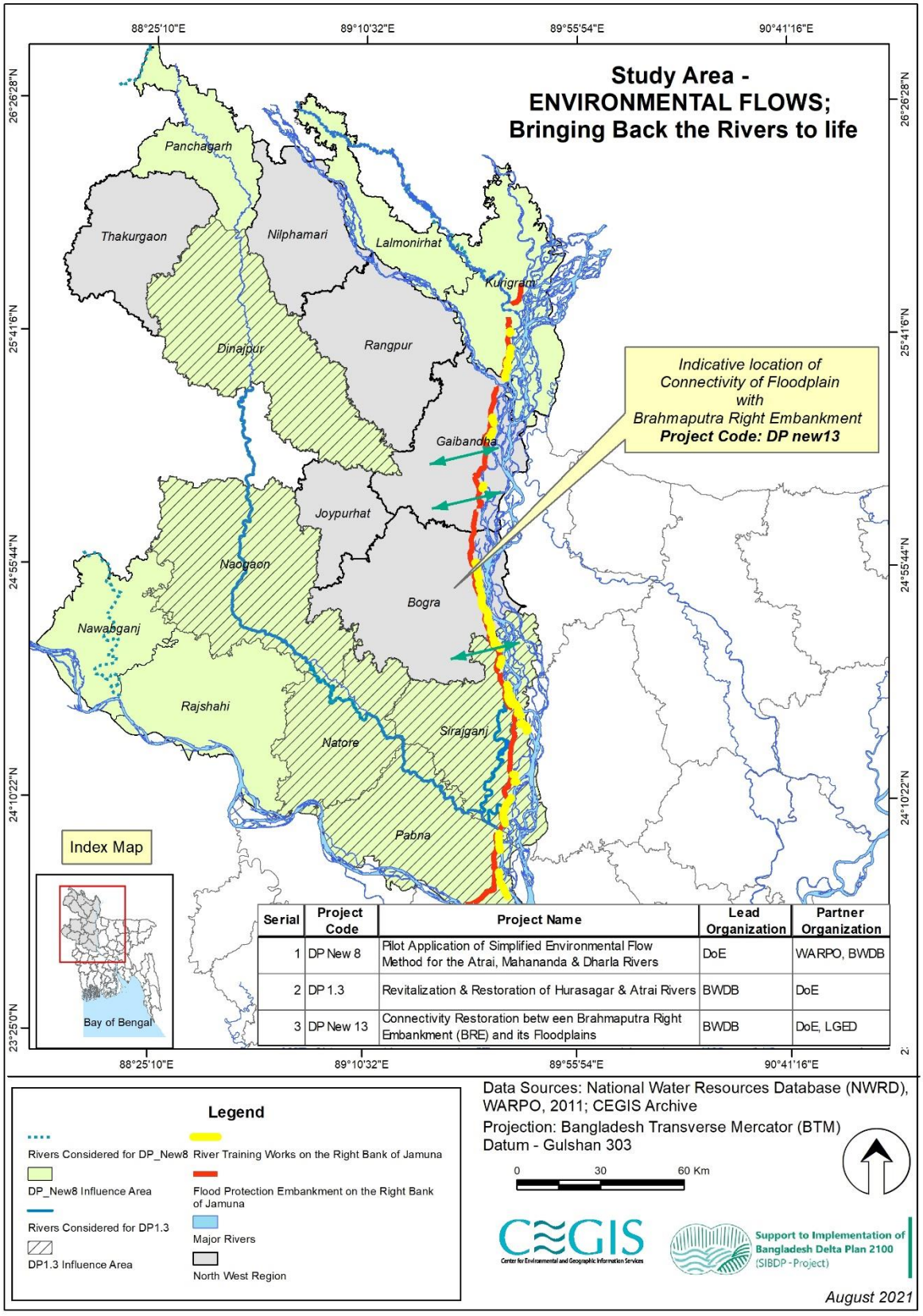


Figure 4.1: Study Area of EEP Objective 1: Environmental Flows

The key projects partners are as follows:

Lead:

- DoE
- BWDB

Project implementation partners:

- LGED
- BMDA
- BADC
- DoF
- WARPO
- Knowledge Institutes - IWM, CEGIS, RRI, BARI, BRRI, SRDI etc and NW based universities (Rajshahi, Rangpur, Dinajpur etc)

4.2.2 Investment needs and projects

Short term investment projects (including studies), up to 2025

1) Pilot application of simplified environmental flow method for the Atrai, Mahanada and Dharla rivers, with linkages to **DP 1.4**, **DP 1.5** and **DP 25.3** as well as **DP 25.2**, projects implemented under the NW W4A programme. A portfolio of investment projects will be developed as part of this project up to 2025.
2) **DP 1.3** Revitalization & restoration of Hurasagar & Atrai rivers, included in the BDP2100 Investment Plan and also assessed with the Bangladesh Metamodel.
3) Connectivity restoration between Brahmaputra Right Embankment (BRE) and its floodplains along with distributaries and tributaries, with a Concept Note in development.

Medium term investment projects (including studies), up to 2050

It is anticipated that once an applicable method has been developed, that GoB and financing agencies will develop river restoration investment projects, many of which will be multi-purpose and be integrated into area development and water quality improvement projects.

ID	Task Name
1	**NW IP: ENVIRONMENTAL FLOWS**
2	**Pilot application environmental flow Atrai, Dharla and Dhudkum**
3	develop BD applicable method
4	carry out 3 pilots
5	monitoring
6	draft guideline for environmental flows
7	**Revitalization & restoration of Hurasagar & Atrai rivers**
8	detailed feasibility study
9	implementation
10	monitoring and adaptation
11	**Connectivity restoration between Brahmaputra Right Embankment (BRE) and its**
12	pre-feasibility study
13	preliminary approval
14	detailed feasibility study
15	GO / NO GO decision
16	financing proposal
17	implementation and monitoring
18	**NW IP: RESTORING CHALAN BEEL**
19	**Barind Area Fisheries Resources Development**
20	**Hurasagar Fiseries Management and Development Project**
21	**Revitalization of Khals**
26	**Integrated Development and Restoration Programme (IDRP) of Chalan Beel**
48	**NW IP: POLLUTION CONTROL AND TREATMENT**
49	**Strengthening monitoring capacity of the DoE in the NW Basin**
54	**Development register of pressures and emissions on water bodies in NW basin**
58	**Financing mechanism for local governments to invest in (domestic) wastewater treatment**

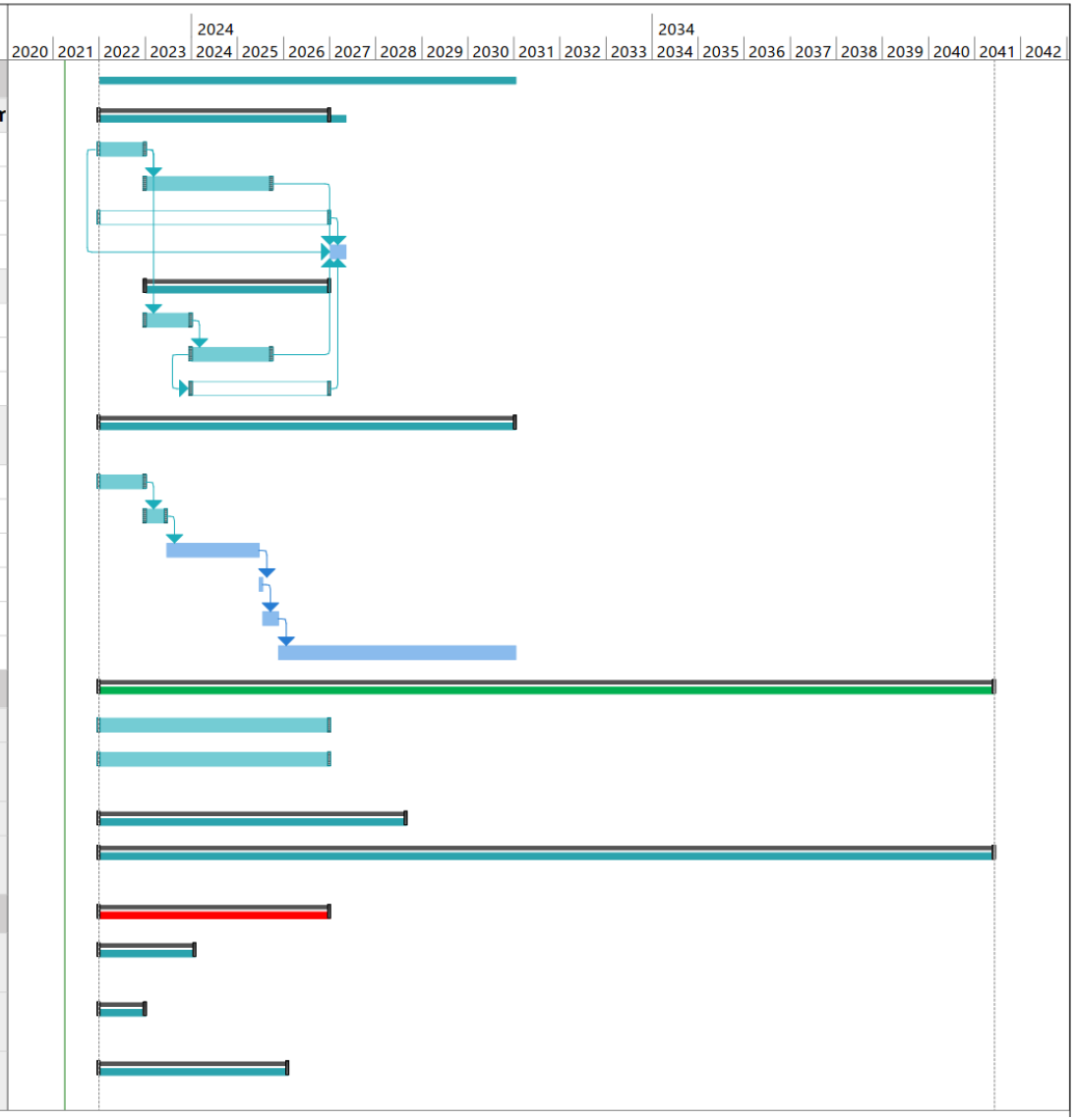


Figure 4.2: Implementation schedule NW EE Programme Objective 1: Environmental Flows

Table 4.2: MCA NW EE Programme Objective 1: Environmental Flows

NW Environment and Ecosystems Programme Objective 1: Environmental Flows

Project Code	Project Name	Criteria: Relation to Bangladesh Delta Plan 2100 Goals: Goal 1: Flood damage	Goal 1: Flood affected population	Goal 2: Food security	Goal 2: Rice production	Goal 2: Fish production	Goal 2: Sustainable groundwater	Goal 2: Access to safe drinking water	Goal 4: Water quality	Goal 4: Ecosystems services	Goal 5: Capacity development	Poverty Reduction: Poverty Reduction	Implementation feasibility: Implementation readiness	Implementation feasibility: Potential financing
NEW	**Pilot application of simplified environmental flow method for the Atrai, Dharla and Dhudkumar rivers**	0	0	0	0	0	0	0	1	1	2	0	2	2
DP 1.3	**Revitalization & restoration of Hurasagar & Atrai rivers**	2	1	0	1	1	0	0	1	1	0	0	1	1
NEW	**Connectivity restoration between Brahmaputra Right Embankment (BRE) and floodplain**	2	2	2	0	3	0	0	1	2	2	2	-2	1

Legend
-3 Major Negative Impact
-2 Moderate Negative Impact
-1 Minor Negative Impact
0 No Impact
1 Minor Positive Impact
2 Moderate Positive Impact
3 Major Positive Impact

** NEW = Newly Developed*
** EXIST = Existing Concenpt Note, not included in the BDP2100 Investment Plan*

4.3 NW EEP Objective 2: Restoring Chalan Beel

The Chalan Beel restoration programme lies at the heart of the NW-Environment and Ecosystems programme (NW-EEP), including infrastructure modification, restoration of beels for fisheries and ecological purposes, reduction of negative flood impacts including associated social conflicts, drainage congestion, and locally driven green economic growth. The Chalan Beel programme has its origin in a number of separately formulated sectoral projects, developed by the Bangladesh Water Development Board (BWDB), the Local Government Engineering Department (LGED), Barind Multipurpose Development Authority (BMDA) and the Department of Fisheries (DoF) and a strong locally-led desire to improve the livelihoods of fisheries and agriculture communities as well as civil society as a whole.

As part of the preparation of this NW Implementation Programme, a broad-based consultation session or *delta atelier* was held on Chalan Beel under SIBDP early 2020. In the delta atelier, residents and local government representatives expressed a strong desire to restore and develop the Chalan Beel area, the Atrai and connected other rivers, enhance local economic development opportunities and adopt an integrated and participatory approach. The stakeholders expressed a hands-on willingness to take active part in such an integrated programme and displayed a thorough insight in the bio-physical, social and economic challenges and opportunities. A report on the delta atelier is included in the NW State of the Basin report, published by SIBDP.

The second objective of the NW-EEP is to:

> *"restore the wetland system of Chalan Beel to meet the multiple needs of fisheries, agriculture, tourism and ecology, by: i) restoring dry season flows and year-round connectivity; ii) modifying infrastructure to accommodate multiple interests; iii) provide protection against disastrous floods, and iv) invigorating the local economy through green economic growth."*

Against this background, and building on comprehensive studies carried out by CEGIS, IWM and local consultants, the proposed sectoral projects on roads, fisheries and FCD development are now linked in one programme for the restoration and development of the Chalan Beel area (integrated and adaptive approach). In addition, the Chalan Beel programme will focus on the whole area of influence, rather than single polders or river stretches, and address all key sectors and interests (holistic approach).

Associated *performance targets* for the programme are:

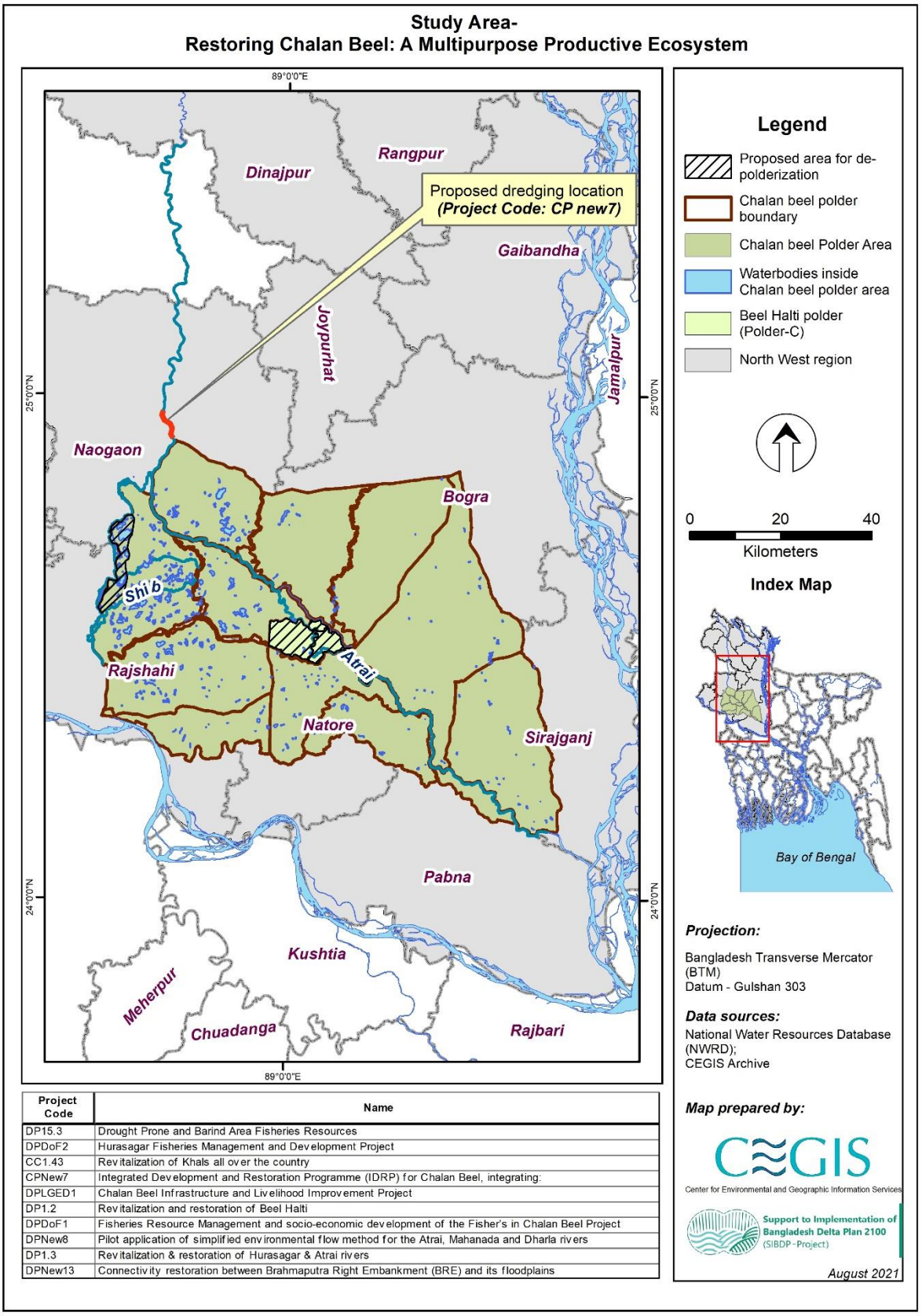
1. Restored biological connectivity of the Chalan Beel river-floodplain-beel system, with signature species, by 2035
2. Enhanced fish productivity of capture and culture fisheries, by 25% and 10% respectively, by 2030
3. Reduced flood damage, by 50% for flood events with a flood return period of 1:5 and 25% for flood events with a return period of > 1:10 or higher
4. Increase cropping intensity and crop diversification with more economical or cash crop cultivation.
5. Enhanced agricultural productivity, by 10% in economic terms, by 2030
6. Reduced conflicts by 50%, by 2030
7. Positive Economic Rate of Return (ERR) of ..%
8. Improve capacity of local water management organisations (WMOs) for improve participatory water management
9. Improve water conveyance and water retention capacity, to preserve more water in post monsoon ready to use for the subsequent dry season
10. Improve navigation, specially during monsoon
11. Improve Ground Water (GW) recharge

4.3.1 Programme organization

Such an integrated and area-based programme needs strong and highly qualified programme management. At least three implementing agencies are directly involved in the programme: the Bangladesh Water Development Board (BWDB), mandated to develop FCDI infrastructure serving areas above 1000 has; the Local Government Engineering Department (LGED), with a mandate to develop rural roads, markets and bridges and FCDI infrastructure serving areas of less than 1000 has; and the Department of Fisheries (DoF), mandated to develop capture and culture fisheries. From a regulatory standpoint, the Department of Environment (DoE), is a key competent authority whilst the Department of Land (DoL) will play a role in the land management and -ownership related aspects of the programme. In addition, local government bodies at District and Upazila level, as well as organisations of residents, fisherfolk and agriculture producers, and Water Management Organizations (WMO) will play a role.

The respective implementing agencies will form a professionally equipped Program Management Unit (PMU), asper the regulatory rules and procedures. The main functions of the PMU are:

- Initiating and supervising the design of a long term, adaptive, holistic and integrated development programme for Chalan Beel, building on and adapting project proposals already developed on fisheries, flood protection and road development, and without excluding other emerging proposals. A Concept Note has been prepared for the setup of the programme, titled: **Integrated Development and Restoration Programme (IDRP) for Chalan Beel**, included as draft Concept Note in the *Annex: Portfolio Investment and Knowledge Projects NW Environment and Ecosystems Programme*
- Designing and leading a stakeholder consultation unit to initiate and structure stakeholder consultation during formulation, feasibility studies, design, implementation and monitoring
- Supporting the development of DPPs through a Project Preparation Unit (PPU), to develop investment projects proposals as part of the **IDRP Chalan Beel** with the identified agencies for fast track development as well as inclusion in the 9th Five Year Plan
- Supervising the development and application of assessment, planning, design and monitoring tools such as detailed- and meta-models, visual aids and smartphone applications
- Leading a small program management team for monitoring, coordination, planning and reporting to partners and the Delta Wing as well as maintaining linkages to other BDP2100 projects in the NW-FRM, NW-W4A and NW-EE programmes.



Project Code	Name
DP15.3	Drought Prone and Barind Area Fisheries Resources
DPDoF2	Hurasagar Fisheries Management and Development Project
CC1.43	Revitalization of Khals all over the country
CPNew7	Integrated Development and Restoration Programme (IDRP) for Chalan Beel, integrating:
DPLGED1	Chalan Beel Infrastructure and Livelihood Improvement Project
DP1.2	Revitalization and restoration of Beel Halti
DPDoF1	Fisheries Resource Management and socio-economic development of the Fisher's in Chalan Beel Project
DPNew8	Pilot application of simplified environmental flow method for the Atrai, Mahanada and Dharla rivers
DP1.3	Revitalization & restoration of Hurasagar & Atrai rivers
DPNew13	Connectivity restoration between Brahmaputra Right Embankment (BRE) and its floodplains

Figure 4.3: Study Area of EEP Objective 2: Restoring Chalan Beel

Lead Agencies:	*Contributing Agencies:*
➢ BWDB ➢ LGED ➢ Department of Fisheries (DoF)	➢ DAE and BADC ➢ DoE (regulatory role) ➢ Ministry of Land ➢ Sector and community representatives ➢ Contractors and engineering consultants, as well as design and implementation consultants ➢ Knowledge institutes IWM, CEGIS, RRI, BARI, RRI, BFRI, SRDI and NW based universities (Rajshahi)

4.3.2 Investment needs and projects

Short term investment projects (including studies), up to 2030

Three investment projects have already been included in the BDP2100 Investment Plan (Volume 2):

- DP 1.2 Revitalization and restoration of Beel Halti
- DP 1.3 Revitalization & restoration of Hurasagar & Atrai rivers
- CC 1.43: Revitalization of Khals all over the country

In addition, four additional projects, proposed by the DoF and LGED, were assessed during the development of this BDP2100 Implementation Programme:

- Fisheries Resource Management and socio-economic development of the Fisher's in Chalan Beel Project, proposed by DoF
- Chalan Beel Infrastructure and Livelihood Improvement Project, proposed by LGED
- DP 15.3 Drought Prone and Barind Area Fisheries Resources Development
- Hurasagar Fisheries Management and Development Project

These investment projects, which focus on fisheries, FCDI modification and rationalization as well as road and market infrastructure will be combined into one adaptive and holistic area-based development **Integrated Development and Restoration Programme (IDRP) for Chalan Beel**, which will include the five projects proposed for the BDP Investment Plan. A draft Concept Note has been prepared for the programme, included in the Annex.

Strong linkages exist between the proposed IDRP and the following proposed projects in the NW-Environment and Ecosystems programme:

- Pilot application of simplified environmental flow method for the Atrai, Dharla and Mahananda rivers
- Financing mechanism for local governments to invest in (domestic) wastewater treatment
- Strengthening monitoring capacity of the DoE in the NW Basin
- Private sector innovation programme for cleaner production techniques
- Program for developing register of pressures and emissions in the NW

Medium term investment projects (including studies), up to 2050

Although the IDRP Chalan Beel still needs to be detailed, it is foreseen that, being an adaptive programme, investments will go beyond 2030. Two phases are proposed for IDRP Chalan Beel; a first phase until 2030 and a second phased up to 2040. The investments include additional FCDI infrastructure, transport and communication infrastructure and economic zone development.

The draft implementation schedule and MCA scoring matrix are presented here below.

ID	Task Name
1	**NW IP: ENVIRONMENTAL FLOWS**
18	**NW IP: RESTORING CHALAN BEEL**
19	**Barind Area Fisheries Resources Development**
20	**Hurasagar Fiseries Management and Development Project**
21	**Revitalization of Khals**
22	inventory and prioritization NW
23	detailed planning
24	implementation
25	monitoring and adaptation
26	**Integrated Development and Restoration Programme (IDRP) of Chalan Beel**
27	**detailed feasibility study**
28	review existing project propsoals BWDB, LGED and DoF
29	draw lessons learnt from past interventions
30	formulate and assess intervention options
31	**develop draft IDRP**
32	define programme objectives and outputs
33	set up progamme governance
34	draw up planning and budget
35	define Terms of Reference for phase 1
36	approval phase 1
37	**IDRP phase 1**
38	inception and detailed planning
39	implementation
40	monitoring and adaptation
41	formulation of phase 2
42	approval phase 2
43	**IDRP Phase 2**
47	Follow up
48	**NW IP: POLLUTION CONTROL AND TREATMENT**

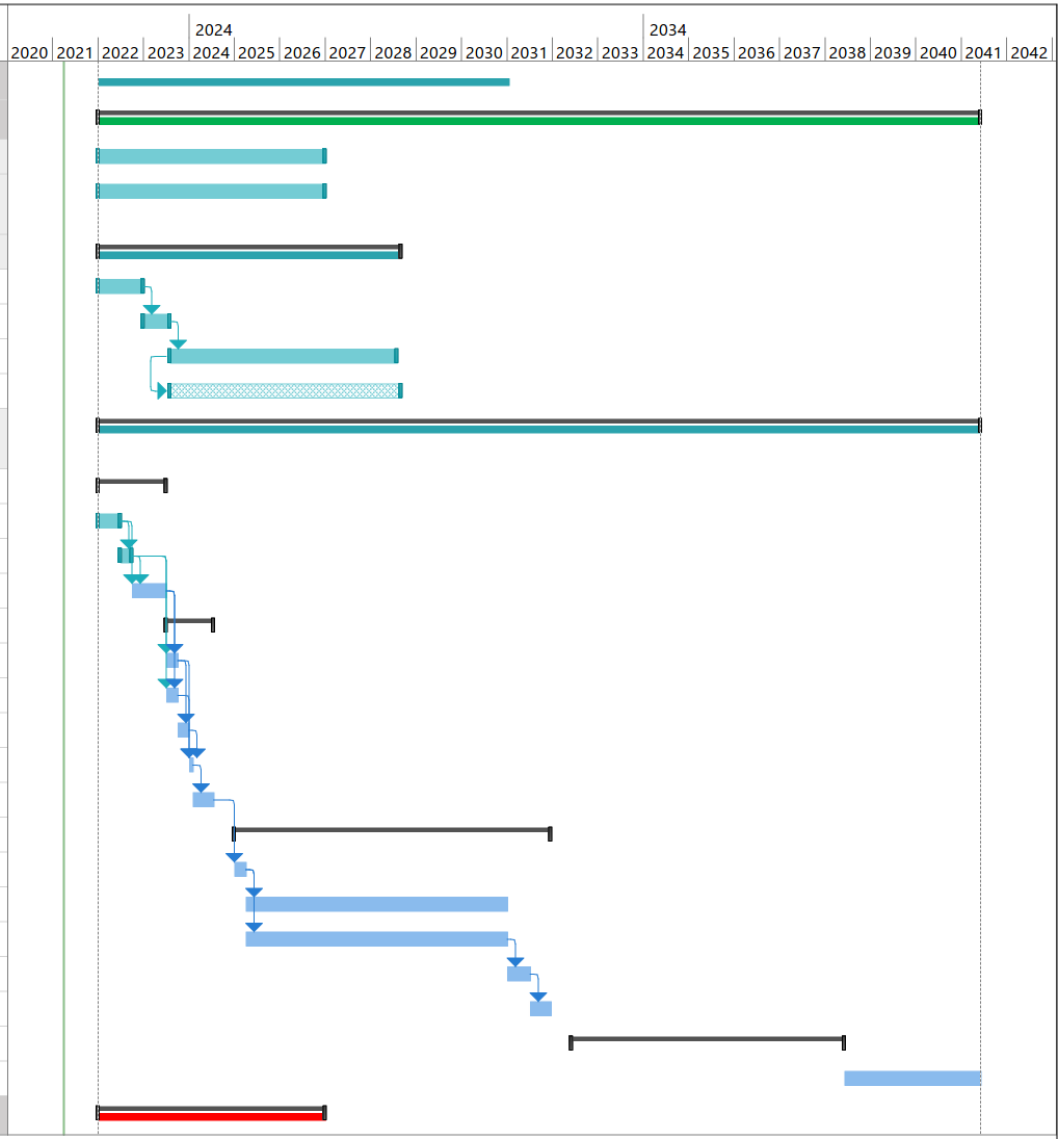


Figure 4.4: Implementation schedule NW EE Programme Objective 2: Restoring Chalan Beel

Table 4.3: MCA NW EE Programme Objective 2: Restoring Chalan Beel

NW Environment and Ecosystems Programme Objective 2: Restoring Chalan Beel

Project Code	Project Name	Criteria: Relation to Bangladesh Delta Plan 2100 Goals: Goal 1: Flood damage	Goal 1: Flood affected population	Goal 2: Food security	Goal 2: Rice production	Goal 2: Fish production	Goal 2: Sustainable groundwater	Goal 2: Access to safe drinking water	Goal 4: Water quality	Goal 4: Ecosystems services	Goal 5: Capacity development	Poverty Reduction: Poverty Reduction	Implementation feasibility: Implementation readiness	Implementation feasibility: Potential financing
NEW	Application of environmental flow method for the Atrai, Dharla, Dhudkumar rivers	0	0	0	0	0	0	0	1	1	2	0	2	2
CC 1.43	Revitalization of Khals all over the country	1	1	1	0	1	0	0	1	1	0	1	0	1
DP 1.3	Revitalization & restoration of Hurasagar & Atrai rivers	2	1	0	1	1	0	0	1	1	0	0	1	1
DP 1.2	Revitalization and restoration of Beel Halti	1	1	1	1	1	0	0	0	1	0	1	1	1
EXIST	Fisheries Resource Management and Socio-economic development in Chalan Beel	0	0	1	0	2	0	0	0	1	1	1	2	1
EXIST	Chalan Beel Infrastructure and Livelihood Improvement Project	-1	-1	1	0	0	0	0	-1	-1	1	1	2	1
NEW	Integrated Development and Restoration of Chalan Beel	3	3	2	0	2	0	0	2	3	2	1	1	2

Legend

-3	Major Negative Impact
-2	Moderate Negative Impact
-1	Minor Negative Impact
0	No Impact
1	Minor Positive Impact
2	Moderate Positive Impact
3	Major Positive Impact

Support to Implementation of Bangladesh Delta Plan 2100 (SIBDP)

Kingdom of the Netherlands

* *NEW = Newly Developed*

* *EXIST = Existing Concenpt Note, not included in the BDP2100 Investment Plan*

4.4 NW EEP Objective 3: Pollution Control and Treatment

Water quality is a key emerging issue in the NW, even if the available data on which to base this is patchy, at best. However, given the trend observed in e.g. the Dhaka Metropolitan Area (DMA), the available data in the NW and the nature and growth of urban areas and industry in the NW basin, it is probable that water quality is already a key issue in the basin. Reliable surveys are missing however, particularly of the chemical-biological quality of the wetlands and subsequent habitat suitability. Moreover, an operational system is not yet in place to systematically monitor, register and control the emission of pollutants and assess their impact on water quality and ecology.

The third objective of the NW Environment and Ecosystems programme is therefore:

"to minimise chemical and biological pressures on the surface and groundwater system, through: i) the application of clean production techniques in industry; ii) treatment of domestic wastewater; iii) good agri-environmental practices; and iv) strict enforcement of environmental regulations."

Associated *performance targets* for the programme are:

1) Monitoring system, for all rivers and water bodies, and all relevant parameters, by 2025
2) Register of pressures and emissions in place, by 2030 of all industries, urban areas and land use types
3) Permitting and fining system, for all rivers and water bodies, by 2030
4) Financing mechanism for local governments to invest in water treatment, by 2023
5) Private sector innovation programme, for clean production techniques, by 2023
6) Agri-environment innovation and investment scheme, by 2030

4.4.1 Programme organization

The Department of Environment (DoE) is mandated by law to monitor, control and enforce the emission and treatment of pollutants to the aquatic environment. Other involved organizations include the Water Resource Planning Organization (WARPO), as planning organization, the Department of Agriculture Extension (DAE) and the Bangladesh Agriculture Development Corporation (BADC), and the Ministry of Industries, as key development agencies. Given the mandate of DoE and the parent Ministry of Environment (MoE), and the urgent need of monitoring and pollution control capacities in the NW, a regular project organisation will be set up. A project implementation unit (PIU) under DoE will take care of integration and coordination, communication, monitoring and reporting to the Delta Wing.

Lead:	***Project implementation partners:***
➢ DoE	➢ LGED ➢ WASA ➢ DPHE ➢ DAE-BADC ➢ Industry associations ➢ Agriculture producer associations ➢ BSCIC ➢ DoF

4.4.2 Investment needs and projects

Short term investment projects (including studies), up to 2030

No investment projects were included in the BDP2100 Investment Plan. Therefore, considering the above, in the short term, two knowledge development projects will be taken up, developed as Concept Note:

1) Strengthening monitoring capacity of the DoE in the NW

2) Program for developing register of pressures and emissions in the NW

Notwithstanding the lack of reliable data, already, two 'no-regret' investment projects will also be taken up in the programme in the short term:

3) Financing mechanism for local governments to invest in (domestic) wastewater treatment
4) Private sector innovation programme for cleaner production techniques

For both projects, Concept Notes have been developed, included in the Annex: Portfolio Investment and Knowledge Projects NW Environment and Ecosystems Programme.

Two additional knowledge and investment projects are proposed, which are not yet developed as Concept Note:

1) Permitting and fining system, for all rivers and water bodies, by 2030, which can be set in place after the monitoring system and register of emissions have been put in place and a financing mechanism for domestic wastewater treatment and cleaner production techniques are in place
2) Agri-environment innovation and investment scheme, by 2030, for which the programme can build on international experience on agri-environmental programming[15].

Medium term investment projects (including studies), up to 2050

A large investment portfolio is foreseen after 2030 up to 2050 including:

- Investment in domestic wastewater treatment for Divisional and District capitals
- Development of Clean Production techniques in all major industries
- Investment in local sanitation and faecal sludge treatment, through the NW Water Supply and Sanitation programme

The implementation schedule and MCA scorecard are presented here below.

[15] A useful example is the Agri-Environment schemes of the European Union Rural Development Programme (RDP)

ID	Task Name
1	**NW IP: ENVIRONMENTAL FLOWS**
18	**NW IP: RESTORING CHALAN BEEL**
48	**NW IP: POLLUTION CONTROL AND TREATMENT**
49	**Strengthening monitoring capacity of the DoE in the NW Basin**
50	review existing network and define requirements for surveillance monitoring, trend detection and compliance checking
51	installation operational monitoring and reporting system
52	development and population monitoring database, visualisation and early warning system
53	training and capacity building for DoE and WARPO
54	**Development register of pressures and emissions on water bodies in NW basin**
55	development and population GIS database on pressures and emissions in the NW
56	develop a register for compliance checking and enforcement
57	training and capacity building for DoE and WARPO
58	**Financing mechanism for local governments to invest in (domestic) wastewater treatment**
59	inventory of potential funding sources and mechanisms, in-country and international
60	review of international best practice
61	formulation financing proposal
62	approval
63	set up and test programme for local governments in the NW
64	**Private sector innovation programme for cleaner production techniques**
65	review of lessons learnt in-country and internationally
66	scoping of technologies and programme set-up
67	programme formulation
68	approval
69	implementation and monitoring
70	training and capacity building for DoE and industries

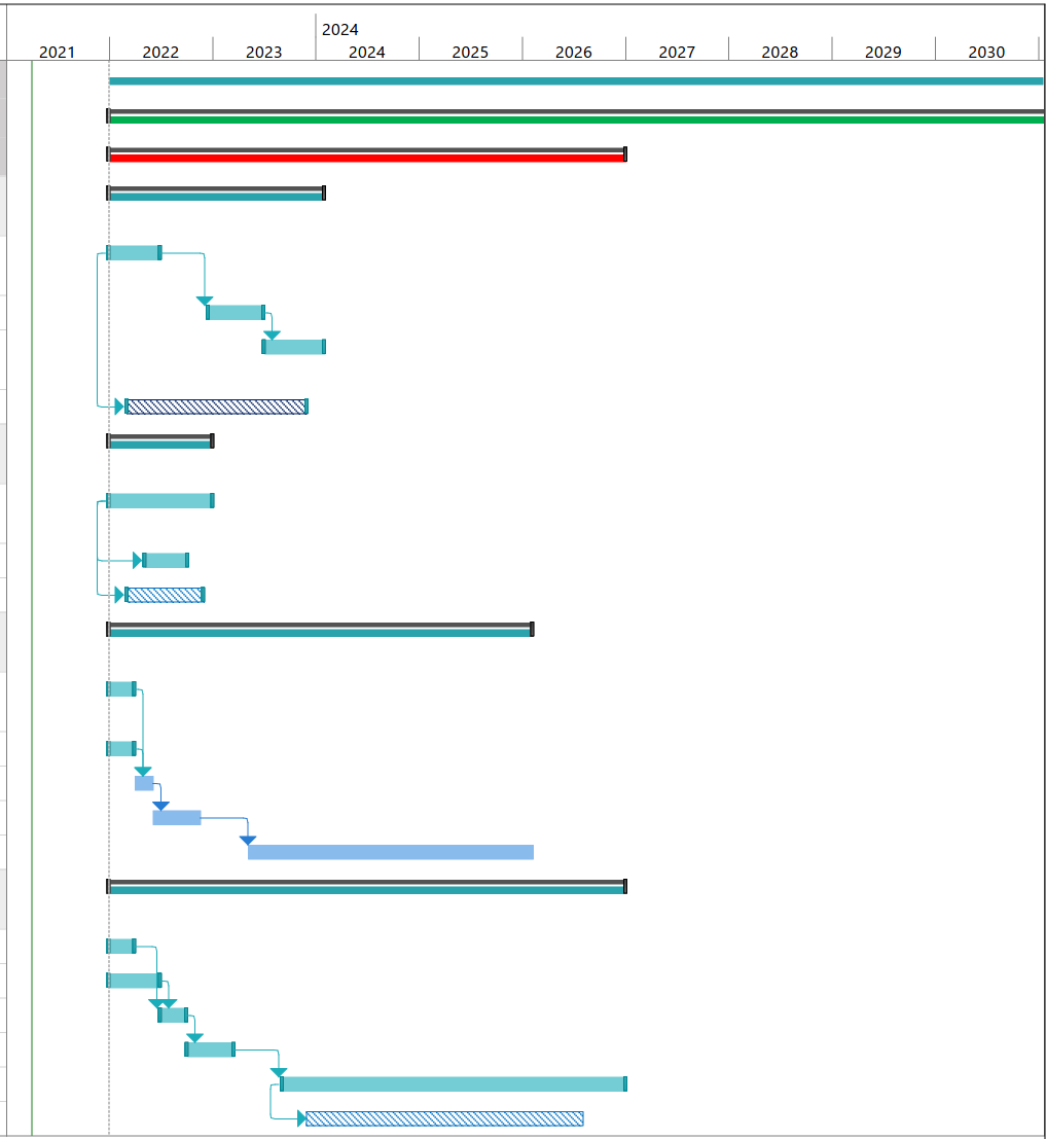


Figure 4.5: Implementation schedule NW EE Programme Objective 3: Pollution Control and Treatment

Table 4.4: MCA NW EE Programme Objective 3: Pollution Control and Treatment

NW Environment and Ecosystems Programme Objective 3: Pollution Control and Treatment

		Criteria												
		Relation to Bangladesh Delta Plan 2100 Goals										Poverty Reduction	Implementation feasibility	
		Goal 1		Goal 2					Goal 4		Goal 5			
Project Code	Project Name	Flood damage	Flood affected population	Food security	Rice production	Fish production	Sustainable groundwater	Access to safe drinking water	Water quality	Ecosystems services	Capacity development	Poverty Reduction	Implementation readiness	Potential financing
NEW	Strengthening monitoring capacity of the DoE in the NW Basin	0	0	0	0	0	0	0	2	2	3	0	1	2
NEW	Program for developing register of pressures and emissions on water bodies in NW basin	0	0	0	0	0	0	0	1	1	3	0	2	2
NEW	Financing mechanism for local governments to invest in (domestic) wastewater treatment	0	0	0	0	1	0	1	2	1	1	0	0	0
NEW	Private sector innovation programme for cleaner production techniques	0	0	0	0	0	1	0	2	1	2	0	1	1

Legend

-3 Major Negative Impact
-2 Moderate Negative Impact
-1 Minor Negative Impact
0 No Impact
1 Minor Positive Impact
2 Moderate Positive Impact
3 Major Positive Impact

Support to Implementation of Bangladesh Delta Plan 2100 (SIBDP)

Kingdom of the Netherlands

** NEW = Newly Developed*

** EXIST = Existing Concept Note, not included in the BDP2100 Investment Plan*

5 NW Water Supply and Sanitation Programme

5.1 Introduction and Objectives

The Water Supply and Sanitation (WSS) programme centers on achieving basic water security and sustainable development goals: ensuring safe and reliable access to water supply and sanitation for the whole population of the basin with adequate supply of qualntity and quality water to the population both for rural and urban areas. There is a strong link with water quality through the development of improved sanitation and wastewater treatment systems in all districts and major settlements, with cost recovery principles advocated for all WSS services, elements that are included in the national WSS Strategy. Key activities include development of sewage treatment plants in all district headquarters; advanced treatment driven by the desired environmental quality standards of receiving waters; faecal sludge management facilities and practices; conversion of localized systems to piped distribution networks; and securing scarce groundwater supplies in areas where an overdraft is taking place and ensuring the priority of groundwater use for water supply above other groundwater use. Gradual shifting of Surface Water based water supply from the Ground Water, specially for the municipality, pouroshova and Division head quarters. Recharge of ground water and rainwater harvest would be of a prority steps to protect the GW dpletion in the NW area.

Many of the pressing issues on water and sanitation in Bangladesh are present in the NW basin. As discussed above, the effect of declining groundwater is felt severely and hand-tubewell (STW) based solutions have needed to be changed to deep abstraction wells (DTW). This trend is expected to continue and calls for strict water regulation and abstraction allocation. Like in most of Bangladesh, faecal sludge management requires urgent development (technical, institutional and cost recovery) particularly in urban areas. For urban areas, water resources assessment is required to decide whether (preferential allocation of) groundwater can be operated sustainably, or whether a shift towards surface water sources is needed, with long distance transport. These developments will enhance a trend towards piped system solutions. In view of these challenges, effective introduction of cost recovery principles is important. The NW basin has a relatively high proportion of hard to reach unions, with some typical water and sanitation constraints. These are outlined here below, along with suggested strategies for sustainable solutions. These strategies and measures are further discussed in the Annex on strategies.

Table 5.1: Challenges and strategies for water and sanitation in the NW basin

Challenges	Strategies for Sustainable Solutions
Dry season water scarcity	- Groundwater recharge - Excavation, regeneration and protection of rain fed ponds and khals - Prioritizing water supply over irrigation, particularly for high quality water resources
GW level decline	- Reduced groundwater abstraction for agriculture thorough licensing and control - City Urban and Metropolitan areas, SW based water supply system should be installed replacing GW. - Storage of surface water and groundwater recharge
Sanitation options become unhygienic due to water scarcity	- Campaigns on water conservation, use of surface and rainwater and eco-sanitation
Poverty	- Socio-economic development, including diversification and agro-processing

CC9.10 Piped water supply project in 100 Pourashavas

CC9.13 Village piped water supply system project

Table 5.2: Objectives and Performance Targets Water Supply and Sanitation Programme NW basin

Objectives	**Performance targets**
OBJECTIVE 1: DRINKING WATER SUPPLY	
The first objective is to ensure safe and affordable drinking water supply	1. In 2030, 100% of households use improved facility of drinking water, located on premises, available when needed, and free from contamination (Ref: SDG). 2. Improve 100% water source for household usage 3. Water point at their dwelling/yard/plot or within 30 minutes round trip collection time 4. Water quality at source within drinking water standard limit of ECR, 2017 5. Household drinking water free of E. coli contamination 6. Water available 24 hours or when needed 7. Source need to be protected from climate induced natural disaster 8. Water infrastructure should be climate and disaster resilient
OBJECTIVE 2: SANITATION AND WASTEWATER MANAGEMENT	
The second objective is to ensure access to safe and reliable sanitation and sustainable wastewater management	1. In 2030, 100% of households use improved latrines that are within 20m of the household, used by all members of the household and which is clean year-round, had hand washing facilities available inside or within 5m of the latrine (ref: SDG) 2. There should be no shared latrine 3. All improved sanitation facilities include flush or pour flush to piped sewer systems, septic tanks or pit latrines, ventilated improved pit latrines, pit latrines with slabs and composting toilets 4. Excreta need to be safely disposed in situ or through safe transport and treatment/reuse off premises 5. A safely managed sanitation chain be maintain to protect the health of individuals and communities, as well as the environment. 6. Latrines to be protected from climate induced natural disaster 7. Sanitation infrastructure design be climate and disaster resilient

6 Adaptation Pathways

6.1 Adaptive Pathways to support Adaptive Planning

A number of the investment and policy decisions in this BDP2100 NW Implementation Programme have significant and often long-term consequences. In addition, many of the long-term objectives in the programme require near-term decisions. Making sound near-term decisions is critical, however, these need to be taken in an unpredictable and dynamic environmental with competing and changing conditions and interests.

The Dynamic Adaptive Policy Pathways (DAPP) approach supports the development of an adaptive plan that can deal with conditions of deep uncertainties. The approach has inspired the Adaptive Delta Management concept of both the Bangladesh Delta Plan (BDP2100) and the Dutch Delta Programme. An adaptive plan specifies actions to be taken immediately to be prepared for the near futures and actions to be taken now to keep options open to adapt if needed in the future. The exploration of adaptation pathways is one of the main ingredients of an adaptive plan. A monitoring system collects information to get early warning signals (triggers) for implementation of actions or for reassessment of the plan. This figure illustrates the DAPP approach.

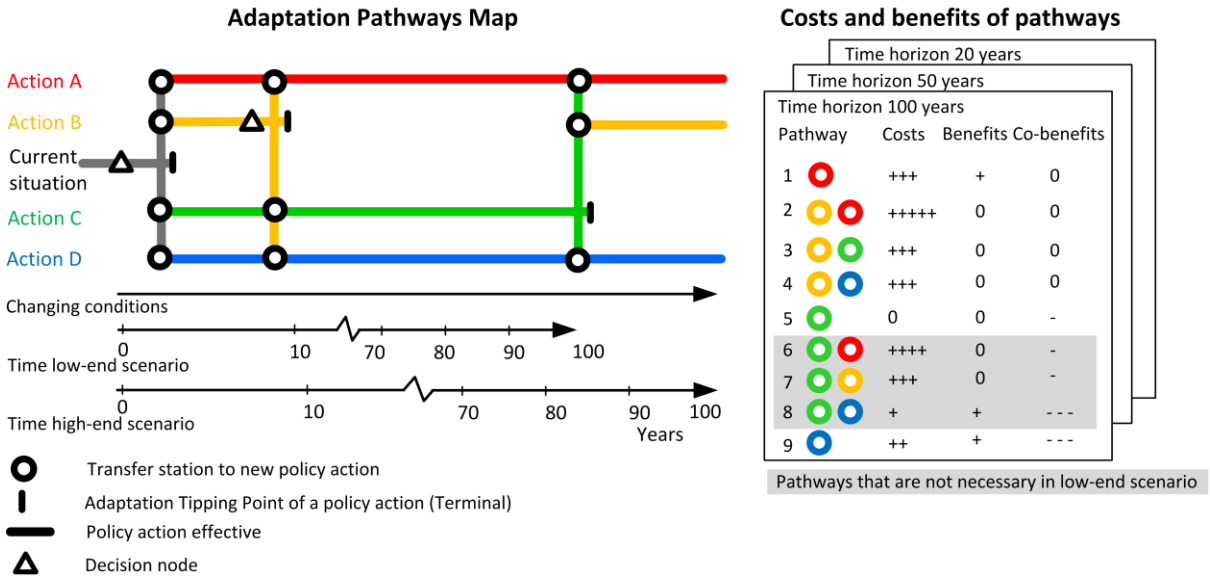


Figure 6.1: An archetype adaptation pathway

Source: Haasnoot et al, Deltares[16]

Adaptation Pathways underpin key principles and approaches of Adaptive Delta Management in the BDP2100, with the goal of ***becoming a more flexible, robust and resilient delta.***

The most important of these principles and approaches with respect to ADM in the BDP2100, are:

Holistic planning: Addressing problems of a system in a comprehensive way, viewing the system in relation with its interdependent elements. Multiple policy domains may be involved

Integrated approach: Combination of relevant elements to understand the total system

[16] Haasnoot M., H. Middelkoop, A. Offermans, E. van Beek, W.P.A. van Deursen. Exploring pathways for sustainable water management in River deltas in a changing environment. Climatic Change

Adaptation Pathway: A sequence of measures to achieve a set of goals under changing external conditions, like climate or socio-economic factors; and Adaptation Tipping Point: Threshold conditions under which an action or strategy no longer meets goals or standards

Adaptation Tipping Point: Threshold conditions under which an action or strategy will no longer meet a set of predefined policy or strategic goals or standards

Scenario: A plausible narrative of potential future conditions, to serve as a basis for action (Van Notten, 2005). In ADM, scenarios describe the 'external context' that are outside one's influence, and mostly policy-free

Strategy: From Delta Vision point of view Strategy is a coherent combination of measures that contributes to reaching the Delta Goals.

6.2 Application in the NW Basin

There are two cases in NW where uncertainty plays a large role and where adaption pathways add value to the analysis, programming, implementation and monitoring:

- Groundwater management in the Barind, preserving a previous resource for future generations
- Restoring Chalan beel as a multifunctional landscape

Both cases involve adapting to changing scenario (climate and socio-economic, land use) conditions and a substantial degree of uncertainty which has a strong influence on both near- and medium- and long term decisions. These cases are illustrated in the sections below.

6.2.1 Sustainable groundwater management in the barind

The Barind or NW strategy 1: *Balancing Supply and Demand for Sustainable and Inclusive Growth,* was developed in the BDP2100 to foster sustainable groundwater management in the Barind and discussed in more detail in Chapter 1 of this document. The strategy is formulated as:

Ensuring water availability by balancing supply and demand for sustainable and inclusive growth lies at the heart of the first Strategy for northwest region. Increased droughts and water shortages for different socio-economic sectors are expected in the future and, if one continues with the 'business as usual' strategy, these constraints will hamper the sustainable growth as envisaged by Government in the National Sustainable Development Strategy (NSDS, 2013, GED). Two of the three developed sub-strategies are focused specifically on promoting that balance between supply and demand:

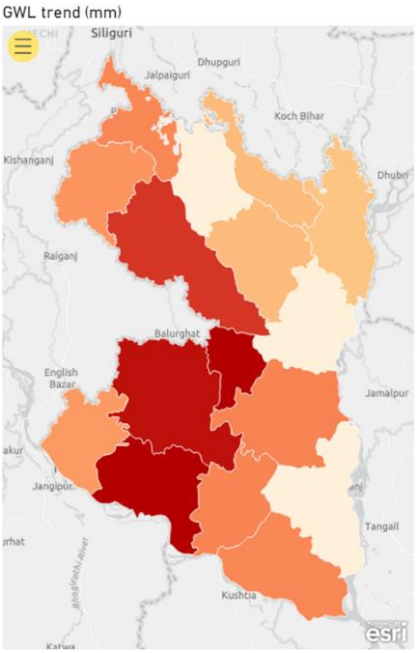


Figure 6.2: Groundwater level trend in the Barind (red = declining, source: Bangladesh Metamodel)

- Sub-strategy 1.1: Supply management and additional irrigation

Where adequate water resources exist or can be developed, from the Ganges and regional rivers, this sub-strategy is geared towards providing additional irrigation water for sustainable and inclusive growth. The key beneficiary of this sub-strategy is the agriculture sector and, where valuable groundwater supplies can be substituted by surface water resources, benefitting the environment, and water supply and industry sectors. Sustainable operation & maintenance of irrigation systems is a particularly essential feature of this sub-strategy.

- Sub-strategy 1.2: Demand management and efficient water use

This sub-strategy is aimed at reducing the demand for freshwater, for those areas where additional water resources cannot be (economically) developed or where more urgent socio-economic priorities such as safe water supply, industry, ecology or navigation receive a higher priority. A mix of interventions is included, consisting of less water consuming crops to more efficient irrigation and more effective management and pricing.

The measures or projects to support these strategies have been further elaborated in this implementation programme, visualized here below. The *increased supply* strategy entails enhancing water resources from

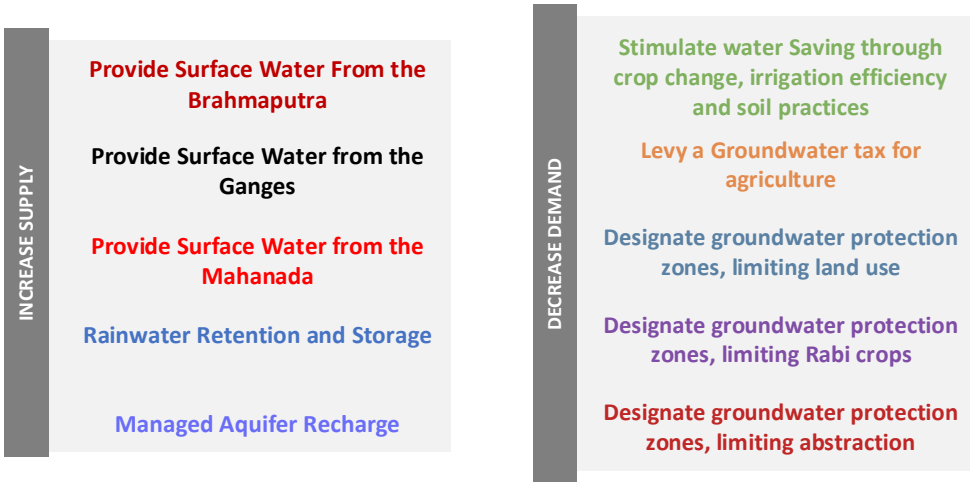


Figure 6.3: Identified measures as part of the adaptation pathway for sustainable groundwater management in the Barind

Source: This implementation programme

surface water to replace the use of groundwater for irrigation, to allow the aquifer to recover for use for domestic or other high value purposes. In the adaptive delta management approach, no-regret measures are preferred to start with, which are supplemented by additional measures when their effectiveness in reaching the goals (or *measure lifetime*) is no longer adequate and new measures are needed. By definition, no-regret measures provide adequate benefits, regardless of the future scenario. These early adaptation measures should also be flexible to allow for adaptation to changing bio-physical and socio-economic conditions. This does not mean that large, infrastructure works are not included in the sequence of measures but simply that first, more adaptive and locally tailored measures are preferred.

In this case, the first intervention is Managed Aquifer Recharge (or MAR), followed by or carried out in combination with surface water retention and storage, as visualized here below by the black circle or *transfer point*. In the pathway below, five measures are included, from small scale and localized measures such as MAR and small-scale storage and retention to larger, more costly interventions such as pumping surface water from the Mahananda, Ganges and ultimately, the Brahmaputra rivers. Viewed from the perspective of adaptive delta management, the measures also become progressively more complex to adapt to changing conditions. The large measures such as providing irrigation from the Ganges (through pumping) and the Brahmaputra (through a combination of gravity flow and pumping) also require more time to prepare and implement: the *implementation lead time*. This is visualized by the smaller dashed line. The larger dashed line signifies that a measure becomes less effective over time, such as the case for MAR. The black stop bar signifies that a *measure is no longer effective*. The narrow lines below the graph illustrate the changing scenario conditions according to the *selected scenario*, for which the pathway is developed, in this case *Active* and *Productive scenarios*.

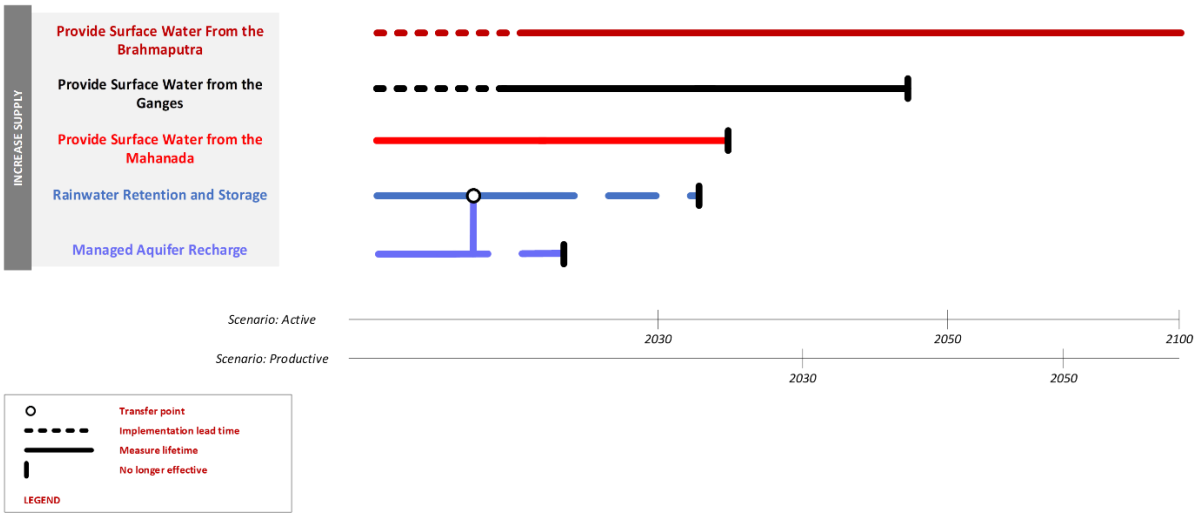


Figure 6.4: Increase water supply measures side by side

The next step in developing the pathway is assessing the (combined) effectiveness of measures using quantitative analysis or and expert judgement, in this case, expert judgement by the multidisciplinary SIBDP team was used, along with partial analysis with the Bangladesh metamodel[17]. Based on this analysis, a pathway is developed, visualizing the most optimal adaptive *increase water supply* strategy. This adaptation pathway is visualized here below. A transparent line indicates that a measure is not (yet) considered as other measures are still effective in reaching the goal.

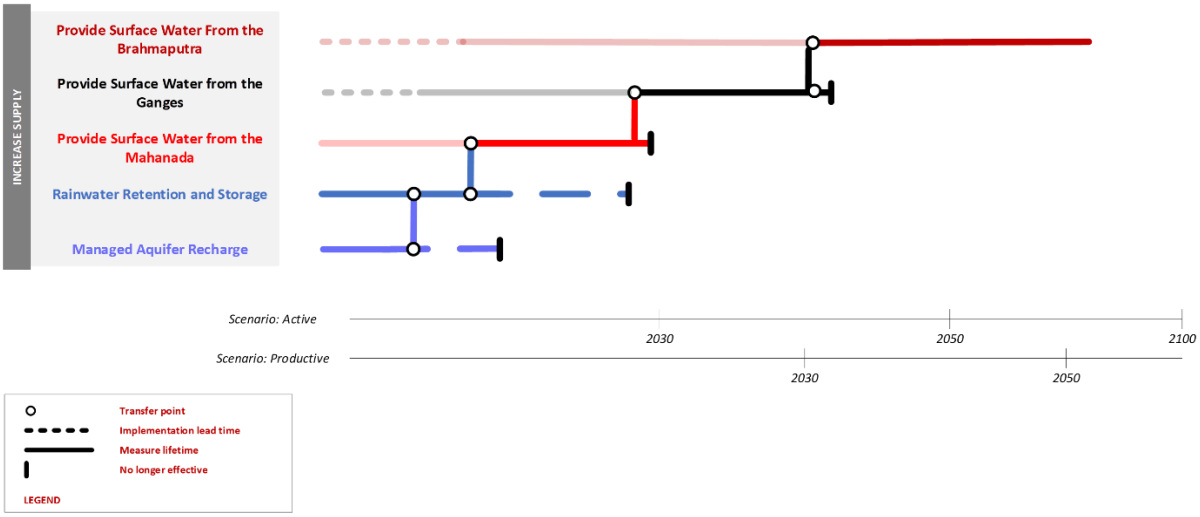


Figure 6.5: Increase water supply measures in the adaptation pathway

On the other side, a demand-based strategy offers opportunities, called the *decrease demand* strategy above. Following the same logic as described above for the *increase water supply strategy*, we start with no-regret measures which can be implemented locally and adapted easily to different scenarios. In this case, the measure is to further stimulate crop diversification by moving from high water demanding crops, primarily Boro rice, to less water demanding crops. If that measure does not lead to reaching the goals,

[17] The analysis with the metamodel should be carried out in more depth when moving to the next planning stage: preparing for implementation and investment

then we move on to more complex water demand reducing measures such as levying a groundwater use tax for agriculture and designating groundwater protection zones. These additional, measures are not necessarily expensive, such as the large-scale surface water development in the *increase water supply* strategy, but they are complex to implement and enforce.

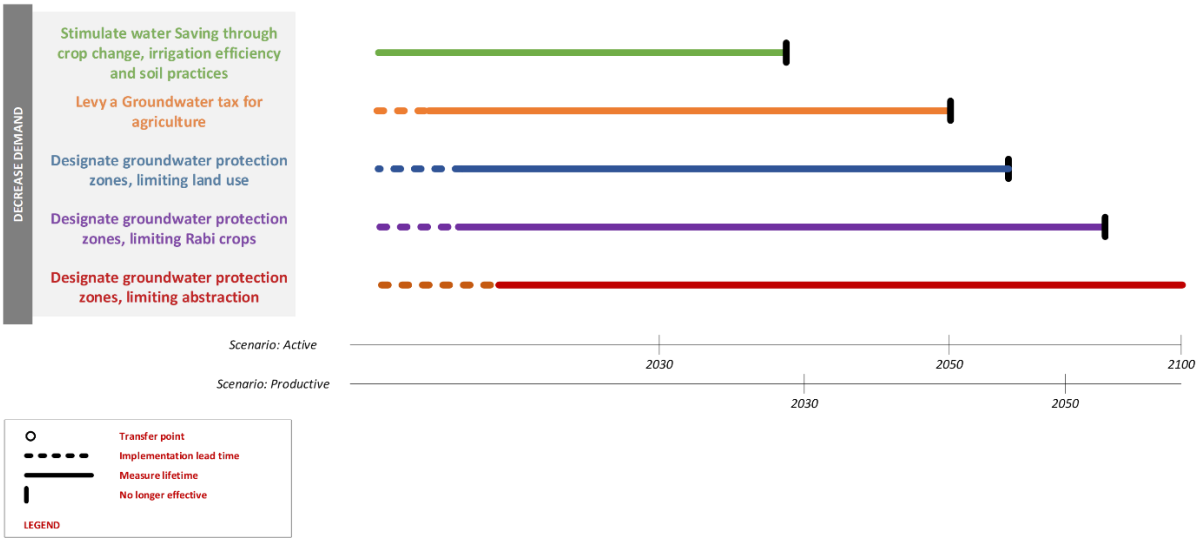


Figure 6.6: Decrease water demand measures side by side

The next step in developing the pathway is assessing the (combined) effectiveness of measures using quantitative analysis or and expert judgement, in this case, expert judgement by the multidisciplinary SIBDP team was used, along with partial analysis with the Bangladesh metamodel. Based on this analysis, a pathway is developed, visualizing the most optimal *decrease water demand* strategy. This adaptation pathway is visualized here below. A transparent line indicates that a measure is not (yet) considered as other measures are still effective in reaching the goal.

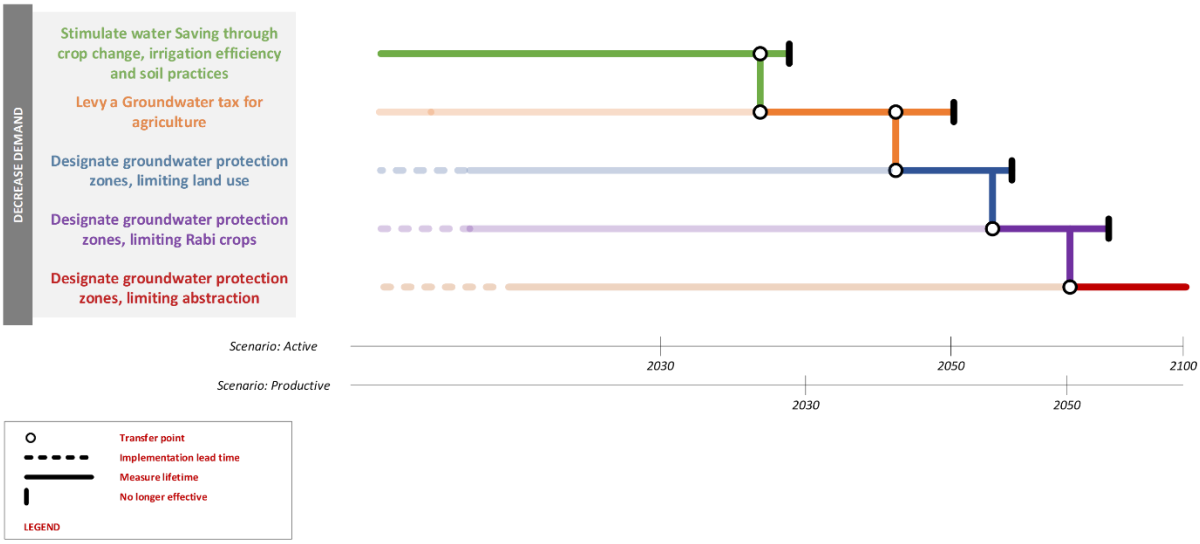


Figure 6.7: Decrease water demand measures in the adaptation pathway

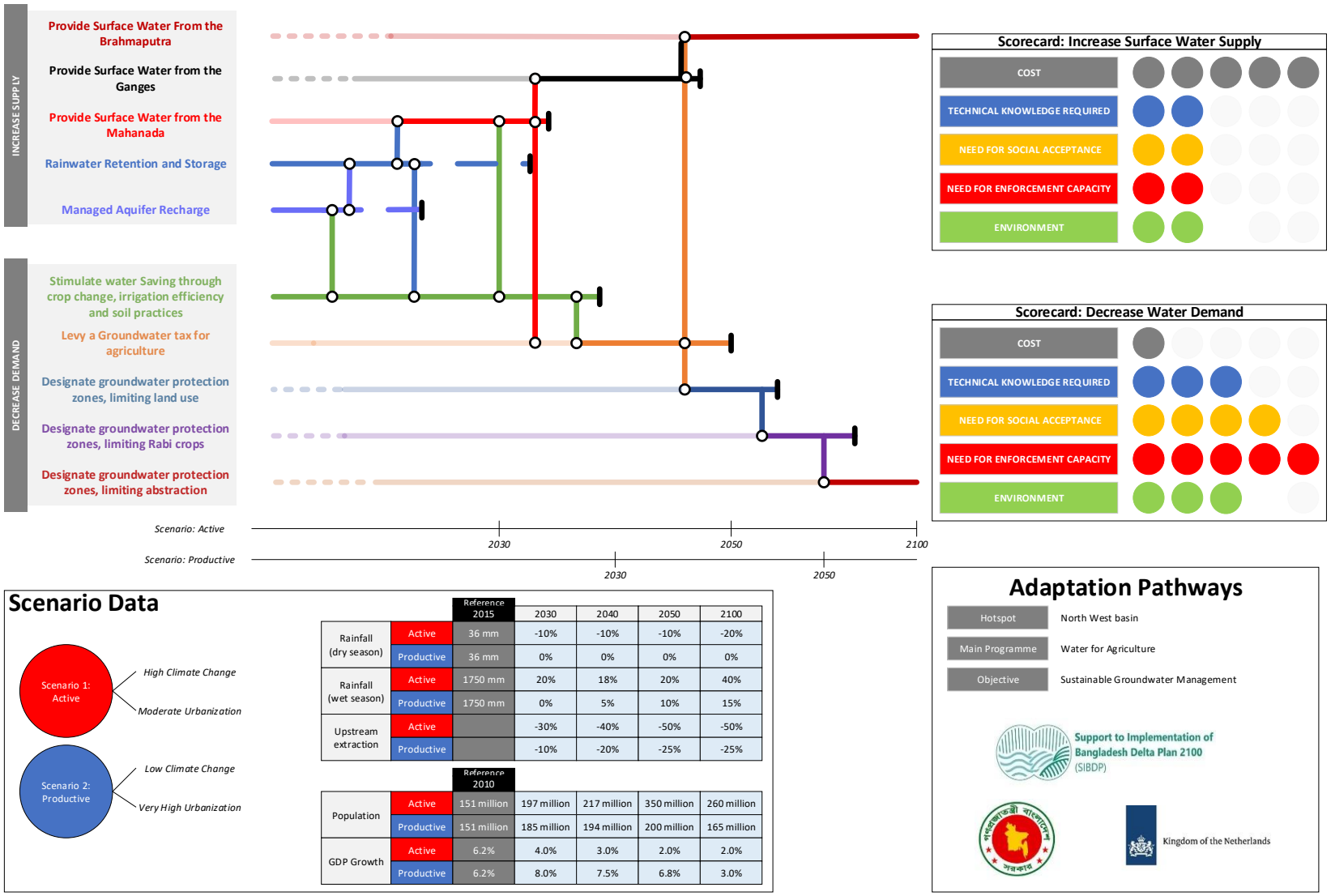
The final step towards developing an integrated adaptation pathway is by combining the *increase water supply* and *decrease water demand* measures into one adaptation pathway. This is done by making logical combinations of measures from both strategies. One such logical combination is visualized here below, but it should be understood that such combinations need to be well analyzed and compared to reach a firmer conclusion.

The adaptation pathway therefore serves two purposes: i) it visualizes and structures measures in time, taking into account changing external scenario conditions, to facilitate taking decisions on the most optimal (combination of) measures, and ii) it helps policy makers and planners to be prepared for future changes and by already having identified and analyzed a portfolio of projects and investments.

This does not mean that the adaptation pathway replaces existing forms of assessment, comparison and analysis such as Multi Criteria Analysis or Social and Environmental Cost Benefit Analysis. Rather, it complements these approaches and uses information from those forms of integrated assessment to develop a well-prepared adaptation pathway. The more uncertain the future, the more beneficial the adaptation pathways are for planners and decision makers.

Comparing measures and strategies is not straightforward as we are assessing them against a wide range of indicators, in line with the holistic, adaptive and integrated approach of the BDP. For this purpose, we use scorecards which simplify the presentation of decision-making indicators. Deeper analysis can then be carried out to compare (combinations of) measures and strategies in more detail.

These measures have been structured into one integrated adaptation pathway, here below.



		Reference 2015	2030	2040	2050	2100
Rainfall (dry season)	Active	36 mm	-10%	-10%	-10%	-20%
	Productive	36 mm	0%	0%	0%	0%
Rainfall (wet season)	Active	1750 mm	20%	18%	20%	40%
	Productive	1750 mm	0%	5%	10%	15%
Upstream extraction	Active		-30%	-40%	-50%	-50%
	Productive		-10%	-20%	-25%	-25%

		Reference 2010				
Population	Active	151 million	197 million	217 million	350 million	260 million
	Productive	151 million	185 million	194 million	200 million	165 million
GDP Growth	Active	6.2%	4.0%	3.0%	2.0%	2.0%
	Productive	6.2%	8.0%	7.5%	6.8%	3.0%

Figure 6.8: Adaptation Pathway Sustainable groundwater management in the Barind

6.2.2 Restoring Chalan Beel as a multifunctional landscape

The Barind or NW strategy 2: *Minimizing losses due to floods and drainage congestion,* was developed in the BDP2100 to alleviate floods and drainage congestion in the Barind and NW basin, discussed in more detail in Chapter 1 of this document. The strategy is aimed at protecting existing assets, lives and livelihoods and providing the conditions for continued investment, development and prosperity. A balance is needed between safe and productive living and economic conditions, free from disruptive floods and drainage congestion, and long-term provision of key ecosystem services such as groundwater recharge, water quality and ecological connectivity. This strategy is therefore closely linked to wetland and beel restoration (included in the *Barind or NW strategy 1*) and the aim is to minimize the negative impacts of floods whilst not jeopardizing the positive impacts. The relevant sub-strategies are:

- Sub-strategy 2.1: Minimizing losses due to floods

Climate change and the increasing value of assets in the NW basin will lead to an increased flood risk up to 2050 and beyond. The lower part of the basin is typically most affected by floods during the monsoon when prolonged and intense rainfall coincides with high water levels in the main rivers, impeding drainage. Many FCD systems were designed over 25 years ago and are in urgent need of repair and modernization. A key aspect is considering multiple functions and interests and appreciating the positive impacts of flooding: replenishment of beels and wetlands, fish migration and spawning, groundwater recharge and flushing of nutrients and pollutants from the water system.

- Sub-strategy 2.2: Alleviate waterlogging in urban and rural areas

In the NW, urban and rural area drainage congestion prevails. This is caused by the combined effect of: i) decreased infiltration and increased run-off due to increased built up areas; ii) inadequate maintenance of urban and rural drainage networks; iii) siltation, waste accumulation and encroachment; and iv) insufficient drainage capacity, due to the construction of roads, embankments and other infrastructure on the floodplains without adequate provision for drainage. In addition to economic disruption, health and environmental hazards are key impacts of waterlogging. Infrastructure modification and river management are key elements of this sub-strategy. Smart dredging is advocated, considering natural flow and sedimentation processes.

- Sub-strategy 1.3: Preserve and enhance valuable wetlands and ecosystems

The wetlands and water bodies provide a key source of livelihood for many rural poor in the northwest region. Decreased floodplain connectivity and related degradation of wetlands is mainly caused by past development of roads and infrastructure, and water abstraction for irrigation in the Rabi season. The Chalan beel restoration programme lies at the heart of this sub-strategy, including infrastructure modification and restoration of beels for fisheries and ecological purposes.

The measures or projects to support these strategies have been further elaborated in this implementation programme, visualized here below:

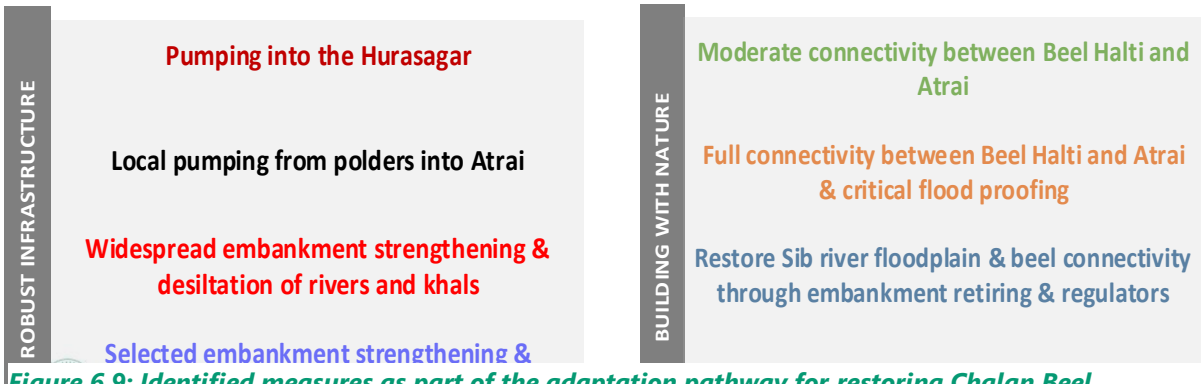


Figure 6.9: Identified measures as part of the adaptation pathway for restoring Chalan Beel

Source: This implementation programme

Following the same approach as outlined above on groundwater management in the Barind, an integrated adaptation pathway was developed to analyse and structure the measures for the restoration of Chalan Beel as a multifunctional landscape. Again, two broad strategies are developed; the *robust infrastructure* and the *building with nature* strategy. Although, analysis was carried out using the Bangladesh metamodel (see also Annexes B and C of this report), the below transfer points and implementation lifetimes were determined using expert primarily, with the metamodel results providing quantitative information to inform the expert analysis.

In this case, the first intervention is strengthening of the selected embankment, followed by or carried out in combination with widespread embankment strengthening, as visualized here below by the black circle or *transfer point*. In the pathway below, four measures are included, from small scale and localized measures such as strengthening embankment to larger, more costly interventions such as pumping into the Atrai and ultimately to the Hurasagar. Viewed from the perspective of adaptive delta management, the measures also become progressively more complex to adapt to changing conditions. The large measures such as pumping into the Atrai and Hurasagar also require more time to prepare and implement: the *implementation lead time*. This is visualized by the smaller dashed line. The larger dashed line signifies that a measure becomes less effective over time, such as the case for strengthening the embankment. The black stop bar signifies that a *measure is no longer effective*. The narrow lines below the graph illustrate the changing scenario conditions according to the *selected scenario*, for which the pathway is developed, in this case, *Active* and *Productive scenarios*.

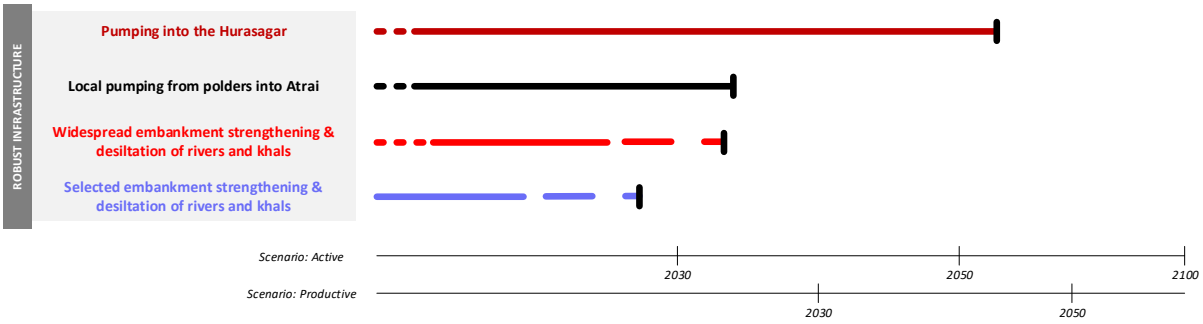


Figure 6.10: Robust infrastructure measures side by side

The next step in developing the pathway is assessing the (combined) effectiveness of measures using quantitative analysis or and expert judgement, in this case, expert judgement by the multidisciplinary SIBDP team was used, along with partial analysis with the Bangladesh metamodel[18]. Based on this analysis, a pathway is developed, visualizing the Robust infrastructure strategy. This adaptation pathway is visualized here below. A transparent line indicates that a measure is not (yet) considered as other measures are still effective in reaching the goal.

[18] The analysis with the metamodel should be carried out in more depth when moving to the next planning stage: preparing for implementation and investment

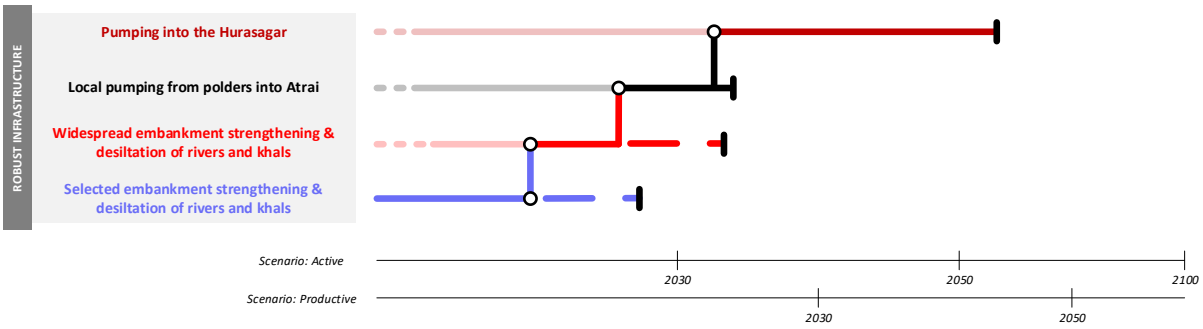


Figure 6.11: Robust infrastructure measures in the adaptation pathway

On the other side, a nature-based strategy offers opportunities, called the *building with nature* strategy above. Following the same logic as described above for the *Robust infrastructure*, we start with no-regret measures which can be implemented locally and adapted easily to different scenarios. In this case, the measure is to moderate connectivity to full connectivity of beel Halti and Atrai. If that measure does not lead to reaching the goals, then we move on to more complex measures such as restoring floodplain through embankment retirement and regulators. These additional, measures are not necessarily expensive, such as the depoldering in the *building with nature* strategy, but they are complex to implement and enforce.

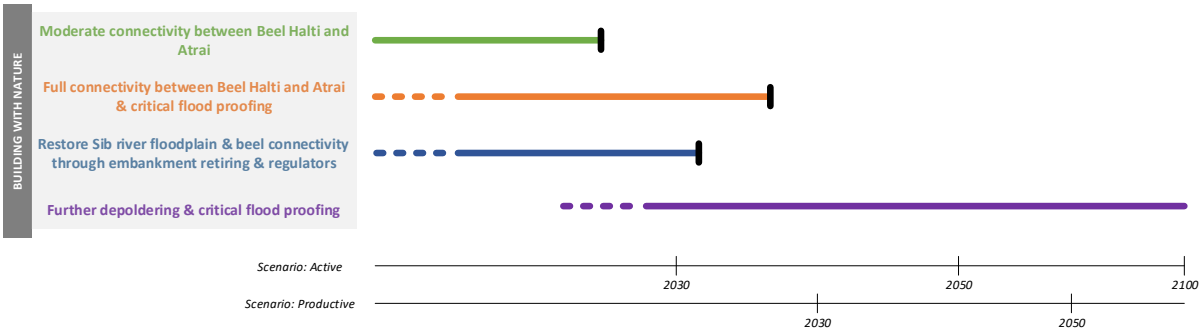


Figure 6.12: Building with nature measures side by side

The next step in developing the pathway is assessing the (combined) effectiveness of measures using quantitative analysis or and expert judgement, in this case, expert judgement by the multidisciplinary SIBDP team was used, along with partial analysis with the Bangladesh metamodel. Based on this analysis, a pathway is developed, visualizing the *building with nature* strategy. This adaptation pathway is visualized here below. A transparent line indicates that a measure is not (yet) considered as other measures are still effective in reaching the goal.

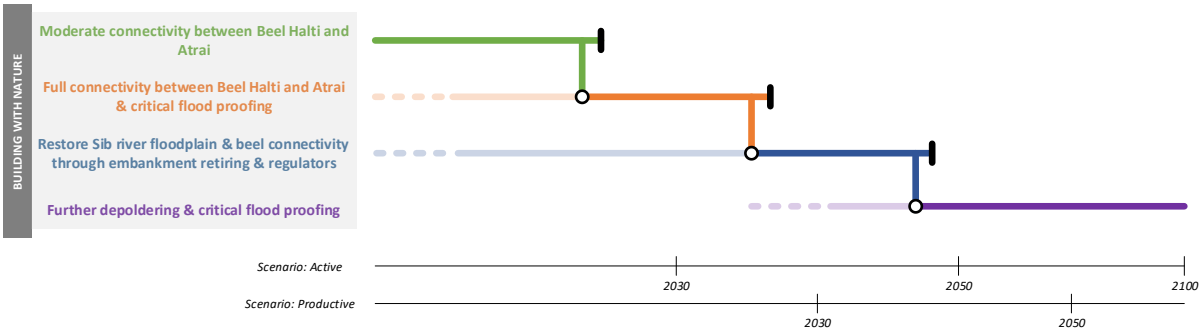


Figure 6.13: Building with nature measures in the adaptation pathway

The final step towards developing an integrated adaptation pathway is by combining the *Robust infrastructure* and *Building with nature* measures into one adaptation pathway. This is done by making logical combinations of measures from both strategies. One such logical combination is visualized here below, but it should be understood that such combinations need to be well analyzed and compared to reach a firmer conclusion.

The adaptation pathway therefore serves two purposes: i) it visualizes and structures measures in time, taking into account changing external scenario conditions, to facilitate taking decisions on the most optimal (combination of) measures, and ii) it helps policy makers and planners to be prepared for future changes and by already having identified and analyzed a portfolio of projects and investments.

This does not mean that the adaptation pathway replaces existing forms of assessment, comparison and analysis such as Multi-Criteria Analysis or Social and Environmental Cost-Benefit Analysis. Rather, it complements these approaches and uses information from those forms of integrated assessment to develop a well-prepared adaptation pathway. The more uncertain the future, the more beneficial the adaptation pathways are for planners and decision-makers.

Comparing measures and strategies is not straightforward as we are assessing them against a wide range of indicators, in line with the holistic, adaptive and integrated approach of the BDP. For this purpose, we use scorecards which simplify the presentation of decision-making indicators. Deeper analysis can then be carried out to compare (combinations of) measures and strategies in more detail.

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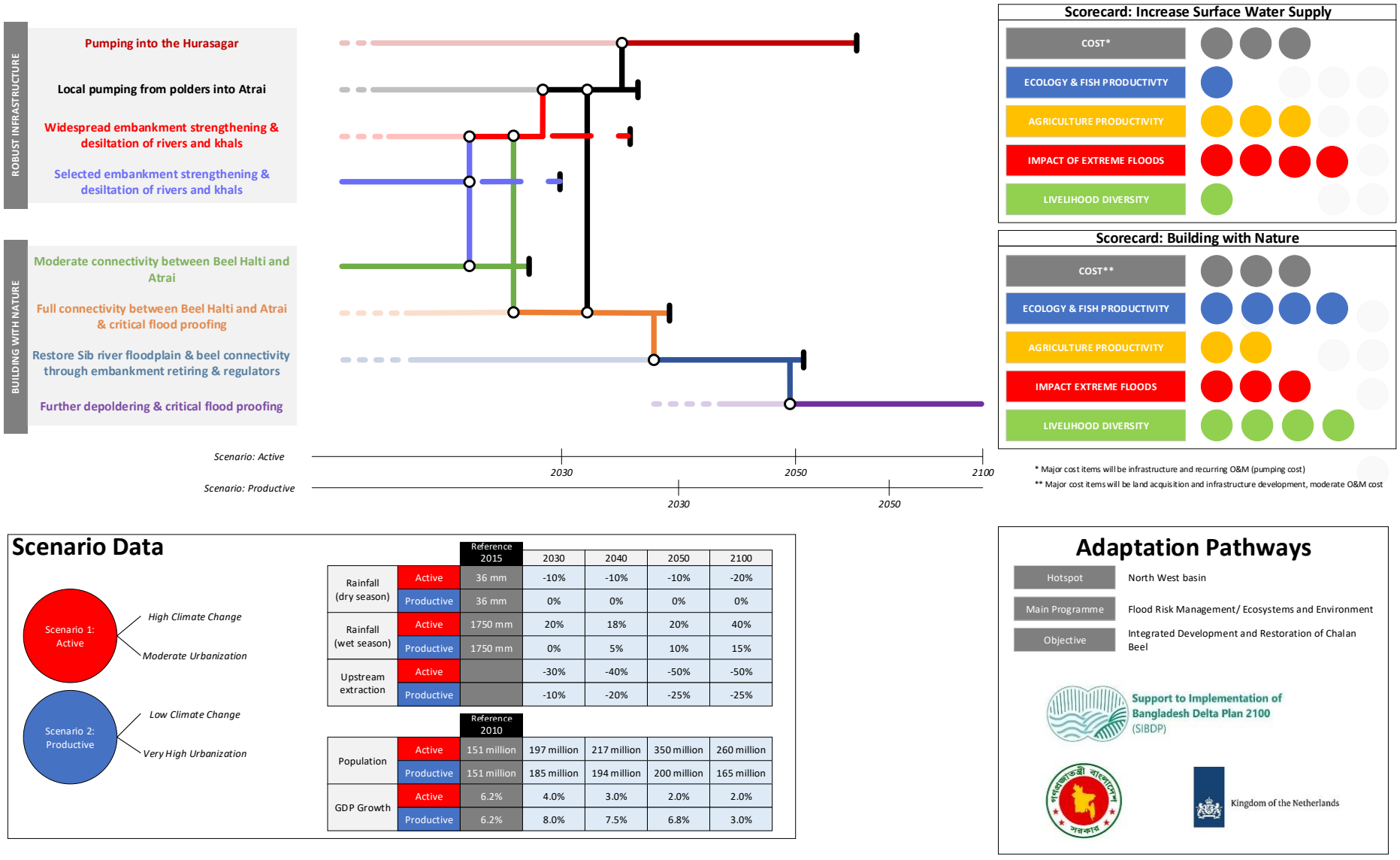

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		Reference 2010				
Population	Active	151 million	197 million	217 million	350 million	260 million
	Productive	151 million	185 million	194 million	200 million	165 million
GDP Growth	Active	6.2%	4.0%	3.0%	2.0%	2.0%
	Productive	6.2%	8.0%	7.5%	6.8%	3.0%

Figure 6.14: Adaptation Pathway restoring Chalan Beel

Annex A: Concept Notes Existing and Newly Developed Programmes and Projects

A1: NW FRM Programme

A1.1 Existing Concept *Notes* (From BDP2100 Investment Plan)

Project Name: Revitalization and restoration of Beel Halti

DP 1.2 REVITALIZATION AND RESTORATION OF BEEL HALTI

BACKGROUND

Flood control and drainage (FCD) projects undertaken so far have been unable to fulfill their stated objectives. They have caused adverse economic, social and environmental impacts. Examples of adverse impacts include crop damage, loss of wetland, damage to fisheries, and closure of navigation routes. Further, construction of embankments and improvement of drainage facilities resulted in loss of flood plains and bio-diversity.

PROJECT DESCRIPTION

This project will focus on integrated water management. It will also address technical considerations like flood flow management and drainage improvement during the wet seasons and water management to meet irrigation requirements during the dry season. Social and environmental concerns will be addressed through local stakeholder engagement, and design and operation of structures and embankments. The project also seeks to restore beels, revive fisheries, and improve water navigation in the area.

The project has an estimated implementation period of 4 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Restoration of the Chalan Beel, (ii) Improved Protection against Normal Flooding, (iii) Conservation and Preservation of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs.

EXPECTED BENEFITS

The project is expected to increase cropping intensity by approximately 6.72 per cent as a result of better flood and drainage management. Crop production is also expected to increase due to increased crop area, reduced crop destruction due to floods and augmentation of surface water irrigation. Other benefits include enriched soil fertility, longer fishing periods and employment.

The project has an estimated economic benefit-cost ratio of 1.40.

RESPONSIBLE MINISTRY

Ministry of Water Resources

EXECUTING AGENCY

Bangladesh Water Development Board

DELTA PLAN GOAL(S)

#1 *Ensure safety against water and climate change related disasters*
#2 *Ensure water security and efficiency of water usages*
#4 *Conserve and preserve wetlands and ecosystems and promote their wise use*

FINANCING

	Mil BDT	Mil USD
Capex	4,763	60
Opex	111	1

**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- Rajshahi, Naogaon, Bogra, Pabna and Sirajganj Districts
- Bounded by Naogaon-Mohadevpur road and Santahar-Bogra railway line in the North, Rajshahi-Charghat road and Baral-Nandakuza river in the West and Bogae-Nagarbari highway in the East
- 5,66,666 hectares of gross project area; 75 per cent of which is cultivated

Source: GED, DP1.2 Project Concept Note

FINANCE AND DELIVERY MODALITY

Since there is no potential for private financing or climate financing, this project will have to be delivered by the public sector.

Project Name: Revitalization & Restoration of Hurasagar & Atrai Rivers

DP 1.3 Revitalization & Restoration of Hurasagar & Atrai Rivers

Background

Almost all of Bangladesh's rivers have silted up due to sediment flow from upstream areas. This includes the Hurasagar and Atrai Rivers. Siltation is impeding navigation during the dry season along these rivers. Siltation has also made their banks more prone to erosion, increasing the risk of flooding. In addition, the ecological carrying capacity of both rivers has reduced over time.

Project Description

This project involves dredging the Hurasagar and Atrai Rivers to increase their discharge capacity and navigability. The project also involves 30km of river bank protection works along the Atrai River to protect against erosion.

The project has an estimated implementation period of 2 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Improved Protection against Normal Flooding, (ii) Improved Protection against Normal Flooding, (iii) Improved Protection against Normal Flooding Protection and Improvement of Major River Banks against Erosion.

Expected Benefits

River bank protection works will mitigate erosion and increase resilience against flooding. The dredging will also mitigate against bank erosion and flooding. The interventions will also facilitate agriculture and fisheries, as well as river navigation. It is also expected that dredging will lead to ecological restoration due to increased river flow during the dry seasons.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

Bangladesh Water Development Board

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*
#2 *Ensure safety against water and climate change related disasters*
#3 *Ensure integrated river systems and estuaries management*
#4 *Conserve and Preserve Wetlands and Ecosystems and Promote their Wise Use*
#6 *Achieve optimal and integrated use of land and water resources*

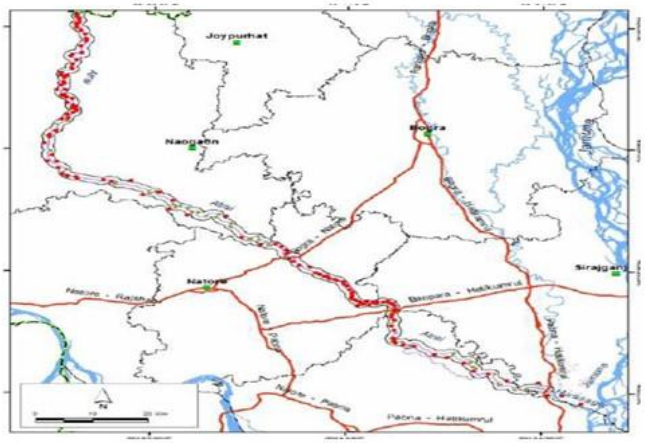
Financing

	Mil BDT	Mil USD
Capex	89,522	1,128
Opex	25,694	324

**Costs are estimated—to be refined through feasibility study.*

Project Area

- Nagaon, Pabna, Sirajganj Districts



Source: GED, DP1.3 Project Concept Note

Finance and Delivery Modality

Since there is no private financing or climate financing potential, this project will have to be delivered by the public sector.

Project Name: Program for Implementation of Rationalized Water Related Interventions in Hurasagar Basin

DP 1.21 IMPLEMENTATION OF RATIONALIZED WATER RELATED INTERVENTIONS IN HURASAGAR BASIN

BACKGROUND

The Hurasagar basin waterways are of poor quality because of industrial waste from industrial expansion without effective effluent treatment plants (ETPs), as well as high levels of fecal sludge. Industrial growth has also led to increased demand for water. Collectively, these issues have led to flood and drainage problems, drought and low flow, river navigation problems, loss of habitat and species, deterioration of water quality, and agricultural damage.

PROJECT DESCRIPTION

The project consists of a program preparatory study to fully define the problem and establish finalized solutions, before moving on to full program implementation. Possible program components include infrastructure modernization (dredging, reinforcing river banks, housing resilience, strengthening sluices, restoring beels, and establishing effective ETPs for industry), knowledge building (flood flow zoning, flood risk assessment and forecasting) and institutional support (participatory water management).

The project has an estimated implementation period of 10 years. The project is linked to the following Delta Plan strategies: (i) Improve Drainage and Prevent Water Logging in Chittagong and Barisal and Other Large Urban Cities with High Economic Density, (ii) Ensure Freshwater Supply to Support the Industrial Growth, (iii) Improvement of Conveyance Capacity and Navigability of the Rivers, (iv) Improvement of the Water Quality as per Local and International Standard by Reducing the Pollution of Water from Point and Non-point Sources of Pollution.

EXPECTED BENEFITS

Expected benefits include reduced vulnerability to flooding, reduced health impacts from poor water quality, improved river navigation, reduced bank erosion, faster responses to emergency situations, and reduced loss of habitat and species.

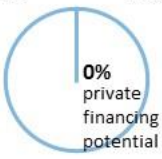
A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

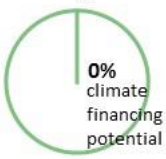
DELTA PLAN GOAL(S)

#1 *Ensure safety from floods and climate change related disasters*
#2 *Ensure water security and efficiency of water usages*
#3 *Ensure sustainable and integrated river systems and estuaries management*
#4 *Conserve and preserve wetlands and ecosystems and promote their wise use*
#5 *develop effective institutions and equitable governance for water resources management*
#6 *Achieve optimal use of land and water*

FINANCING

	Mil BDT	Mil USD
Capex	15,934	201
Opex	250	3





**Costs are estimated—to be refined through feasibility study.*

RESPONSIBLE MINISTRY

Ministry of Water Resources

EXECUTING AGENCIES

BWDB, LGED, BADC, BMDA, WARPO, RHD, DPHE, DAE, DoF, FD, DLS

PROJECT AREA

- Hurasagar Basin (NW Hydrological Region) of Bangladesh
- It encompasses the Rajshahi and Rangpur Administrative Divisions
- It is bounded by the Brahmaputra-Jamuna and Ganges rivers
- The basin includes Rajshahi and Rangpur Divisions

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

Since there is no private financing or climate financing potential, this project will have to be delivered by the public sector.

A1.2 New Concept Notes

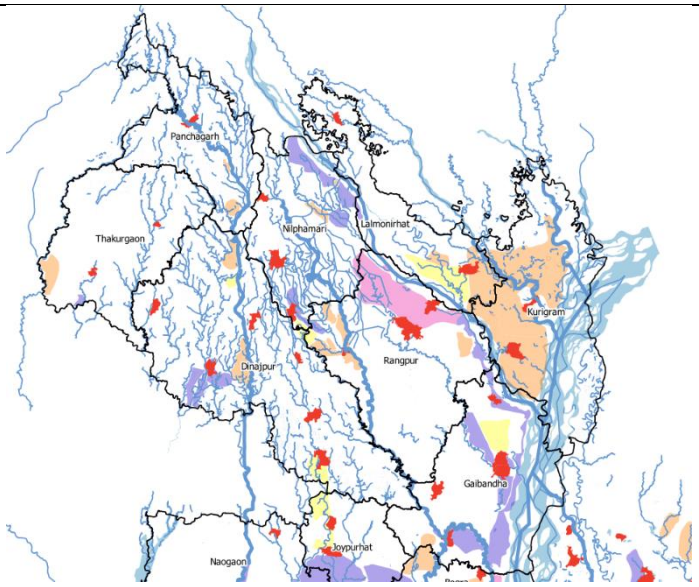
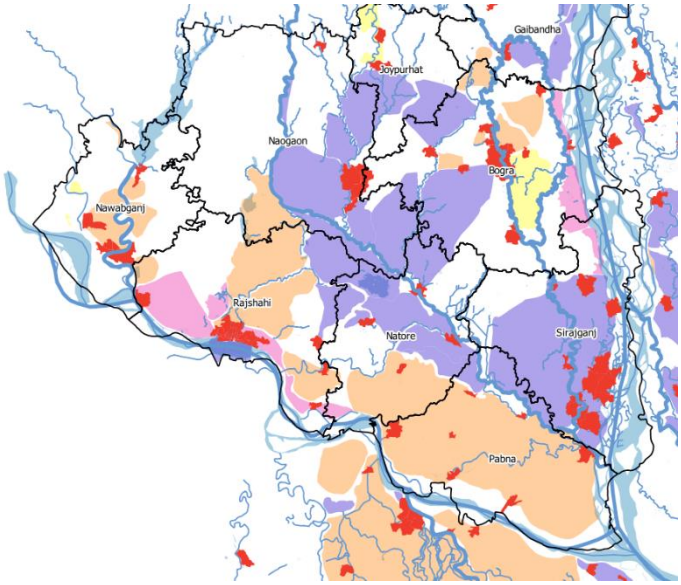
Project Name: Rationalization program of Water Sector Projects in Hurasagar Basin (incl. perennial river system-approach)

Project Title:	***Rationalization program of Water Sector Projects in Hurasagar Basin (incl. perennial river system-approach)***
Relevant Sector:	Water, Agriculture, Fisheries, Livestock
Location of the Project:	Hurasagar Basin (NW Hydrological Region) of Bangladesh. Rajshahi and Rangpur divisions are within this basin. In the Bangladesh Delta Plan 2100, most of the Barind and Drought Prone area are in this basin.
Relevant BDP Goal & Why this Project is BDP 2100 related:	• Goal 1: Ensure safety against water and climate change-related disasters. • Goal 2: Ensure water security and efficiency of water usages • Goal 3: Ensure sustainable and integrated river systems and estuaries management. • Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use • Goal 5: Develop effective institutions and equitable governance for in-country and transboundary water resources management; • Goal 6: Achieve optimal use of land and water. BDP2100 aims to adopt a holistic approach in which projects will address the management of water security, food security, environmental sustainability, integrated transportation, social and economic growth etc. BDP finds the need for a more integrated, multi-sectoral approach to surface water management. This is a rationalization program with the modernization of the infrastructure. Though the main idea comes from the WMIP project, to make this program holistic and adaptive, lots of other sector's intervention has been added. That is why this project is directly related to the BDP.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	• Infrastructure • Knowledge & Information • Institutional
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Short term (up to 2030)
Project Duration:	10 Years
Rationale:	**Background**: The Hurasagar basin is in the North-West hydrological region of Bangladesh. The Hurasagar basin is the largest hydrological region by its area and encompasses the Rajshahi and Rangpur Administrative Division of 16 Districts and is bounded by the Brahmaputra-Jamuna and Ganges rivers. Its total NCA (net cultivable area) is 2.35Mha. The High Barind is the only elevated land. A large area of depressions or beels exists in the southern part of this region. This area is collectively called 'Chalan Beel'. In the monsoon, the area acts as a huge flood retention reservoir. The main sources of inflow into the region are runoff from local rainfall and spilling from the large bordering rivers, particularly the Jamuna and the Teesta. The Upper Karatoya-Atrai-Baral and the Jamuneswari-Karatoya-Bangali are the two main river

	systems draining the greater part of the North-West region. These two river systems drain into the Hurasagar River. Rivers in the northern part, are mostly cross-border rivers and flashy in nature. Except the Mohananda all other rivers drain into the Jamuna River, so their drainage and downstream condition is governed by stage of the Jamuna River. The drainage pattern in the middle part of the North-West area is complex in nature. The Atrai-Baral basin is characterized by flat topography in its southern part and slightly steeper ground in the north and northwest. The areas between these rivers comprise the inter-fluvial depression of the Chalan Beel, which conveys significant floodplain flows during the monsoon. The Barind Tract and the Atrai basin, a part of the Chalan Beel, are the controlling features for land and river development in this region. Another north-south natural boundary of this region is the right bank of the Jamuna River. Areas along the Teesta River and the right bank of the Brahmaputra-Jamuna River and the south-eastern portion of the area, at the confluence of the Brahmaputra-Jamuna and the Ganges, are subjected to annual flooding during the monsoon season. Other areas are relatively free from flood damage. There are lots of rivers/khals to drain out the excess water. The major agricultural production comes from rice crops. About 10.72 million tons of rice is annually produced in the region, which is about 32% of total rice production of Bangladesh. Among the rice production, Aus, Aman and Boro crops contributes about 4.0%, 40.5% and 55.5% of the total rice production respectively. In the recent years, hi-yielding rice has been introduced. Though the production is high, the water demand for this variety is also very high. To meet up this demand, irrigation is required. The main source of irrigation in this area is groundwater (95.4%, BBS, 2012-13). This huge amount of water extraction causes depletion of GWT. Fish habitats of this area are primarily classified into capture and culture fish habitats. Fish production from open water sources is still considerable as the area is ravaged by a huge expanse of wetlands. The estimated total production of fish in this region is around 518,291 Ton, which comes from both capture (38%) and culture (70%) fisheries. Due to less water in the dry season, the culture fisheries have increased a lot in the recent years. According to the census, total livestock and poultry population is about 53.40 million. Among the livestock and poultry population about 8.83 million are cattle and buffaloes, 6.98 million are goats and sheep, and 37.59 million are fowls and ducks in the region. A lot of industries have also been developed recently which does not have effective ETP. This industrial waste causes environmental and water pollution which are harmful for livelihood, agriculture and fisheries. In the industries, there are also need for water, which has increased drastically. Faecal sludge management is also a problem. Most of the cases, the sludge goes to the rivers/khals which decreases the quality of the surface water. From the early 60s, to reduce those problem, 51 FCD(I) projects have been completed by BWDB in this region. These water sector projects were mainly designed to reduce (agricultural) flood damage and develop irrigation facilities. Due to lacking O&M budgets and capacity, the water infrastructure (e.g. embankments, regulators, etc.) have been deteriorated and is becoming more vulnerable day by day. Further, after implementation they have particularly in the Atrai basin heavily influenced the perennial river system working; leading to unexpected siltation of river bed and hydrological alteration, and leading to hampered ecosystem functioning, due to breaking up the natural interconnections between rivers, wetlands and beels. Current and future demands on the

	water sector project services will change and amplified by population dynamics (e.g. growth and urbanization) and climate change. So, rationalization of the existing water resources development projects with sustainable and efficient water resources management become very important for reducing flood and drought damage and increasing irrigation facilities, food production as well as economic growth. **Problem Statement:** • Erosion along the river banks • Flood and drainage problem in the project area due to siltation • Depletion of GWT due to excessive use of GW irrigation • Drought and low flow • Vulnerability to climate change • Navigation problem due to siltation and human intervention • Lack of proper water use and management • Loss of habitat and species • Deterioration of water quality • Threatening of the potential production of agriculture, fisheries and livestock • Lack of operation and maintenance
Objectives of the project:	The overall objective of the project is to manage the water to protect from flood and increase agricultural, fisheries and livestock production The 51 FCD(I) existing projects need to be assessed on their designed performance, on existing and future needs. The development path of the water sector projects is expected to be in two main ways (Strategy FR 2, page 223 BDP2100): **a) multi-purpose schemes:** • agri-urban development: protection of urban growth centers, special economic zones and industries, critical infrastructure in combination with intensified but small-scale agricultural production. • environmental values development: restoration of wetlands, extensification of agricultural production, intensification of fisheries management **b) agriculture based schemes:** • agricultural production optimization: intensification, large-scale and mechanization of agricultural production supported with full water control The size and layout of existing (and possibly new) schemes need to be re-assessed, as well as their position and role in the overall hydrological water system; i.e. some projects need to be re-delineated (e.g. smaller, larger, split), restoring permanent connectivity between the active river floodplain and beels by lowering embankments, as well as giving room to perennial rivers to restore their natural floodplain (setback of water structures). **Phase 1**: Rationalization assessment (outcome: rationalization implementation programme with prioritized projects) - Develop assessment method - Apply assessment method to all different project areas - Prioritization based on low-performance project areas, sectoral and systemic impacts - Capacity building in different agencies to develop/apply assessment method - Public consultation

	Phase 2: Rationalization design / implementation - Based on performance targets per project area, designate the interventions, e.g. • Conjunctive GW and SW use • Rainwater harvesting • Improve communal SW storage • Improve internal drainage capacity by restoring natural drainage (khals) or pumped drainage • Restoration of beels, ponds, and dighis • Re-delineate flood embankments • Tailor-made regulator design (Drainage, Storage, Fish-passes) • Floodplain zoning / flood-proofing of housing • Riverbank stabilization • Tree plantations on banks and berms • Water supply and sanitation • Increase irrigation efficiency • Adapt cropping patterns to suitable conditions • Fish sanctuaries and production areas • Water treatment from industrial effluents (ETPs) - Regulations on water use for agriculture, livestock, fisheries, domestic, industry etc. - Improve communications network (inter-modal design); flood-free access and functioning of roads - Optimize design to minimize land acquisition and need for resettlements - Promoting of water management organizations, e.g. for O&M, following participatory water resources management guidelines - Research on drought-tolerant cropping varieties Monitoring program
Please Link the result framework (RF) of the project of BDP-2100	
Expected socio-economic benefits:	• Enhanced local initiative in development, management and upkeep of irrigation schemes • Better and sustained maintenance funding for irrigation schemes leading to the reduced social cost • Capacity building activities will create an informed community with long term implications in local community development

Detailed description of the Project:	 **Fig.** Existing water sector projects in Rangpur division (excl. irrigation projects) In the Rangpur division, one can observe two major FCDI schemes (Kurigram district), major river embankments along Teesta and Brahmaputra, and several relatively smaller FCD(I) and sole drainage project areas. It is unclear what the current status and functioning of all these projects are. The density of the projects in Panchagarh, Thakurgaon, Nilphamari and Dinajpur districts suggest that there may be hardly any largescale hydrological system interference and that it may be safe to assume that the existing projects can be valued individually.  **Fig.** Existing water sector projects in Rajshahi division (excl. irrigation projects) In the Rajshahi division, one can observe a larger share of project area. It is clear that for this division one should start with a systemic approach, as the different projects have a high correlation with each other. An intervention in one project will create an impact in the other. 1. **Problem analysis**: What is the nature and size of the specific problems at hand in the region? Flood forecasting scenarios should be part of the analysis. Can problems be grouped over locations? 2. **Possible solutions; types of interventions**: What are the most relevant envisaged

	types of interventions addressing the problems and how can they be grouped? 3. **Pre-feasibility of interventions**: what are potential technical and non-technical interventions (solutions), what are potential costs of these solutions and what type of institutional set-up or capacity building is needed? 4. **Categorization of regions or locations**: How can the target subregion(s) be categorized? What is the right geographic scope for developing separate feasibility studies? 5. **Prioritization and selection**: How can both sub-regions and types of interventions be prioritized? What kind of criteria should be used? What is an appropriate timing and sequencing of interventions? 6. **Synergies**: Can synergies (and conflict) of the program's impacts with other SDG's be identified? 7. **Relevant actors**: What actors are envisaged to be involved? Is any kind of capacity building required?
Indicative cost: (in lac taka)	
O&M cost:	
Lead Implementing Ministry and Agency:	**Ministry:** Ministry of Water Resources (MoWR), Ministry of Agriculture (MoA), Ministry of Fisheries and Livestock (MoFL)
	BWDB (rationalize FCD/FCDI projects (1000 ha above), stabilize the river banks, promote participatory water management and internal water management, restoration of beels, ponds, dinghies etc.) **LGED** (rationalize FCD/FCDI projects (less than 1000 ha), rehabilitate existing bridges/culverts with proper design considering water passage) **BADC** (ensure conjunctive use of GW and SW, optimize water use using DRAS model or other scientific tools) **BMDA** (develop techniques for GW recharge and ensure it) **WARPO** (flood zoning, assessment, forecasting, water requirement assessment) **RHD** (modify/build bridges ensuring navigation and water passage) **DPHE** (supply fresh water, ensure sanitation facility) **DAE** (disseminate climate smart agricultural technology and product) **DoF** (conserve fish habitat) **FD** (afforestation on banks and berms of the embankment and other potential locations) **DLS** (ensure livestock health, disseminate new LS production technology and ensure production)

Project Name: Revitalization and Restoration of Chalan Beel

Hotspot:	Barind and Drought Prone Area
Project Code:	DP 1.2
Project Title:	***Revitalization and Restoration of Chalan Beel***
GENERAL DESCRIPTION AND STRATEGY & GOAL ALIGNMENT and PLANNING PHASE	
Function: • **Infrastructure** • **Knowledge & Information** • **Institutional**	Infrastructure
Timing: • **Short term (up to 2030)** • **Medium term (2030-2050)** • **Long term (>2050)**	Short term (up to 2030) The project duration is 4 years and may be started at any time between now and 2025.
Location of the Project	The project is located in the districts of Rajshahi, Naogaon, Natore, Bogura, Pabna and Sirajganj. The Project area is bounded by Naogaon-Mohadevpur road and Santahar-Bogura railway line in the North; Rajshahi-Charghat road and Baral-Nandakuza river and Pabna project in the South; Barind tract along the Sib Barnai river in the West; and Bogura -Nagarbari highway in the East. The polders A, B, C & D of Chalan Beel area are located along the right bank of the Atrai river; The Naogaon Polder, Bogura polders 2, 3 & 4 and SIRDP are located along the left bank of the Atrai and therefore, the river Atrai plays the main role in water management of the Chalan Beel area. Impacts of the Chalan Beel are also extended to its southern side on the Baral and Barnai projects which do not form part of the Chalan Beel. Bogura polder 4 is open to natural condition. The Beel Halti is within Chalan Beel Polder C and is a large beel area. The gross area of the project is about 5,66,000 ha of which cultivated area is about 75%. Population is about 5.28 million (2001 census). **Linkages with other pr.ojects** This project is linked with North Rajshahi Irrigation Project (proposed), Ganges Barrage project (proposed), Revitalization and restoration of Hurasagar and Atrai rivers (proposed), River Management Improvement Program (proposed)and Flood and Riverbank Erosion Risk Management Investment Program (under implementation).
Rationale of the Project:	**BACKGROUND** The present project covers a vast area including 11 polders and projects implemented 2 to 3 decades earlier in and around the Chalan Beel which were completed. Full flood control and drainage (FCD) activities of the polders created higher inundation outside the polders, particularly outside of polder-D in the western Barind area. Such adverse impact (inundation) provoked outside dwellers to cut the embankment frustrating the objectives of the projects. PROBLEM STATEMENT • Past flood control and drainage (FCD) projects in the locality have caused adverse impact on economic, social and environmental sectors like loss of income from T. Aman rice cultivation due to uncertainty in monsoon rain, damage of B. Aman rice,

	adverse impact on fisheries, loss of wet land, communication disturbances from cuts and branches in embankments, closure of inexpensive navigation routes etc. • The FCD projects on both banks of the Atrai river could not fulfil all the objectives for which they were conceived. The area once characterised by huge water bodies and extensive flood plains, were the main habitat and breeding grounds for the traditional fish species has been severely affected. • Construction of embankments and improvement of drainage facilities have resulted in loss of flood plains and bio-diversity impacting economic, social and environmental sectors. • Thus there is need to solve the problems of uncertainty in Aman rice cultivation as well as reducing damage to B. Aman, rice, increasing capture fisheries, restoring navigation routes etc.
Detailed description of the Project:	Integrated Water Management involving technical, social and environmental concerns will be addressed under the project. The technical considerations will mainly focus on the issues of flood flow management and drainage improvement during wet season while creating the scope of water management for meeting the dry season irrigation requirement from surface water. The project also offers an excellent opportunity to address the restoration of ecologically particularly valuable beels, the incorporation of the interests of fisheries and navigation in the area. Social and environmental concerns will be addressed through engagement of local stakeholders in a participatory manner (Source: CEGIS (2007) Page 204) and through the design and operation of the structures and embankments. The analysis of existing problems shows that the project area suffers from tremendous flash flooding in the upstream polders while downstream polders suffer from submergence as a result of back water effect generated due to high water level maintained in the downstream in the mighty Jamuna River during the wet season. In addition, the production of fisheries has declined, affecting the livelihoods of the fisher folk. This aspect of the project is likely to be benefitted by the outcome of RMIP and FRERMIP. To briefly describe the concept of present planning, the polders and projects are classified into three clusters and the main river systems where interventions have been chosen for water resources management. As per feasibility study, the project area is divided into 11 Polders or Units including the Chalan Beel Polders A, B, C, and D; Bogura Polders 2, 3, and 4; Naogaon Polder, Baral project, Barnai Project, Sirajganj Integrated Rural Development Project (SIRDP) and the Main Rivers in Natore, Rajshahi, Naogaon, Bogura, Sirajganj and Pabna districts. In the Feasibility Study Report a series of options were tried with different kinds of infrastructures as well as river excavation. The options are; Option-1; this is the base condition or the present condition with lots of public cuts and breaches in the embankment. Option-2; this is the full FCD condition of the polders with no breaches and no spilling over the existing embankments. Option-3a; this adds option-2 with excavation of Atrai River in the downstream. Option-3b; this includes option-2 with excavation of Atrai River in the upstream. Option 3c; this undertakes option-2 with excavation of Sib River. Option-3d; this considers option-2 with excavation of Barnai River. Option-4a; Main public cuts are provided with structures or weirs allowing flood time flow of water through the polders and closing of all breaches. Option-4b; Same as option-4a plus River Fakirni closed by a cross dam. Option-5a; Same as option-4a with the provision of excavation of Sib River as under option-3c and large structures are replaced by low height embankments & Option-5b; same as under option-5a with additional FCD for Beel Halti area only. The results were tabulated for water levels and flooded areas in all the eleven polders. Criteria those were considered are the possibility of public cuts, minimum land

acquisition & rehabilitation, people perception, sustainability of interventions, navigation and fishery development prospects, social acceptability etc.

It was found that of all the options, **option 5(a)** is the best choice from a feasibility perspective as well as the stakeholders choice. Under this option water is allowed inside the polders during flood season allowing migration of fishes and uninterrupted navigation, protecting Rabi crops and boro paddy; and protecting Aman & Aus crops from sudden floods which previously used to be caused due to public cuts. The option also provides additional surface water irrigation during dry reason by means of rubber dams. One additional regulator has been proposed across Baral Nandakuza for additional supplementary irrigation under Baral Project.

A map showing the polders (Units) within the project is attached in **Figure DP 1.2.2.** Infrastructure Components of the Project are given in the following table:

Name of major items	Quantity	Unit/Cost (In Lac Taka)
Re-sectioning of Embankment	304.98 km	km/22.36
Bank Protective Work	5.122 km	km/1159.98
Embankment Slope Protection	41.00 km	km/333.12
Breach closure	3.10 km	km/84.45
Re-excavation of khal/river	220.00 km	km/19.38
Construction of Regulator	9 Nos	No./378.60
Construction of Rubber Dam	3 Nos	No./1129.51
Construction of Water Retention Structure	1 No.	No./568.73
Construction of Inlet/Outlet	18 Nos	No./12.36
Low height embankment	1.94 km	km/917.36
Construction of Bridge	5 Nos.	No./186.27
Rehabilitation of existing structure	118 Nos.	No./3.03

The cost has been calculated on the basis of approved design vetted by BWDB design office and as per approved current schedule of rates of Rajshahi O&M Circle, BWDB, Rajshahi effect from the FY: 2014-15

Objectives:

The overall objective of the project is to enhance the livelihood and food security for the local communities. The project purpose is to protect the lands from flood events and to extend the irrigation coverage in the dry season. The specific objectives of the project are:

- Allow controlled water in the polders in wet season in order to support agriculture, fisheries etc. Besides, water would be made available during dry season for agricultural activities through conjunctive use of surface and groundwater;
- Mitigating adverse environmental impacts of past projects;
- Preservation of biodiversity;
- Promotion of culture fisheries and allowing flood plain capture fisheries.

BDP2100 Goals and Indicators:

The project addresses the following BDP2100 objectives:

- Goal 1: Ensure safety against water and climate change related disasters
- Goal 2: Ensure water security and efficiency of water usages
- Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use

The following BDP2100 sub-indicators are relevant:

- Reduction of flood extent (area, crops, people affected)
- Increasing dry season irrigation coverage

<table>
<tr><td></td><td colspan="2">• Water related ecosystem sustainability
• Ecosystem services and goods harnessing</td></tr>
<tr><td colspan="3">COSTS AND BENEFITS OF THE PROJECT (INCLUDING METHOD OF ESTIMATION)</td></tr>
<tr><td>Indicate source:
• Feasibility Study
• (Pre-)Feasibility Study)
• Project Idea</td><td colspan="2">Development Project Proforma/Proposal (DPP) for Integrated Water Resources Management of Chalan Beel Area including Beel Halti Development Project, BWDB, was updated to 2014/15 prices from Feasibility study (2006/7). Figures referred in CN are from DPP.

The feasibility study has been completed by Engineering & Planning Consultants Ltd (EPC) in association with Design Planning and Management Consultant Ltd.; Bangladesh Engineering & Technological Services Ltd.; and Kranti Associates Ltd. Two separate study named EIA/SIA and Mathematical modelling studies have also been conducted by CEGIS and IWM respectively.

The start date of FS study on March 1, 2006 and submitted final report on August 2007. In the following sections all figures etc are taken from the DPP re-casted in January 2015. It may be noted here that re-casted DPP only updated cost figures. Benefit figures (arising from cropping intensity increase etc.) are kept same.</td></tr>
<tr><td rowspan="2">Investment costs estimate (including method used)
Use FS results</td><td>Financial</td><td>Economic</td></tr>
<tr><td>BDT 4,474.7 million</td><td>BDT 3,405.3 million</td></tr>
<tr><td colspan="2"></td><td>The estimate of cost has been prepared on the basis of approved design vetted by BWDB design office and as per approved current schedule of rates of Rajshahi O&M Circle, BWDB, Rajshahi effect from the FY: 2014-15
Indicative financial cost (2015): 4,751.88 BDT million</td></tr>
<tr><td>Year in which prices are denominated
Use FS results</td><td colspan="2">2014-15 prices</td></tr>
<tr><td rowspan="3">Project Duration & Distribution of investment costs
Use FS results</td><td colspan="2">The project duration: 4 years.
Source (DPP Page 2)</td></tr>
<tr><td>Financial</td><td>Economic</td></tr>
<tr><td>1st Year: BDT 1,431.84 million
2nd Year: BDT 1,081.93 million
3rd Year: BDT 1,617.00 million
4th Year: BDT 3,44.01 million
Total : BDT 4,474.77 million</td><td>1st Year: BDT 1,089.6 million
2nd Year: BDT 823.3 million
3rd Year: BDT 1,230.5 million
4th Year: BDT 261.7 million
Total : BDT 3,405.3 million</td></tr>
<tr><td rowspan="2">Related annual O&M costs estimate (basis Is same year as above) and method used.
Use FS results</td><td>Financial</td><td>Economic</td></tr>
<tr><td>1st Year to 4th Year = BDT 0 million
5th Year to 30th Year = BDT 104 million per year
Source (DPP, Economic Analysis, Appendix F Page 128)</td><td>1st Year to 4th Year = BDT 0 million
5th Year to 30th Year = BDT 93.8 million per year
Source (DPP, Economic Analysis, Appendix F Page 129)</td></tr>
<tr><td colspan="2"></td><td>After completion of the project major repair/rehabilitation works will be accomplished from regular O&M budget of BWDB. Annual O&M works will be done by BWDB's existing manpower.</td></tr>
<tr><td>Total lifetime of project
Use FS results</td><td colspan="2">30 years</td></tr>
</table>

DIRECT and INDIRECT (type of) benefits (description) ***Use FS results***	**DIRECT BENEFITS** • Cropping intensity would be increased by about 6.72% as a result of better flood and drainage management (CEGIS (2007) Page XXIII.) • Crop production would be increased by about 0.26 and 0.49 million metric tons of paddy and non-paddy respectively due to increase of crop area, save the crop from flood damage and augmentation of surface water irrigation etc. Among the non-paddy crops Maize, Garlic, Vegetables and Potato would be increased significantly.	
	INDIRECT BENEFITS • Soil fertility would be enriched due to allowing monsoon flood within the project areas to some extent and increase surface water irrigation • Project activities will create employment opportunities of 0.60 million man days annually and these will contribute to poverty alleviation. • The employment opportunities of agricultural labour will increase by around 9,000 thousand man days per year after implementation of the project. • The length of fishing period will increase from six to seven month and total 1,584 thousand man-days of employment opportunities will be created for the fishing communities. *Source: CEGIS (2007)*	
Estimate Value of each type of Benefits (prices in same year as above) and method used ***Use FS results***	Financial 1st Year to 4th Year = BDT 0 million 5th Year to 30th Year = BDT 1,139.7 million per year Source (DPP, Economic Analysis, Appendix F Page 129	Economic 1st Year to 4th Year = BDT 0 million Agricultural Benefits 5th Year to 30th Year = BDT 908.7 million per year Source (DPP, Economic Analysis, Appendix F Page 129)
Economic Internal Rate of Return: ***Use FS results***	17.14% Source DPP	
Economic Net Present Value: ***Use FS results***	BDT 1,245 million Source: DPP	
Economic Benefit-Cost Ratio ***Use FS results***	1.40 Source: DPP	
Opportunity for private sector:	Not applicable	

ENVIRONMENT OF IMPLEMENTATION AND ITS POTENTIAL IMPEDIMENTS	
Lead Implementing Agency	Bangladesh Water Development Board (BWDB)
Capacity of implementing agency: • ***Sufficient (Y/N)*** • ***Solution, if not?***	Yes

Other stakeholders involved and their role	BWDB will organize and implement programmes for fisheries, agriculture and beneficiaries participation through involvement of DOF, DAE and BRDB respectively.
Actions needed (like a resettlement plan?)	Resettlement action plan (RAP) required. O&M plan for infrastructure.
Risks foreseen and identified mitigation measures.	The implementation and operation is subject to several risks: a) Delayed procurement for civil works would significantly increase the risk of further loss of lands & properties; b) The major flood flow velocities & increased river bank erosion and water levels could exceed the design criteria during the project life; c) Construction cost overruns due to inappropriate design, inexperienced contractors, insufficient funding to complete projects on time and cost escalation along with contractor's financial claims; d) The poor standards of operation and maintenance could jeopardize the works. Besides, adequate funding may not be allocated for execution of timely routine and preventative maintenance upon end of the implementation program; e) The mismanagement of future water sector investment, operation and management could jeopardize project sustainability; f) Inadequate O&M funding would reduce the life of the investments requiring premature rehabilitation. *(Source: DPP, 2015 Page 15)*
Permits needed? If Yes, which ones?	Environmental clearance is mandatory. Environmental clearance has already been taken from DoE
EIA needed?	Study covers the EIA
SIA needed?	Study covers the SIA
Land acquisition required? Y/N	Yes, 8.34 hectare

EXPERTS OPINION	
Adaptive Delta Management ***Based on the 5 ADM principles.*** ***See also Adaptive Delta Management chapter of BDP2100 document***	**1. Adaption for goal achievement:** The program provides a building block for achieving the BDP2100 goals identified in this concept note. **2. Adaptive Pathways & Tipping Points:** This program provides a first step to address identified challenges. Based on Flood risk management strategy, sequencing of cascading projects will be ensured in order to achieve safety standards by 2030. Use input from Concept Note of a study project on "Integrated Modelling to Support Adaptive Delta Management for Water Sector".

	For ground water tipping point research, refer to Concept Note on 'Expansion and Modernization of Monitoring Network and Tools for Sustainable Development, Management and Governance of Groundwater in Bangladesh'. **3. Multi-sectoral:** ADM defines holistic approach with multi-sector and ministerial action. Involvement of other sectors (fisheries, agriculture, livestock, environment, forest etc.) to be included in studies required for project implementation. **4. Avoiding Over- and under-investments:** Involving stakeholders in a timely fashion, cascading need based priority projects, learning by doing. **5. Connect Private and Public agendas:** ADM requires public and private initiatives (PPP, innovative contracting, licencing). In general adhering to cost recovery principles increases the chance for finding windows of opportunity.
Action needed for new FS	• New FS should incorporate the Adaptive Delta Management principles • During feasibility study, the project should be designed involving all sectors i.e. agriculture, fisheries, livestock, navigation, water supply and sanitation, environment and forest and the physical intervention should be identified.
Observation/Comment	**a. <u>The CBA method</u>** Methodology of original 2007 FS is highly questionable with an economic IRR 40.83% and a financial IRR of 41.18%. This seems to have been rationalized in the 2015 DPP with an economic IRR of 17.14% and a financial IRR of 16.65% (although no revenues resulting from project go directly to the state). More fundamentally, it is not correct to calculate NPV, IRR and C/B ratio with updated costs but old benefits – which seems to be the case. NPV and IRR will drop automatically, but the results become invalid. It is not clear of several key benefits such as fisheries, navigation and ecology are part of CBA method – but they should. **b. <u>Risk assessment</u>** A holistic inventory and assessment of different risks associated with the project has not been done to a sufficient extend in FS. **c. <u>Integrated approach of implementation</u>** Where stakeholders have been identified in the study (and Note), this is often done in a 'box-ticking' manner. **d. <u>Institutional capacity assessment</u>** FS does not provide in-depth capacity assessment of implementing agencies.
Comments BDP2100 strategy team	Beel restoration fits with strategy promoting more nature based water management. Need for careful planning and dialogue where agriculture is affected by beel restoration. As the flood and drainage pattern in the area will change, detailed hydraulic modelling should be carried out to optimise the design. Improved early warning systems should be part of the project, to minimise unexpected damages. PWM should be in place at the onset of the project.
Comments GED	• Project is required to be designed keeping in view the entire Chalan Beel area considering all aspects such as water flow, fisheries, crop production and operation of road communication;

	• Maintenance of rich Ecosystem Services of this area is also needed to be taken into consideration
Input Parameter Values for Incorporating Interventions	**Options to be Simulated:** Full FCD condition of the polders with no breaches and no spilling over the existing embankments. Main public cuts are provided with structures or weirs allowing flood time flow of water through the polders, large structures are replaced by low height embankments and closing of all breaches including excavation of Sib River. **Activities Planned to Perform** • Excavation of Sib river • Main public cuts are provided with structures or weirs • closing of all breaches • large structures are replaced by low height embankments **Changed Parameters in Metamodel:** • Water level reduced by 1m at N174 (to imitate the impact of dredging) • In the six districts- Rajshahi, Naogaon, Natore, Pabna, Sirajganj, Bogura- – Increased drainage efficiency to 0.75 (+25%) – Considering SW irrigation – Increased SW irrigation efficiency to 0.45 (+80%) – SW irrigation pump capacity set to $3m^3/s$ – Increased GW irrigation efficiency to 0.6 (+33.33%) – Keeping regulators open from January to October
Expected Outputs	• Increase in water storage of Shib river • Increase in drainage capacity of the beel area • Water is allowed inside the polders during flood season allowing migration of fishes and uninterrupted navigation, protecting Rabi crops and boro paddy; • Decrease in Ground water Depletion

Project Name: Revitalization and Restoration of Chalan Beel – Climate Resilient Roads

<table>
<tr><td>Project Title:</td><td>Revitalization and Restoration of Chalan Beel- Climate Resilient Roads</td></tr>
<tr><td>Relevant Sector:</td><td>Road Transport and Infrastructure</td></tr>
<tr><td>Location of the Project:</td><td>The project area is located in the Northwest Region known as the Chalan Beel area. Project location is surrounded by Naogaon-Mohadevpur road and Santahar-Bogura railway line in the north; Rajshahi-Charghat road and Baral-Nandakunza river in the south; Barind tract along the Sib-Barani river in the west and Bogura-Nogorbari highway in the east.
11 Polders are within this study area: Naogaon (Naogaon polder), Bogura (Bogura polder 2, 3, 4), Sirajganj (Polder SIRDP, Polder 4), Rajshahi (Polder D, C, Barnai project, Baral project), Natore (Polder A, B, C), Pabna (Polder A)
<table>
<tr><th>Division</th><th>District</th><th>Upazila</th></tr>
<tr><td rowspan="6">Rajshahi</td><td>Bogra</td><td>Adamdighi, Bogra Sadar, Dhupchanchia, Kahaloo, Nandigram, Shajahanpur, Sherpur</td></tr>
<tr><td>Naogaon</td><td>Atrai, Manda, Mahadebpur, Naogaon Sadar, Raninagar, Niamatpur</td></tr>
<tr><td>Natore</td><td>Singra, Natore Sadar, Bagati Para, Baraigram, Gurudaspur, Lalpur</td></tr>
<tr><td>Pabna</td><td>Bhangura, Chatmohar, Faridpur, Santhia</td></tr>
<tr><td>Rajshahi</td><td>Baghmara, Mohanpur, Paba, Tanore, Boalia, Durgapur, Matihar, Puthia, Shah Makhdum, Bagha, Charghat</td></tr>
<tr><td>Sirajganj</td><td>Royganj, Shahjadpur, Tarash, Ullah Para</td></tr>
<tr><td></td><td>6 Nos</td><td>38 Nos</td></tr>
</table></td></tr>
<tr><td>Relevant BDP Goal & Why this Project is BDP 2100 related:</td><td>Project related Hotspots is: The Barind and Drought Prone Areas
Table 1.1: Relationship between Hotspots and Hydrological Regions
<table>
<tr><th>Hotspots</th><th>Hydrological Zones</th></tr>
<tr><td>Barind and Drought Prone Areas</td><td>North West Region</td></tr>
</table>
Table 1.2: Bangladesh Delta Hotspots – Basic Socio-Economic Indicators 2011
<table>
<tr><th>Hotspots</th><th>Area (km^2)</th><th>Population (million)</th><th>Average per Capita Income (BDT)</th><th>Literacy Rate (%) (7 years and above)</th><th>Population Density (person per km^2)</th></tr>
<tr><td>Barind and Drought Prone Areas</td><td>22,848</td><td>22.8</td><td>20,453</td><td>47.1</td><td>999</td></tr>
</table>
Table 1.3: Mapping of Districts to Hotspot Areas
<table>
<tr><th>Hotspots</th><th>Number of Districts</th><th>Name of District</th></tr>
<tr><td>Barind and Drought Prone Areas</td><td>6</td><td>Bogra, Naogaon, Natore, Pabna, Rajshahi, Sirajganj</td></tr>
</table></td></tr>
<tr><td>Types of Project: Infrastructure Knowledge & Information/ Institutional</td><td>Infrastructure</td></tr>
<tr><td>Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)</td><td>Short term (up to 2030)</td></tr>
<tr><td>Project Duration:</td><td>4 years from 2022 to 2025</td></tr>
</table>

<table>
<tr><td></td><td>First phase for feasibility study from 2022 to 2023 -1 yr
2nd phase for implementation from 2023-2025 – 2 yr</td></tr>
<tr><td>Rational (Justification) of the project:</td><td>Background

Bangladesh is a country of rapid economic growth. In recent years, Bangladesh has been able to sustain GDP growth above 7%. About two-thirds of the population lives in rural areas and about 11.3% live below the extreme poverty line. The main reasons for this growth are the stability of the macro-economy, adequate investment in the public sector, including mega-projects, remittances and the unimaginable success of the manufacturing sector.

The Govt. of Bangladesh has set 8th Five Year Plan (2020-2025) with a view to 'Promoting Prosperity and Fostering Inclusiveness'. To provide a sustainable development pathway that is resilient to disaster and climate change is a key objective of this plan.

Problem Statement

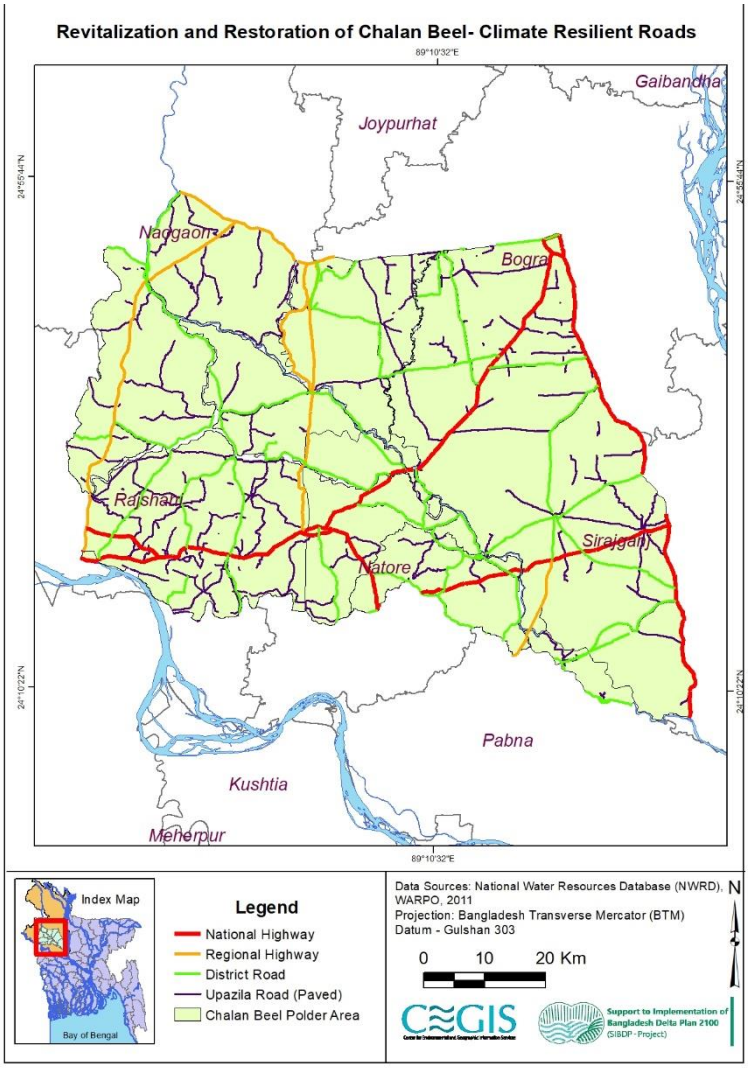
Although several development programs have been implemented in the last few years, more than half of the rural roads in these districts are still unpaved. Most of the paved road network does not cater to the impact of climate change and increased risk of disasters.</td></tr>
<tr><td>Objectives of the project:</td><td>The main objective of the project is to increase the living standards of the people in the Chalan Beel area through the development of rural infrastructure. The specific objectives are:

• Socio-economic development of the Chalan Beel region through the development of rural road networks.
• Improvement in existing road network for enhancing sustainability considering impact of climate change and increased risk of disasters.</td></tr>
<tr><td>Please link the result framework (RF) of the project of BDP-2100</td><td>
<table>
<tr><th rowspan="2">No</th><th rowspan="2">Indicators</th><th rowspan="2">Sub-Indicators</th><th rowspan="2">Quantity</th><th colspan="3">Parameters</th></tr>
<tr><th>2016</th><th>2030</th><th>2050</th></tr>
<tr><td colspan="7">(Goal 1: Ensure safety from flood and climate change related disasters)</td></tr>
<tr><td rowspan="7">Table 13.5 (1A)</td><td rowspan="7">Risk free zones from natural disasters</td><td>Average flood affected area[36]</td><td>% of total area of Bangladesh</td><td>25</td><td>25</td><td>25</td></tr>
<tr><td>Catastrophic flood affected area[37]</td><td>"</td><td>60</td><td>55</td><td>50</td></tr>
<tr><td>Drought (extreme) free area[38]</td><td>"</td><td>53</td><td>75</td><td>90</td></tr>
<tr><td>Storm surge affected area[39]</td><td>% of total coastal zone[40]</td><td>29</td><td>10</td><td>5</td></tr>
<tr><td>Dry season salinity[41] intrusion free area[41]</td><td>"</td><td>47</td><td>65</td><td>50</td></tr>
<tr><td>Waterlogging free area</td><td>"</td><td>97</td><td>100</td><td>100</td></tr>
<tr><td>Table</td><td>Population</td><td>Flood</td><td>Nos. in</td><td>88</td><td>60</td><td>20</td></tr>
</table>
</td></tr>
</table>

	13.5 (IB)	vulnerable to natural disasters	vulnerable people	million			
			Cyclone vulnerable people	"	8	7	5
			Erosion vulnerable people	"	1	0.7	0.2
			Waterlogging vulnerable people	"	0.9	0.2	0.1
	(Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use)						
	Table 13.5 (4A)	Permanent wetland with connectivity		No connectivity	Establish connectivity	Full maintenance	Full maintenance
	Table 13.5 (4B)	Seasonal wetland with connectivity	-	No connectivity	Establish connectivity	Full maintenance	Full maintenance
	Table 13.5 (4C)	Habitat protection	Area of perennial aquatic habitat	Ha	13,200	13,200	Tbd (?)
			Area of seasonal aquatic habitat	"	30,880	30,880	Tbd (?)
			Area of marine habitat	"	32,300	32,300	Tbd (?)
	Table 13.5 (4D)	Ecosystem services and goods harnessing	-	Qualitative judgment	Poor	Fair	Good
Expected socio-economic benefits (quantitative):	About 1.55 crore people in 38 upazilas of the above 06 districts will directly benefit from this project. In particular, the project in question will make a significant contribution to the improvement of the living standards of people of all walks of life, including farmers, marginalized people and the elderly.						

Changed parameters in Metamodel:	• Updating data-
	  ○ Length of Roads Upazila-wise
	  ○ Relative height of aforementioned type of roads
	• Changing the values in Flood Damage Function to imitate effects of climate resilient roads
	• Increasing Drainage efficiency						

Expected Outputs from Meta Model run:	• Decrease in damage to river floods • Decrease in Flood Extent • Decrease in dry season river flow (increased drainage efficiency leading to more GW infiltration)						

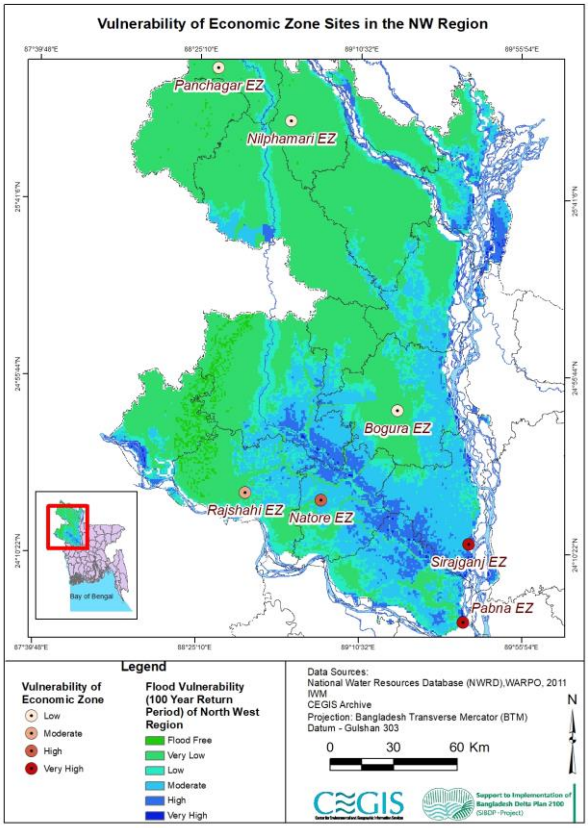
Detailed description of the project (Component wise):	Project Area:  **Component 1 Vulnerability Assessment & Detailed Feasibility Study:** • Assessing vulnerability of existing road network using geospatial analysis and numerical modelling techniques • Assessing need for developing new roads and upgrading existing road network (Origin-Destination survey, traffic volume analysis and projection etc.) • Checking spatial suitability of known climate resilient road infrastructure options (both geometric and structural design components). • Environmental and Social Impact Assessment of proposed road development • Stakeholder consultation and need assessment for Land Acquisition Plan and Resettlement Action Plan • Preparation of guideline and design manual for development of climate resilient road network • Draft implementation plan and expert consultation sessions. • Final implementation plan **Component 2 Road Construction:** • Preparation of DPP for approval of ECNEC. • Carrying out detail engineering survey(s) • Grade Inspection • Acquisition of Right of way (if necessary)

	• Earthwork (cutting/filling, clearing forest etc.) • Starting road construction **Component 3 Operation and Maintenance:** • Training professionals on climate resilient road network design steps • Regular patchwork and repair work on road surface • Regular checking and necessary installation of geometric elements such as road markings and signs, road signals etc.
Indicative cost: (in lac taka)	400000.00 Lakh Taka
O&M cost:	54000.00 Lakh Taka
Lead Implementing Agency:	Ministry: Ministry of Local Government Rural Development & Co-operatives, Ministry of Road Transport and Bridges
	Executing Agency: Local Government Engineering Department &, Roads and Highways Department

Project Name: Vulnerability assessment of Economic Zones in the NW Region and Option Analysis

Project Title:	***Vulnerability assessment of Economic Zones in the NW Region and Option Analysis***
Relevant Sector:	Infrastructure, water, flood and disaster management
Location of the Project:	Northwest Region
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 1: Ensure Safety from Floods and Climate Change Related Disasters Goal 6: Achieve Optimal and Integrated Use of Land and Water Resources
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge & Information
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Short term (Up to 2030)
Project Duration:	2 years
Rationale (Justification) of the Project:	**Background** 7 Economic Zones are existing in the North West region (as of 2020). According to the perspective plan 2041 and GoB's commitment to develop 100 economic zones, more Economic Zones might be developed in the North West Region. **Problem Statement** As critical infrastructures, these zones are prone to multifaceted vulnerabilities (physical, social, economic) to hazards such as Flood, Riverbank erosion, drought.
Objectives of the project:	Overall objective: The overall objective is to assess the vulnerability of economic zones due to flood. Specific objective: • Assessment of coping, adaptation and recovering capacity (at institutional/ demographic level) of inside/ in the vicinity of Economic Zones in NW based on the vulnerability of critical infrastructures to hazards such as Flood, Erosion, Drought. • Identification and Checking feasibility of interventions for reducing assessed vulnerabilities.n
Please Link the result framework (RF) of the project of BDP-2100	
Expected socio-economic benefits (quantitative):	• Prioritized factors for developing specific Emergency Response Pathways • Selected suitable locations for EZ sites resulting in reduced cost for land development • Identified vulnerable road and rail networks leading to better planning and decision making (in terms of road and rail network development), reducing overhead costs • Identified strategy-level interventions for the vulnerable regions to aid the decision makers in planning

	• Identified need for development of Land Acquisition Plans and Resettlement Action Plans . • Protected EZ's with less damage enabling uninterrupted and increased economic activities;

Detailed description of the Project (Component wise):	
	Activities:
	Component 1 - Data Collection and Preliminary Survey:
	• Reconnaissance survey
	• Data Collection for accessibility of local people to emergency response measures using Focus Group Discussion and Personal Interview techniques
	• Secondary data collection for setting up hydrologic and hydraulic model for EZ site and adjacent areas (precipitation, temperature, DEM etc.)
	• Collection of Mouza maps for preparing Land Acquisition Plan and Resettlement Action plan
	• Origin-Destination survey and Traffic Volume Survey
	Component 2 – Modeling
	• Setting up and running hydrologic models for rainfall-runoff analysis
	• Setting up and running hydraulic models for flood depth for several return periods
	Component 3- Analysis of model results and subsequent assessment
	• Using geospatial techniques:
	  ○ Assessing the spatial suitability of EZ sites
	  ○ Assessing the accessibility of local people to emergency response measures

	○ Assessing the vulnerability of road and rail network in the adjacent areas ○ Assessing the connectivity of EZ sites (and adjacent areas) in terms of road and rail network. • Expert Consultations and qualitative analysis • Assessing the need for Land Acquisition Plan or Resettlement Action Plan for areas adjacent to proposed EZ sites
Input Parameters for Incorporating interventions in Metamodel	• Planned Activities ○ Flood proofing EZ sites and adjacent areas ○ Flood proofing roads (NR, RR, ZR) adjacent to/ approaching EZ sites ○ Increasing Embankment height ○ Increasing drainage efficiency ○ Reducing GW irrigation ○ Increasing SW irrigation
Expected outputs from Metamodel	• Reduced flood damage • Reduced flood extent • Increase drainage capacity of the EZ-site-upazillas • Less GW irrigation leading to increased dry season flow
Indicative cost: (in lac taka)	200 Lakh Taka
O&M cost:	Not required
Lead Implementing Agency:	BEZA
	Executing Agency: BWDB, CEGIS, IWM, LGED

Project Name: A stress-test to design climate resilient road infrastructure

Project Title:	***A stress-test to design climate resilient road infrastructure***
Relevant Sector:	Water, Roads, Industry, Local Government
Location of the Project:	NW region, road network Bogura
Relevant BDP Goal & Why this Project is BDP 2100 related:	Delta Goal 1: Ensure safety from floods and climate related disasters. National Flood Risk Management strategy. OBJECTIVE 1: PRIORITY ECONOMIC ZONES; protecting economic strongholds and critical infrastructure, is related to: i) the existing and planned Economic Zones in the basin; ii) key urban growth centres; iii) critical roads and markets; and iv) energy infrastructure.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Infrastructure Knowledge & Information
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Short term - Up to 2030
Project Duration:	2 years
Rationale:	• Aging road network in Bangladesh • New investments upcoming, population increase, leading to increased vulnerability and risk • Climate change results in increased hazards • Rapid urbanization results in fast infrastructure development • More complex economy with many linkages • Lack of O&M financing and capacity
Objectives of the project:	• Develop a sound and applicable method to assess climate risks to critical infrastructure as well as high potential adaptation measures, structural and non-structural • Review of planning, design and asset management standards and practices for key economic sectors and related infrastructure
Please Link the result framework (RF) of the project of BDP-2100	1A Risk free zones from natural disasters 1B Population vulnerable to natural disasters
Expected socio-economic benefits (quantitative):	Decreased direct and indirect damage to roads, services, industries and livelihoods,
Detailed description of the Project (Component wise):	• Identify hazards on specific road network resulting in "blue spots". • Identify vulnerability of hazards to socio-economic parameters (community, traffic disruptions, economy) • Develop hazard maps and risk maps for a pilot road-infra network of Bogura • Carry out blue spot assessment and review existing guidelines • Review previous road flood risk studies in Bangladesh • Review international approaches to determining road infrastructure flood risk assessments and implementing approaches • Review current design criteria and assessments at LGED / RHD to making roads

	climate resilience • Derive a simple, effective and applicable method to determine multi-hazard flood risks on road network • Provide training to agencies and designers • Apply the derived method to a specific road network in Bogura, resulting in a risk analysis • Sharing results and analysis with key stakeholders from the different sectors • Modify infrastructure/design criteria
Indicative cost: (in lac taka)	50
O&M cost:	
Lead Implementing Agency:	Ministry: Road Transport and Bridges, Local Government and Cooperatives, Industry, Health
	Executing Agency: RHD and LGED

Project Name: Flood Insurance Scheme for flood vulnerable underprivileged people of Hurasagar Basin

Project Title:	***Flood Insurance Scheme for flood vulnerable underprivileged people of Hurasagar Basin***
Relevant Sector:	Water, Disaster Management and Relief, Social Welfare,
Location of the Project:	Kurigram, Lalmonirhat, Gaibandha, Sirajganj, Pabna of NW Region
Relevant BDP Goal & Why this Project is BDP 2100 related:	*BDP* Goal 1: Ensure safety from floods and climate change related disasters *OBJECTIVE 3: Vulnerable Communities; Safeguarding Livelihoods and Leaving No-One Behind of FRM*
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge & Information
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Short Term (Up to 2030)
Project Duration:	3-5 years
Rationale (Justification) of the Project:	**Justification** - Works as alternative risk transfer mechanism for flood marooned people - Applicable as non-structural measure for flood vulnerable communities - Easy to accommodate in the present Flood Emergency Relief Program **Problem** - Labour wage loss during flood event often remain unnoticed - Lack of coordinated relief program during severe flood event often worsen the distress of the flood victims - Difficult to bring everyone under flood protection due to budget constraint
Objectives of the project:	Assess the opportunity of risk transfer mechanism to be incorporated into disaster management planning and budgeting. The activities related to this objective are: - Determine the extent of deep uncontrolled flooding (historical and extreme events) - Develop flood indices (depth of flood, duration of flood, rising and receding cycle of flood etc.) - Identify flood vulnerable areas and classify them into different priority zones - Develop database of flood vulnerable communities and their socio-economic conditions according to National Poverty Line - Design pragmatic insurance scheme and involve local administration for pilot projects - Establish sustainable development plan for flood insurance and include in the Fifth Year Plan
Please Link the result framework (RF) of the project of BDP-2100	Goal 1B Population vulnerable to natural disasters Table 13.5: The BDP 2100 Development Results Framework
Expected socio-economic benefits (quantitative):	Marginal People living in the target area

Detailed description of the Project (Component wise):	National insurance cooperation (government-owned organisation) to provide knowledge about the opportunities. SEADRIF: Southeast Asia Disaster Risk Insurance Facility
Indicative cost: (in lac taka)	Tentative 1000 Million BDT (Say, 100,000 households & 10,000 BDT as Pay out for a single year)
O&M cost:	
Lead Implementing Agency:	Disaster Management & Relief Ministry: Water Resources;
	Executing Agency: DDM, SBC, Public Administration

A2: NW Environment and Ecosystem Programme

A2.1 Existing Concept Notes (From BDP2100 Investment Plan)

Project Name: Revitalization of khals all over the Country

CC 1.43 REVITALIZATION OF KHALS ALL OVER THE COUNTRY

BACKGROUND

Bangladesh is a land of alluvial rivers of different sizes which carry out the drainage load of the existing low lying beel areas through internal connecting khals. These khals have been found to get silted up and their water reserve capacity has been reduced to a great extent. As a result, in the monsoon season, flooding occurs very quickly and lasts for a long period. Moreover, in lean periods, Bangladesh faces scarcity of water for irrigation due to the poor water reserve capacity in the existing khals. For rapid poverty reduction, the Government's priority is to develop the rural areas where the poorest people live. This requires accelerated growth in the agricultural and rural sector.

PROJECT DESCRIPTION

The main objective of this project is to boost agricultural production, improve the drainage system, and improve the navigation system and fish culture in all the basins of Bangladesh.

The project has an estimated implementation period of 10 years. The project is linked to the following Delta Plan strategies: (i) Improvement of Conveyance Capacity and Navigability of the Rivers, (ii) Sustainably Intensifying Agricultural Production Systems.

EXPECTED BENEFITS

The project is expected to improve the drainage system, increase agricultural and fisheries production, improve livelihood of local people, reduce poverty, and recharge groundwater.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

RESPONSIBLE MINISTRY

-

EXECUTING AGENCIES

Bangladesh Water Development Board (BWDB)
Department of Fisheries (DoF)
Department of Agricultural Extension (DAE) Local Government Engineering Department (LGED)

DELTA PLAN GOAL(S)

#2 *Ensure water security and efficiency of water usages*
#4 *Conserve and Preserve Wetlands and Ecosystems and Promote their Wise Use*
#6 *Achieve optimal and integrated use of land and water resources*

FINANCING

	Mil BDT	Mil USD
Capex	4,577	58
Opex	400	5

**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- Khals in all basins (including Hurasagar, Dhaleshwari, Gorai-Passur, Baleshwar-Tentulia, Gumti-Muhuri, Upper Meghna basins and Chittagong Flood plain)

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

Since there is no private financing potential, this project will have to be delivered by the public sector. Part of the project is likely to be funded by climate financing.

Project Name: Barind area fisheries development project

DP 15.3 BARIND AREA FISHERIES DEVELOPMENT PROJECT

BACKGROUND

Most of the fish consumed in Bangladesh came from inland capture fisheries, until recent decades. A sharp decline of inland capture fisheries is now happening because of over-fishing, use of destructive gears, silting up of water bodies, closure of natural fish passes, and pollution of water bodies by agro-chemicals, industrial wastes and urban sewers. Differently, inland aquaculture experienced fast growth as new technologies were introduced improving fish farming, particularly in pond aquaculture. However, the country is facing some challenges, such as poor brood stock management, inadequacy of the supply of fish and shrimp spawn, desired quality of fish at reasonable price, low availability of reliable and quality fish feed at reasonable cost, spread of infectious diseases of both fish and shrimp, lack of institutional capacity to assist with the needed extension service, ensure supply of quality inputs and quality of the produce and supply chain development. Floodplain aquaculture should combine maintaining sanctuaries of the important beel areas. This must include maintaining sanctuaries in parts of the beel covered by flood plain aquaculture, rearing fries of various indigenous species in nurseries and supplementing natural stock.

PROJECT DESCRIPTION

This project will ensure livelihood security of the vulnerable community in the Barind Tract and support the Government's poverty reduction efforts through a sustainable management of aquaculture and fisheries resources.

The project has an estimated implementation period of 4 years and an operating period of 15 years. The project is linked to the Delta Plan strategies of Conservation and Preservation of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs.

EXPECTED BENEFITS

This project is expected to enhance fish production and productivity, protect fish bio-diversity establishing fish sanctuary, stocking endangered fish fingerlings, and creating awareness. It will also improve the socio-economic conditions of the vulnerable fishery communities, and of the fish farmers. The project will adopt climate smart technologies to address climate change issues in the Barind Area.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

RESPONSIBLE MINISTRY

Department of Fisheries (DoF)

EXECUTING AGENCIES

Ministry of Fisheries and Livestock (MoFL)

DELTA PLAN GOAL(S)

#4 *Conserve and Preserve Wetlands and Ecosystems and Promote their Wise Use*

FINANCING

	Mil BDT	Mil USD
Capex	3,580	45
Opex	179	2

**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- Almost all Barind Tract Districts under Rajshahi and Rangpur Divisions.

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

Since there is no private financing potential, this project will have to be delivered by the public sector.

A2.2 New Concept Notes (EE programme)

Project Name: Pilot application of simplified environmental flow method for the Atrai river and Chalan Beel

Project Title:	***Pilot application of simplified environmental flow method for the Atrai river and Chalan Beel***
Relevant Sector:	Environment
Location of the Project:	Northwest Basin – Atrai river basin and Chalan Beel
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use The project aims to pilot a simple, effective and applicable method for the determination and implementation of an environmental flow regime to contribute to conservation and preservation of the important Chalan beel wetland and the river dependent ecosystems in the Atrai basin.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge & Information, Institutional and Infrastructural
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Up to 2030
Project Duration:	5 years .(one) year to determine the environmental flow regime using a Bangladesh specific method, minor infrastructure modification and annual monitoring and revision of the environmental flow regime for 5 consecutive years)
Rationale (Justification) of the Project:	Determination and implementation of environmental flow regimes for the rivers of Bangladesh is essential to achieve BDP goal 4 regarding conservation and preservation of wetlands and ecosystems. Actual flow regimes deviate from natural flow regimes through manmade modifications, such as dams, embankments and abstractions. Furthermore, water quality is modified by releases of pollutants. This threatens the functioning of wetland and river ecosystems and their capacity to provide ecosystem goods and services to the society (like fisheries habitat, flushing of pollutants, groundwater recharge). Comprehensive environmental flow regimes require a thorough examination of the aims (the ecosystem state, goods and services provision to be achieved) and their relation with environmental flow parameters, such as the flow and water quality and their dynamics within and between years. A separate project is proposed to carry out this examination for the whole of Bangladesh and is foreseen to provide results in five years, based on a typology of river systems applicable country-wide. This project includes a pilot application of a simple, effective and applicable methodology for one river and catchment to develop and apply a Bangladesh specific environmental flows method and to learn lessons to upscale to the country as a whole, including river types in the coast, the hills and the Haor area.
Objectives of the project:	The overall objective is to conserve and restore the ecosystem functioning, goods and services provision of rivers and wetlands. The project purpose is to learn lessons from a pilot application of environmental

	flow determination and implementation for the Atrai basin and Chalan beel. These lessons can then be applied to all rivers. **Specific objectives:** • Derive a simple, effective and applicable method to determine environmental flows • Prepare an institutional framework for implementing environmental flows • Provide training to environmental authorities in environmental flows and management • Identify 1-2 infrastructure investments to improve the environmental flow condition in the target area • Preparing a monitoring plan for baseline and progress monitoring • Document experience and derive lessons learned regarding the determination and implementation of environmental flows
Please Link the result framework (RF) of the project of BDP-2100	
Expected socio-economic benefits (quantitative):	Not possible to determine this a priori quantitatively. Expected benefits are increased capture fish production, improved health conditions for river-based communities, enhanced water quality and nature, increased groundwater recharge.
Detailed description of the Project (Component wise):	• Review previous environmental flow studies in Bangladesh • Review international approaches to determining and implementing environmental flows • Derive a simple, effective and applicable method to determine environmental flows based on limited information regarding flow, water quality, ecosystem functioning, goods and ecosystem services • Map and involve the stakeholders to arrive at a joint problem definition, methods and selected solutions • Provide training to agencies and stakeholders • Prepare an institutional framework for the setting and enforcing of environmental flows together with DOE and other stakeholders • Apply the derived method to the Atrai basin and Chalan beel to determine tentative environmental flows at different locations • Present and discuss the tentative environmental flows within a session with representatives from all stakeholders • Modify infrastructure with a large influence on the environmental flow conditions • Revise the tentative environmental flows • Use the developed institutional framework to set and enforce the environmental flows • Prepare a monitoring plan, including baseline and progress monitoring • Monitor the baseline situation regarding flows, water quality, ecosystem functioning and ecosystem service provision. • Continue monitoring after implementation of the environmental flows • Annually review the monitoring results and based on that revise the environmental flows set as well as the monitoring program • Draw lessons from the pilot experience and apply these in other projects for other rivers
Indicative cost: (in Lac taka)	1,000.00 Lakh Taka (1 M euro): 0,1 M euro per year in the first 5 years for monitoring

	and 0.5 M euro in the first year for the literature reviews, setting-up and application of methodology, preparation of institutional framework and stakeholder participation)
O&M cost:	100 Lakh Taka (0,1 M euro) per year for monitoring and reviewing
Lead Implementing Agency:	Ministry: MoEF&CC
	Executing Agency: DoE

Project Name: Strengthening monitoring capacity of the DoE in NW basin

Project Title:	***Strengthening monitoring capacity of the DoE in NW basin***
Relevant Sector:	Environment
Location of the Project:	Northwest Basin
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 2: Enhance water security and efficiency of water usages (controlling pollution, ensuring water quality). Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use (pollution control and treatment). The objective of the project is to assist the government of Bangladesh in strengthening the monitoring mechanism in the Northwest region to ensure the long-term water quality. The project will help to develop water pollution mapping and strengthen the monitoring and reporting system to control the water quality.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge & Information/ Institutional
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Short term (Up to 2030)
Project Duration:	3 (three) years.
Rationale (Justification) of the Project:	Water quality is a quickly growing concern in the country and the NW basin is no exception. Developments in the Dhaka Metropolitan Area (DMA) can serve as an example, where water quality has deteriorated rapidly from 1990 to 2010. Pollution sources in the basin do not differ much from the national picture and include agro-chemicals, faecal sludge, untreated domestic wastewater, and industrial effluents. Proper monitoring and reporting mechanism are not in place in the NW region. There is insufficient capacity to execute programs for surveillance monitoring, trend detection and compliance checking.
Objectives of the project:	The overall objective of the project is to develop institutional capacity of the implementing agency to monitor water quality to guarantee the future water quality. The specific objectives of a monitoring system are: • Meet river water quality standards and keep a healthy ecosystem and reduced pollution load to the river. • Check compliance of dischargers to the river. • Load assessment from sources of pollution. • Awareness Raising, Stakeholder commitment and ownership of good water quality, by sharing appropriate information. • Operational monitoring and reporting system in place. • Trained staff for monitoring, laboratory analysis and reporting
Please Link the result framework (RF) of the project of BDP-2100	2A Dry season flow availability 2D Urban domestic water efficiency 2G Surface water polluted by industrial wastes 2H Surface water polluted by other wastes

	4C Habitat protection 5D Adequate monitoring mechanism 6D Sectoral use of water
Expected socio-economic benefits (quantitative):	Not possible to determine this a priori quantitatively. Safeguard beneficial water uses (water for drinking water production, fisheries, water for irrigation). Improved health conditions for river-based communities. Enhanced water quality and nature.
Detailed description of the Project (Component wise):	The following activities are envisaged under the proposed project. • Identify the information needs and institutional setting. • Design of a monitoring network, including sampling locations sampling frequencies and parameters based on the information needs. • Asses the present capacity for monitoring, laboratory analysis and reporting. • Training of staff for monitoring, laboratory analysis and reporting. • Purchase equipment for monitoring and laboratory analysis. • Make an implementation plan including an investment plan for equipment and operational costs. • Implementation and execution of the plan for 2 years before it is fully handed over to the DoE. This allows support Support and training on the job for implementation and execution for a 2-year period. This allows for sustainable implementation.
Indicative cost: (in Lac taka)	88 Million Taka. (equivalent 800,000USD, considering bank rate Tk 110 as on October 2022.
O&M cost:	
Lead Implementing Agency:	Ministry: MoEF&CC
	Executing Agency: DoE

Project Name: Program for developing register of pressures and emissions on water bodies in the Northwest Basin

Project Title:	***Program for developing register of pressures and emissions on water bodies in the Northwest Basin***
Relevant Sector:	Environment
Location of the Project:	Northwest
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 2: Enhance water security and efficiency of water usages Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use Goal 6: Achieve optimal and integrated use of land and water resources. The project aims to develop a register of pressures and emissions on water bodies by integrating existing data bases on industries, domestic sources, agglomerations and land use. The register can form the basis for a pollution control program, effective treatment and contribute to improving and maintaining water quality.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge & Information, Institutional.
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Up to 2030
Project Duration:	5 years. A 2-year TA project to define the information needs, make an inventory of existing information and develop a GIS based information system. In the 3 consecutive year the information system must be filled with the required data and an institutional set-up has to be established for keeping the system alive and up to date
Rationale (Justification) of the Project:	Water quality is a quickly growing concern in the country and the NW basin is no exception. Developments in the Dhaka Metropolitan Area (DMA) can serve as an example, where water quality has deteriorated rapidly from 1990 to 2010. Pollution sources in the basin do not differ much from the national picture and include agro-chemicals, faecal sludge, untreated domestic wastewater, and industrial effluents. Many industries do not have a proper waste and wastewater management system and discharge directly into adjacent freshwater bodies. Due to the lack of adequate sanitation facilities in the rural areas, faecal contamination of surface water, particularly in village ponds, is also a problem, as most people in rural areas use ponds for washing and water supply for cooking. Data on pollution sources is scattered over several institutes and authorities. • The DoE has a register on industries. However, the existing databases are incomplete. • The Department of Public Health Engineering (DHPE) is responsible for domestic sanitation. However, an overview of loads by domestic wastewater is not present. Data on the number of inhabitants are available form databases of LGED. • Data on the use of pesticides and crops can be obtained from the Agricultural

	Offices at the Upazilas in the area. • Water resources data can be obtained from the NWRDB, managed by WARPO, however, the database needs to be updated • Satellite images and open street map can be used to locate industries and agglomerations and keep this information updated The collected data is hardly used to produce relevant information for water pollution control. There is need for an integrated information platform for pollution sources that can enable decision support in water quality management through inter-organizational information sharing.
Objectives of the project:	The overall objective is providing information to support decision making in pollution control to prevent further deterioration of the water quality. The purpose is to develop an integrated register of pressures and emissions on the water bodies in the Northwest Basin. Specific objectives: • Developing a GIS based data platform suitable for reporting, policy development and decision making. • Improve/update the underlying databases of e.g. DoE and WARPO • Develop a register for compliance checking and enforcement. • Sharing information by inter organisational cooperation. • Establish an institutional set-up to keep the information system alive and up to data.
Please Link the result framework (RF) of the project of BDP-2100	2F Rural population with safe sanitation 2G Surface water sources polluted by industrial wastes 2H Surface water sources polluted by other wastes 5D Adequate monitoring mechanism 6A Spatial zoning of integrated land and water uses 6D Sectoral use of water
Expected socio-economic benefits (quantitative):	Not possible to determine this a priori quantitatively. Safeguard beneficial water uses (water for drinking water production, fisheries, water for irrigation). Improved health conditions for river-based communities. Enhanced water quality and nature.
Detailed description of the Project (Component wise):	The following activities are foreseen for a 2-year TA project: 1. Workshops to assess the information's needs. 2. Review of all the existing data. 3. Develop a prototype GIS based database and populate it with existing data. 4. Set-up an institutional framework. 5. Training in the use of the system. 6. Draft an implementation plan including tasks, responsibilities, and budgets. <u>Implementation phase</u> After the 2-year TA project, approximately another 3 year is required to collect all the information and enter it into the data base. Within the relevant authorities involved, staff must be allocated.
Indicative cost: (taka)	Indicated cost for a 2- year TA project: 82.5 million taka (equivalent to US$ 750,000, considering US$ 1= BDT 110 as on October 2022) For the implementation phase a team of 3 persons is required to coordinate the

	activities and another 5 staff members are required to collect the information
O&M cost:	To keep the register update after implementation – 3 staff members are required on a permanent basis.
Lead Implementing Agency:	Ministry: MoEF&CC
	Executing Agency: DoE, DPHE, WARPO, DAE, Ministry of Industries, Industries Corporation and representatives (public and private)

Project Name: Financing mechanism for local governments to invest in (domestic) wastewater treatment.

Project Title:	***Financing mechanism for local governments to invest in (domestic) wastewater treatment.***
Relevant Sector	Environment
Location of the Project:	Northwest Basin
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 2: Enhance water security and efficiency of water usages (controlling pollution, ensuring water quality). Besides ensuring reliable and adequate provision of freshwater Goal 2 is on providing sanitation at acceptable levels in relation to defined standards as well as environmental, health, agricultural and industrial needs. Most of the domestic wastewater in the Northwest Basin is not treated, leading locally to severe problems with water quality, including health risks of bacterial pollution. Also, in the major rivers during the dry season oxygen depletion occurs. The project aims to investigate options for financing mechanisms for local governments to invest in wastewater treatment.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge & Information, Institutional and Infrastructural
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Up to 2030
Project Duration:	2 years to investigate and discuss potential financing mechanisms. The project includes a pilot project for 2 middle sized cities or communities, including an investment plan including a sustainable model for operation and maintenance based on cost recovery.
Rationale (Justification) of the Project:	• As local government institutions are only incidentally involved in planning and implementing the systems and have limited resources operation and maintenance are adversely affected. • In many cases operation and maintenance too have become financed as a project rather than a regular and GoB funded programme. • Although it has been shown that as a result of better service management, both billing and collection efficiency (DPHE 2000) improved significantly, sustainable financing of operation and maintenance still is lacking. Therefore, there is need for financial mechanisms for investment in wastewater treatment facilities and sustainable model for operation and maintenance.
Objectives of the project:	The overall objective is to reduce the pollution load by improving and establishing new wastewater treatment facilities in the Northwest Basin.

	Specific objectives: • Support local government in finding models for investing in wastewater treatment facilities. • Ascertain financial models for operation and maintenance.
Please Link the result framework (RF) of the project of BDP-2100	Text Missing
Expected socio-economic benefits (quantitative):	Not possible to determine this a priori quantitatively. Safeguard beneficial water uses (water for drinking water production, fisheries, water for irrigation). Improved health conditions for river-based communities. Enhanced water quality and nature.
Detailed description of the Project (Component wise):	• Review current investments, and models for O&M in Bangladesh. • Assess investment strategies i.e. tax pay, user pay, creditors pay • Review present experiences and models for cost recovery (polluter pays principle) • Assess ability and willingness to pay by the inhabitants • Assess opportunities for the establishment of PPP's • Assess opportunities for design built operate contracts and involvement of the private sector • Develop a business model for private sector operators and investors. • Assess options for (green) loans/bonds and other financial options. • Stakeholder engagement. Proposed to pilot the development of a financial model for 2 – 3 middle sized cities or communities.
Indicative cost: (in lac taka)	
O&M cost:	
Lead Implementing Agency:	Ministry: MoLGRD&C
	Executing Agency: DHPE, LGED

LG

Project Name: Revitalization and restoration of Chalan Beel – Green Beels

<table>
<tr><td>Project Title:</td><td>Revitalization and restoration of Chalan Beel – Green Beels</td></tr>
<tr><td>Relevant Sector:</td><td>Water, Environment, Fisheries and Agriculture</td></tr>
<tr><td>Location of the Project:</td><td>Northwest Region – Polders around Chalan Beel area

Project location is surrounded by Naogaon-Mohadevpur road and Santahar-Bogura railway line in the north; Rajshahi-Charghat road and Baral-Nandakunza river in the south; Barind tract along the Sib-Barani river in the west and Bogura-Nogorbari highway in the east.

11 Polders are within this study area: Naogaon (Naogaon polder), Bogura (Bogura polder 2, 3, 4), Sirajganj (Polder SIRDP, Polder 4), Rajshahi (Polder D, C, Barnai project, Baral project), Natore (Polder A, B, C), Pabna (Polder A)

<table>
<tr><th>Division</th><th>District</th><th>Upazila</th></tr>
<tr><td rowspan="7">Rajshahi</td><td>Bogra</td><td>Adamdighi, Bogra Sadar, Dhupchanchia, Kahaloo, Nandigram, Shajahanpur, Sherpur</td></tr>
<tr><td>Naogaon</td><td>Atrai, Manda, Mahadebpur, Naogaon Sadar, Raninagar, Niamatpur</td></tr>
<tr><td>Natore</td><td>Singra, Natore Sadar, Bagati Para, Baraigram, Gurudaspur, Lalpur</td></tr>
<tr><td>Pabna</td><td>Bhangura, Chatmohar, Faridpur, Santhia</td></tr>
<tr><td>Rajshahi</td><td>Baghmara, Mohanpur, Paba, Tanore, Boalia, Durgapur, Matihar, Puthia, Shah Makhdum, Bagha, Charghat</td></tr>
<tr><td>Sirajganj</td><td>Royganj, Shahjadpur, Tarash, Ullah Para</td></tr>
<tr><td></td><td>6 Nos</td><td>38 Nos</td></tr>
</table>
</td></tr>
<tr><td>Relevant BDP Goal & Why this Project is BDP 2100 related:</td><td>

Goal 1: Ensure safety from floods and climate change related disasters
Goal 2: Enhance water security and efficiency of water usages
Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use
Goal 5: Develop effective institutions and equitable governance for in-country and transboundary water resources management
Goal 6: Achieve optimal and integrated use of land and water resources

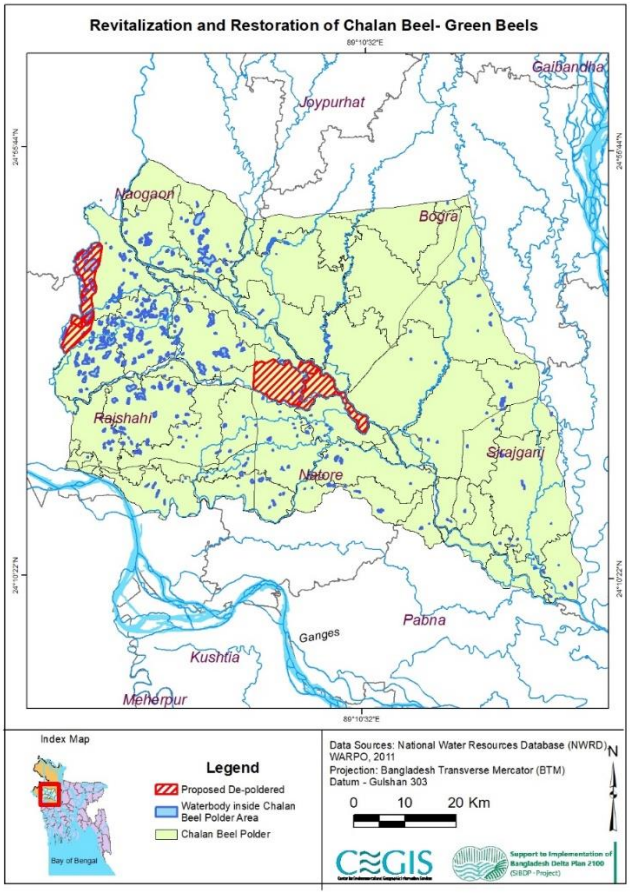
The major aim of the project has four basic dimensions. The specific goals under the dimensions are:

Hydrology: protection against (early) monsoon flooding, facilitate uninterrupted drainage.
Rural and communication infrastructure including roads and markets and services
Ecology and water quality: conservation of wetland connectivity for restoring fish habitats and migratory routes, conservation of habitat for migratory birds, wastewater treatment facilities
Socio-economic development: conflict resolution, equitable development, and raising awareness
Institutional development: operation and maintenance of water infrastructure, participatory water management, community-based fisheries, fish sanctuary delineation.

These aims are highly relevant for achieving the above mentioned BDP 2100 specific goals.
</td></tr>
<tr><td>Types of Project:</td><td>Knowledge & Information, Institutional and Infrastructural</td></tr>
</table>

Infrastructure/ Knowledge & Information/ Institutional	
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Short term (up to 2030): C1 and C2: Phase A and B Medium term (2030-2050): C2 Phase C and C3
Project Duration: ***(during implementation)***	10 – 15 years **2 years** to define the feasible tasks (comparison of different options for implementation using modelling, multi criteria analysis, financial and economic assessment, public and consultation) and develop a shared program of interventions, together with local agencies, civil society and NGOs, **3-10 years** for infrastructural and institutional development and **on going** performance monitoring and awareness building programs.
Rationale (Justification) of the Project: (Background: Provide relevant information about project context Problem Statement: Main problem and Sub problems)	Chalan Beel is the largest Beel in the northwest region of Bangladesh. The Beel area incorporates 21 rivers and around 100 smaller seasonal beels which finally drain into the Padma (Ganges) and the Jamuna river. Atrai, Boral, Sib, and Karatoya are the major rivers that flows within and around the Beel area. This wetland provides a number of services directly or indirectly to millions of people such as drainage and flood control, recharge of the aquifer, local navigation and tourism, livelihood by fishing and cropping as well as habitat for ecosystem. As a solution to control monsoon flooding and protect agriculture in the floodplains of Chalan Beel, embankments along with pumps and sluices were built around Chalan Beel in 1986. Nine polders were established which could not fulfil the main objectives properly due to reasons which was not accounted while planning. As a result, several environmental and social problems occurred: • Flooding outside the polder areas during monsoon. • Drainage congestion and water logging inside the polder areas after monsoon flooding. • Loss of natural drainage connectivity due to blockage by embankments and structures. • Excessive siltation due to the existences of hard structures such as embankment, bridge, road, etc. • Reduction of perennial wetland area and loss of flood water reservation area. • Loss of agricultural production due to poor drainage and irrigation opportunity. • Loss of ecosystem services and goods-e.g. loss of fisheries due to disruption of migration channel. • Deterioration of water quality due to untreated effluent discharge from industries, in the south-eastern part of the area. • Social conflicts between fishermen-farmer, public-government. This project will basically consider the measures which will integrate infrastructural, institutional and environmental solutions to restore the wetland into a sustainable shape.
Objectives of the project: Describe quantitatively on Main (overall)	The <u>overall objective</u> is to restore the wetland system and natural connectivity, provide protection against monsoon flooding, support integrated rural livelihood development, enhance agricultural and fisheries production, environmental-friendly tourism and preserve critical ecological habitats. The key beneficiaries of this project are the people

objective and project purpose of the project. • **<u>Overall objective</u>:** • **<u>Project purpose</u>:** **Additional specific objectives if needed, in 2-3 bullets.** • **Mention additional specific objectives:**	living within the Beel area. **Specific objectives:** ***Upgrade and expand the rural communication and flood infrastructure.*** Activities include: • Excavation to remove siltation* • Fish-friendly structures in embankments, on existing and new structures • Redesign and improve bridges, culverts and roads to enhance communication and decrease flow blockage* • Redesign rubber dams to flush/remove siltation and improve connectivity* • Realignment and re-sectioning of polders D, C, SIRDP and Naogaon, based on detailed hydrological analysis of each intervention and combination of interventions, and taking into account climate change, to open the beel area to the river, protect the agriculture and housing* • Raising of houses, village platform, roads, and bridges* • Development of flood-proof market facilities • Facilities for eco-tourism • Clean production technologies and ETP for industries • Small and medium-scale WTP in 6 district capitals ***Enhance and further develop institution and local governance.*** Activities include: • Training and capacity development of stakeholders and implementing agencies • Environment friendly O&M of rubber dams and regulators (timing, duration) • Declaration of fish sanctuary and community-based fisheries (co-management) and sanctuary management • Regulation of pollution / emissions • Participatory design – multi-stakeholder platform, grievance mechanism, social awareness, conflict resolution mechanisms ***Restore and further develop ecological and ecosystems.*** Activities include: • System of core areas and corridors, beels, khals, floodplain and rivers • Environment friendly structures, fish sanctuaries • Water quality improvement: domestic wastewater and industrial effluent treatment, focus on Narod river (Nature based WWTP in rural areas) • NBS (for erosion control, flood management, etc)
Please Link the result framework (RF) of the project of BDP-2100	1A Risk free zones from natural; disasters 1 B Population vulnerable to natural disasters 2A Dry season flow availability 2G Surface water polluted by industrial wastes 2H Surface water polluted by other wastes 4A Permanent wetland connectivity 4B Seasonal wetland connectivity. 4C Habitat protection 4D Harnessing of ecosystem goods and services 5A Rural people with adequate capacity for WRM
Expected socio-economic benefits (quantitative):	Expected socio-economic benefits include reduced flood damage and crop loss, reduced social conflicts, increased goods and services provided by the rivers and water bodies of Chalan Beel such as fish and recharged groundwater in the dry season. The enhanced environmental services include dry season flushing and dilution of pollutants as well as recreational and landscape values. In addition, the area can be developed as international hot spot for environmental international tourism

Detailed description of the Project (Component wise):	Project Area:
	 
	
	C1: Detailed feasibility study and programme design
	- Study and detailed analysis of the hydrology, ecosystems and agri-fish ecology, including ESIA
	- Integrated design of communication and flood infrastructure
	- Stakeholder consultation and collaboration
	- Draft and final implementation plan, including participation, communication, training and programme management
	- Final design and preparation of implementation
	C2: Phased and adaptive implementation
	- Tender and contract management
	- Phased implementation:
	  - A (Beel Halti, main communication infrastructure, fisheries and agriculture improvement);
	  - B (western beels, communication infrastructure, eco-tourism and agri-fisheries improvement); and
	  - C (northern beels -> idem)
	  - Guidance of stakeholder platforms during implementation
	  - Monitoring and impact assessment
	C3: Follow-up and private sector development

Indicative cost:	1000 - 2000 Crore Taka
O&M cost:	per year for monitoring and reviewing
Lead Implementing	Ministry: MoWR or MoLGRD&C

Agency:	Executing Agency: BWDB or LGED. Partners: DoE, DoF, BADC, DAE, BMDA. Programme management structure
Metamodel input	Several of the physical interventions stated in this concept note can be assessed using the current version of the Bangladesh Metamodel. They are provided with an asterisk (*) in the sections above: - Excavation to remove siltation* - Redesign and improve bridges, culverts and roads to enhance communication and decrease flow blockage - Redesign rubber dams to flush/remove siltation and improve connectivity - Realignment and re-sectioning of polders D, C, SIRDP and Naogaon* - Raising of houses, village platform, roads, and bridges For each of these interventions it is important to identify the exact locations (regional rivers, rubber dams and districts/upazilas). This project would possibly require addition of more regional rivers to the network module. As an alternative, we can start to simulate the excavation of local/regional rivers not in the network node, as increasing the drainage efficiency parameter of the selected upazilas, which is also required to enhance the communication. The raising of houses etc. is probably to decrease flood affected population and flood damage; this can be included by adapting the damage functions/ or height in the flood damage module. It is to be expected that the different interventions selected to be calculated with the metamodel will: - Improved drainage -> decrease rainfall and river flood extents and damages - Unclear impact on agricultural production; on one side will decrease flood damage due to improved drainage (at harvesting season of T. aman), on other side will increase flood damage due to allowed flooding when harvesting HYV Boro; Agri impacts will be localized (one area improve, other area deteriorate) - Decreased flood damage due to lower vulnerability of raised houses and infrastructure - Impact of better functioning rubber dams is a bit unclear; they are probably not yet part of the base condition - Impact on dry season irrigation demand is difficult to predict
Changed Parameters in MetaModel	• Transferring selected area from "Project" to "Non-Project" • Changing values in the 'Flood Damage Function' files (to imitate impact of flood proofing)
Expected output from Metamodel run	• Reduced flood extent • Reduced flood duration • Reduced flood damage
Interpretation of results	Bangladesh Metamodel run in progress.

*this measure/intervention can be assessed using the current version of the Bangladesh Metamodel

Project Name: Integrated Development and Restoration Programme for Chalan Beel

<table>
<tr><td>Hotspot:</td><td>Barind and Drought Prone Area</td></tr>
<tr><td>Project Code:</td><td>CP new 7</td></tr>
<tr><td>Project Title:</td><td>Integrated Development and Restoration Programme for Chalan Beel</td></tr>
<tr><td colspan="2">GENERAL DESCRIPTION AND STRATEGY & GOAL ALIGNMENT and PLANNING PHASE</td></tr>
<tr><td>Function:
• Infrastructure
• Knowledge & Information
• Institutional</td><td>Infrastructure</td></tr>
<tr><td>Timing:
• Short term (up to 2030)
• Medium term (2030-2050)
• Long term (>2050)</td><td>Short term (up to 2030)

The project duration is 4 years and may be started at any time between now and 2025.</td></tr>
<tr><td>Location of the Project (and specific area concerned):</td><td>The project is located in the districts of Rajshahi, Naogaon, Natore, Bogura, Pabna and Sirajganj. The Project area is bounded by Naogaon-Mohadevpur road and Santahar- Bogura railway line in the North; Rajshahi-Charghat road and Baral-Nandakuza river and Pabna project in the South; Barind tract along the Sib Barnai river in the West; and Bogura -Nagarbari highway in the East. The polders A, B, C & D of ChalanBeel area are located along the right bank of the Atrai river; The Naogaon Polder, Bogra polders 2, 3 & 4 and SIRDP are located along the left bank of the Atrai and therefore, the river Atrai plays the main role in water management of the Chalan Beel area. Impacts of the Chalan Beel are also extended to its southern side on the Baral and Barnai projects which do not form part of the Chalan Beel. Bogura polder 4 is open to natural condition. The Beel Halti is within Chalan Beel Polder C and is a large beel area. The gross area of the project is about 5,66,000 ha of which cultivated area is about 75%. Population is about 5.28 million (2001 census).

The districts and upazilas covered in the study area are presented in the following table.

<table>
<tr><th>Division</th><th>District</th><th>Upazila</th></tr>
<tr><td rowspan="6">Rajshahi</td><td>Bogura</td><td>Adamdighi, Bogra Sadar, Dhupchanchia, Kahaloo, Nandigram, Shajahanpur, Sherpur</td></tr>
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<tr><td>Rajshahi</td><td>Baghmara, Mohanpur, Paba, Tanore, Boalia, Durgapur, Matihar, Puthia, Shah Makhdum, Bagha, Charghat</td></tr>
<tr><td>Sirajganj</td><td>Royganj, Shahjadpur, Tarash, Ullah Para</td></tr>
<tr><td></td><td>6 Nos</td><td>38 Nos</td></tr>
</table>
Linkages with other projects</td></tr>
</table>

	This project is linked with North Rajshahi Irrigation Project (proposed), Ganges Barrage project (proposed), Revitalization and restoration of Hurasagar and Atrai rivers (proposed), River Management Improvement Program (proposed)and Flood and Riverbank Erosion Risk Management Investment Program (under implementation).
Rationale of the Project:	**BACKGROUND** The present project covers a vast area including 11 polders and projects implemented 2 to 3 decades earlier in and around the Chalan Beel which were completed. Full flood control and drainage (FCD) activities of the polders created higher inundation outside the polders, particularly outside of polder-D in the western Barind area. Such adverse impact (inundation) provoked outside dwellers to cut the embankment frustrating the objectives of the projects. **PROBLEM STATEMENT** • Past flood control and drainage (FCD) projects in the locality have caused adverse impact on economic, social and environmental sectors like loss of income from T. Aman rice cultivation due to uncertainty in monsoon rain , damage of B. Aman rice, adverse impact on fisheries, loss of wet land, communication disturbances from cuts and branches in embankments, closure of inexpensive navigation routes etc. • The FCD projects on both banks of the Atrai river could not fulfil all the objectives for which they were conceived. The area once characterised by huge water bodies and extensive flood plains, were the main habitat and breeding grounds for the traditional fish species has been severely affected. • Construction of embankments and improvement of drainage facilities have resulted in loss of flood plains and bio-diversity impacting economic, social and environmental sectors. • Thus there is need to solve the problems of uncertainty in Aman rice cultivation as well as reducing damage to B. Aman, rice, increasing capture fisheries, restoring navigation routes etc.
Detailed description of the Project:	Integrated Water Management involving technical, social and environmental concerns will be addressed under the project. The technical considerations will mainly focus on the issues of flood flow management and drainage improvement during wet season while creating the scope of water management for meeting the dry season irrigation requirement from surface water. The project also offers an excellent opportunity to address the restoration of ecologically particularly valuable beels, the incorporation of the interests of fisheries and navigation in the area. Social and environmental concerns will be addressed through engagement of local stakeholders in a participatory manner (Source: CEGIS (2007) Page 204) and through the design and operation of the structures and embankments. The analysis of existing problems shows that the project area suffers from tremendous flash flooding in the upstream polders while downstream polders suffer from submergence as a result of back water effect generated due to high water level maintained in the downstream in the mighty Jamuna River during the wet season. In addition, the production of fisheries has declined, affecting the livelihoods of the fisher folk. This aspect of the project is likely to be benefitted by the outcome of RMIP and FRERMIP. To briefly describe the concept of present planning, the polders and projects are classified into three clusters and the main river systems where interventions have been chosen for water resources management.

As per feasibility study, the project area is divided into 11 Polders or Units including the Chalan Beel Polders A, B, C, and D; Bogura Polders 2, 3, and 4; Naogaon Polder, Baral project, Barnai Project, Sirajganj Integrated Rural Development Project (SIRDP) and the Main Rivers in Natore, Rajshahi, Naogaon, Bogura, Sirajganj and Pabna districts.

In the Feasibility Study Report a series of options were tried with different kinds of infrastructures as well as river excavation. The options are; Option-1; this is the base condition or the present condition with lots of public cuts and breaches in the embankment. Option-2; this is the full FCD condition of the polders with no breaches and no spilling over the existing embankments. Option-3a; this adds option-2 with excavation of Atrai River in the downstream. Option-3b; this includes option-2 with excavation of Atrai River in the upstream. Option 3c; this undertakes option-2 with excavation of Sib River. Option-3d; this considers option-2 with excavation of Barnai River. Option-4a; Main public cuts are provided with structures or weirs allowing flood time flow of water through the polders and closing of all breaches. Option-4b; Same as option-4a plus River Fakirni closed by a cross dam. Option-5a; Same as option-4a with the provision of excavation of Sib River as under option-3c and large structures are replaced by low height embankments & Option-5b; same as under option-5a with additional FCD for Beel Halti area only. The results were tabulated for water levels and flooded areas in all the eleven polders. Criteria those were considered are the possibility of public cuts, minimum land acquisition & rehabilitation, people perception, sustainability of interventions, navigation and fishery development prospects, social acceptability etc.

It was found that of all the options, **option 5(a)** is the best choice from a feasibility perspective as well as the stakeholders choice. Under this option water is allowed inside the polders during flood season allowing migration of fishes and uninterrupted navigation, protecting Rabi crops and boro paddy; and protecting Aman & Aus crops from sudden floods which previously used to be caused due to public cuts. The option also provides additional surface water irrigation during dry reason by means of rubber dams. One additional regulator has been proposed across Baral Nandakuza for additional supplementary irrigation under Baral Project.

A map showing the polders (Units) within the project is attached in Figure DP 1.2. 2 Infrastructure Components of the Project are given in the following table:

Name of major items	Quantity	Unit/Cost (In lakh Taka)
Re-sectioning of Embankment	304.98 km	km/22.36
Bank Protective Work	5.122 km	km/1159.98
Embankment Slope Protection	41.00 km	km/333.12
Breach closure	3.10 km	km/84.45
Re-excavation of khal/river	220.00 km	km/19.38
Construction of Regulator	9 Nos	No./378.60
Construction of Rubber Dam	3 Nos	No./1129.51
Construction of Water Retention Structure	1 No.	No./568.73
Construction of Inlet/Outlet	18 Nos	No./12.36
Low height embankment	1.94 km	km/917.36
Construction of Bridge	5 Nos.	No./186.27
Rehabilitation of existing structure	118 Nos.	No./3.03

	The cost has been calculated on the basis of approved design vetted by BWDB design office and as per approved current schedule of rates of Rajshahi O&M Circle, BWDB, Rajshahi effect from the FY: 2014-15 Ecosystem's conservation and restoration components: C1: Detailed feasibility study and programme design - Study and detailed analysis of the hydrology, ecosystems and agri-fish ecology, including ESIA - Integrated design of communication and flood infrastructure - Stakeholder consultation and collaboration - Draft and final implementation plan, including participation, communication, training and programme management - Final design and preparation of implementation C2: Phased and adaptive implementation - Tender and contract management - Phased implementation: - A (Beel Halti, main communication infrastructure, fisheries and agriculture improvement); - B (western beels, communication infrastructure, eco-tourism and agri-fisheries improvement); and - C (northern beels -> idem) - Guidance of stakeholder platforms during implementation - Monitoring and impact assessment C3: Follow-up and private sector development Indicative cost: to be detailed
Objectives	The overall objective of the project is to enhance the livelihood and food security for the local communities. The project purpose is to protect the lands from flood events and to extend the irrigation coverage in the dry season. The specific objectives of the project are: • Allow controlled water in the polders in wet season in order to support agriculture, fisheries etc. Besides, water would be made available during dry season for agricultural activities through conjunctive use of surface and groundwater; • Mitigating adverse environmental impacts of past projects; • Preservation of biodiversity; • Promotion of culture fisheries and allowing flood plain capture fisheries.
BDP2100 Goals and Indicators	The project addresses the following BDP2100 objectives: Goal 1: Ensure safety against water and climate change related disasters Goal 2: Ensure water security and efficiency of water usages Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use The following BDP2100 sub-indicators are relevant: • Reduction of flood extent (area, crops, people affected) • Increasing dry season irrigation coverage • Water related ecosystem sustainability • Ecosystem services and goods harnessing

<table>
<tr><th colspan="3">COSTS AND BENEFITS OF THE PROJECT (INCLUDING METHOD OF ESTIMATION)</th></tr>
<tr><td>Indicate source:
• Feasibility Study
• (Pre-)Feasibility Study)
• Project Idea</td><td colspan="2">Development Project Proforma/Proposal (DPP) for Integrated Water Resources Management of Chalan Beel Area including Beel Halti Development Project, BWDB, was updated to 2014/15 prices from Feasibility study (2006/7). Figures referred in CN are from DPP.

The feasibility study has been completed by Engineering & Planning Consultants Ltd (EPC) in association with Design Planning and Management Consultant Ltd.; Bangladesh Engineering & Technological Services Ltd.; and Kranti Associates Ltd. Two separate study named EIA/SIA and Mathematical modelling studies have also been conducted by CEGIS and IWM respectively.

The start date of FS study on March 1, 2006 and submitted final report on August 2007.

In the following sections all figures etc are taken from the DPP re-casted in January 2015. It may be noted here that re-casted DPP only updated cost figures. Benefit figures (arising from cropping intensity increase etc.) are kept same.</td></tr>
<tr><td rowspan="3">Investment costs estimate (including method used)
Use FS results</td><td>Financial</td><td>Economic</td></tr>
<tr><td>BDT 4,474.7 million</td><td>BDT 3,405.3 million</td></tr>
<tr><td colspan="2">The estimate of cost has been prepared on the basis of approved design vetted by BWDB design office and as per approved current schedule of rates of Rajshahi O&M Circle, BWDB, Rajshahi effect from the FY: 2014-15
Indicative financial cost (2015): 4,751.88 BDT million</td></tr>
<tr><td>Year in which prices are denominated
Use FS results</td><td colspan="2">2014-15 prices</td></tr>
<tr><td rowspan="3">Project Duration & Distribution of investment costs
Use FS results</td><td colspan="2">The project duration: 4 years.
Source (DPP Page 2)</td></tr>
<tr><td>Financial</td><td>Economic</td></tr>
<tr><td>1st Year: BDT 1,431.84 million
2nd Year: BDT 1,081.93 million
3rd Year: BDT 1,617.00 million
4th Year: BDT 3,44.01 million
Total : BDT 4,474.77 million</td><td>1st Year: BDT 1,089.6 million
2nd Year: BDT 823.3 million
3rd Year: BDT 1,230.5 million
4th Year: BDT 261.7 million
Total : BDT 3,405.3 million</td></tr>
<tr><td rowspan="3">Related annual O&M costs estimate (basis Is same year as above) and method used.
Use FS results</td><td>Financial</td><td>Economic</td></tr>
<tr><td>1st Year to 4th Year = BDT 0 million
5th Year to 30th Year = BDT 104 million per year
Source (DPP, Economic Analysis, Appendix F Page 128)</td><td>1st Year to 4th Year = BDT 0 million
5th Year to 30th Year = BDT 93.8 million per year Source (DPP, Economic Analysis, Appendix F Page 129)</td></tr>
<tr><td colspan="2">After completion of the project major repair/rehabilitation works will be accomplished from regular O&M budget of BWDB. Annual O&M works will be done by BWDB's existing manpower.</td></tr>
<tr><td>Total lifetime of project
Use FS results</td><td colspan="2">30 years</td></tr>
<tr><td>DIRECT and INDIRECT (type of) benefits (description)</td><td colspan="2">DIRECT BENEFITS
• Cropping intensity would be increased by about 6.72% as a result of better flood and drainage management (CEGIS (2007) Page XXIII.)</td></tr>
</table>

COSTS AND BENEFITS OF THE PROJECT (INCLUDING METHOD OF ESTIMATION)		
Use FS results	• Crop production would be increased by about 0.26 and 0.49 million metric tons of paddy and non-paddy respectively due to increase of crop area, save the crop from flood damage and augmentation of surface water irrigation etc. Among the non-paddy crops Maize, Garlic, Vegetables and Potato would be increased significantly.	
	INDIRECT BENEFITS • Soil fertility would be enriched due to allowing monsoon flood within the project areas to some extent and increase surface water irrigation • Project activities will create employment opportunities of 0.60 million man days annually and these will contribute to poverty alleviation. • The employment opportunities of agricultural labour will increase by around 9,000 thousand man days per year after implementation of the project. • The length of fishing period will increase from six to seven month and total 1,584 thousand man-days of employment opportunities will be created for the fishing communities. *Source: CEGIS (2007)*	
Estimate Value of each type of Benefits (prices in same year as above) and method used ***Use FS results***	Financial 1st Year to 4th Year = BDT 0 million 5th Year to 30th Year = BDT 1,139.7 million per year Source (DPP, Economic Analysis, Appendix F Page 129)	Economic 1st Year to 4th Year = BDT 0 million Agricultural Benefits 5th Year to 30th Year = BDT 908.7 million per year Source (DPP, Economic Analysis, Appendix F Page 129)
Economic Internal Rate of Return ***Use FS results***	17.14% Source DPP	
Economic Net Present Value, *Use FS results*	BDT 1,245 million Source: DPP	
Economic Benefit-Cost Ratio ***Use FS results***	1.40 Source: DPP	
Opportunity for private sector: • **Indications of any revenue generating potential (financially)** • **Possibilities for private sector participation in adjacent activities/sectors in project area**	Not applicable	

ENVIRONMENT OF IMPLEMENTATION AND ITS POTENTIAL IMPEDIMENTS	
Lead Implementing Agency	Bangladesh Water Development Board (BWDB)
Capacity of implementing agency:	Yes

• **Sufficient (Y/N)** • **Solution, if not?**	
Other stakeholders involved and their role	BWDB will organize and implement programmes for fisheries, agriculture and beneficiaries participation through involvement of DOF, DAE and BRDB respectively.
Actions needed (like a resettlement plan?)	Resettlement action plan (RAP) required. O&M plan for infrastructure.
Risks foreseen and identified mitigation measures.	The implementation and operation is subject to several risks: a) Delayed procurement for civil works would significantly increase the risk of further loss of lands & properties; b) The major flood flow velocities & increased river bank erosion and water levels could exceed the design criteria during the project life; c) Construction cost overruns due to inappropriate design, inexperienced contractors, insufficient funding to complete projects on time and cost escalation along with contractor's financial claims; d) The poor standards of operation and maintenance could jeopardize the works. Besides, adequate funding may not be allocated for execution of timely routine and preventative maintenance upon end of the implementation program; e) The mismanagement of future water sector investment, operation and management could jeopardize project sustainability; f) Inadequate O&M funding would reduce the life of the investments requiring premature rehabilitation. *(Source: DPP, 2015 Page 15)*
Permits needed? If Yes, which ones?	Environmental clearance is mandatory. Environmental clearance has already been taken from DoE
EIA needed?	Study covers the EIA
SIA needed?	Study covers the SIA
Land acquisition required? Y/N	Yes, 8.34 hectare
EXPERTS OPINION	
Adaptive Delta Management *Based on the 5 ADM principles.* *See also Adaptive Delta Management chapter of BDP2100 document*	**1. Adaption for goal achievement:** The program provides a building block for achieving the BDP2100 goals identified in this concept note. **2. Adaptive Pathways & Tipping Points:** This program provides a first step to address identified challenges. Based on Flood risk management strategy, sequencing of cascading projects will be ensured in order to achieve safety standards by 2030. Use input from Concept Note of a study project on "Integrated Modelling to Support Adaptive Delta Management for Water Sector". For ground water tipping point research, refer to Concept Note on 'Expansion and Modernization of Monitoring Network and Tools for Sustainable Development, Management and Governance of Groundwater in Bangladesh'. **3. Multi-sectoral:** ADM defines holistic approach with multi-sector and ministerial action. Involvement of other sectors (fisheries, agriculture, livestock, environment, forest

	etc.) to be included in studies required for project implementation. **4. Avoiding Over- and under-investments:** Involving stakeholders in a timely fashion, cascading need based priority projects, learning by doing. **5. Connect Private and Public agendas:** ADM requires public and private initiatives (PPP, innovative contracting, licencing). In general adhering to cost recovery principles increases the chance for finding windows of opportunity.
Action needed for new FS	• New FS should incorporate the Adaptive Delta Management principles • During feasibility study, the project should be designed involving all sectors i.e. agriculture, fisheries, livestock, navigation, water supply and sanitation, environment and forest and the physical intervention should be identified.
Observation/Comment	a. <u>The CBA method</u> Methodology of original 2007 FS is highly questionable with an economic IRR 40.83% and a financial IRR of 41.18%. This seems to have been rationalized in the 2015 DPP with an economic IRR of 17.14% and a financial IRR of 16.65% (although no revenues resulting from project go directly to the state). More fundamentally, it is not correct to calculate NPV, IRR and C/B ratio with updated costs but old benefits – which seems to be the case. NPV and IRR will drop automatically, but the results become invalid. It is not clear of several key benefits such as fisheries, navigation and ecology are part of CBA method – but they should. b. <u>Risk assessment</u> A holistic inventory and assessment of different risks associated with the project has not been done to a sufficient extend in FS. c. <u>Integrated approach of implementation</u> Where stakeholders have been identified in the study (and Note), this is often done in a 'box-ticking' manner. d. <u>Institutional capacity assessment</u> FS does not provide in-depth capacity assessment of implementing agencies.
Comments BDP2100 strategy team	Beel restoration fits in with Shapla strategy promoting more nature based water management. Need for careful planning and dialogue where agriculture is affected by beel restoration. As the flood and drainage pattern in the area will change, detailed hydraulic modelling should be carried to optimise the design. Improved early warning systems should be part of the project, to minimize unexpected damages. PWM should be in place at the onset of the project.
Comments GED	• Project is required to be designed keeping in view the entire Chalan Beel area considering all aspects such as water flow, fisheries, crop production and operation of road communication; • Maintenance of rich Ecosystem Services of this area is also needed to be taken into consideration
Input Parameter Values for Incorporating	**Options to be Simulated:**

Interventions	Full FCD condition of the polders with no breaches and no spilling over the existing embankments. Main public cuts are provided with structures or weirs allowing flood time flow of water through the polders, large structures are replaced by low height embankments and closing of all breaches including excavation of Sib River. **Activities Planned to Perform** • Excavation of Sib river • Main public cuts are provided with structures or weirs • closing of all breaches • large structures are replaced by low height embankments **Changed Parameters in Metamodel:** • Water level reduced by 1m (Figure DP 1.2. 3)(to imitate the impact of dredging) • In the six districts- Rajshahi, Naogaon, Natore, Pabna, Sirajganj, Bogra- – Increased drainage efficiency to 0.75 (+25%) – Considering SW irrigation – Increased SW irrigation efficiency to 0.45 (+80%) – SW irrigation pump capacity set to $3m^3/s$ – Increased GW irrigation efficiency to 0.6 (+33.33%) – Keeping regulators open from January to October • Transferring select areas (shown in the map) from Transferring selected area from "Project" to "Non-Project" • Changing values in the 'Flood Damage Function' files (to imitate impact of flood proofing)
Expected Outputs	• Increase in storage of Shib river • Increase in drainage capacity of the beel area • Water is allowed inside the polders during flood season allowing migration of fishes and uninterrupted navigation, protecting Rabi crops and boro paddy; • Decrease in Ground Water Depletion • Reduced flood extent • Reduced flood duration • Reduced flood damage

CONVERTING ALL COSTS and BENEFITS VALUED IN YEAR X into 2015 prices)

Not necessary – DPP 2015 is already in 2015 prices.

ANNEX I: MAPS OF PROJECT LOCATION

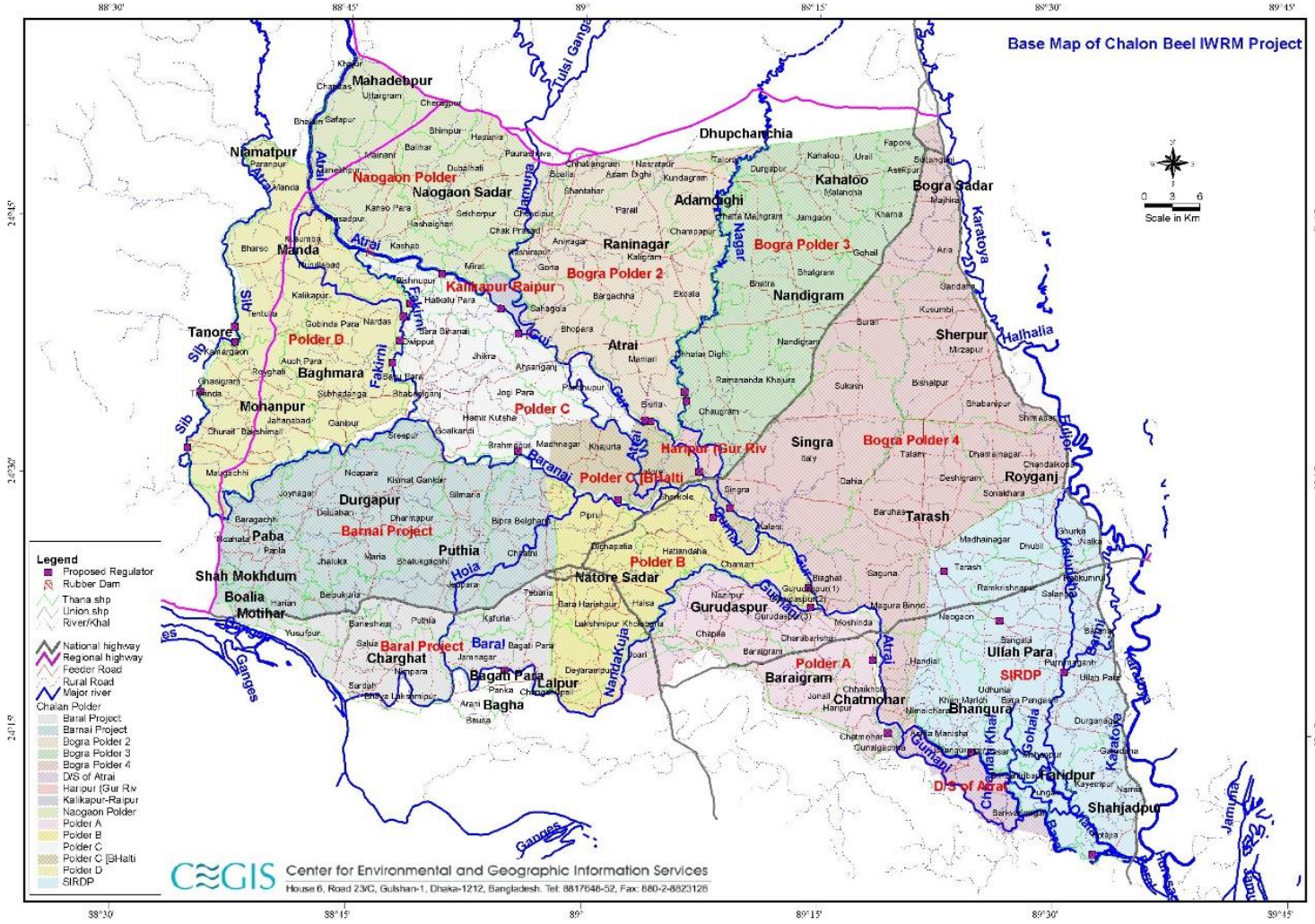


Figure DP 1.2.1: Location of the Chalan Beel IWRM Project

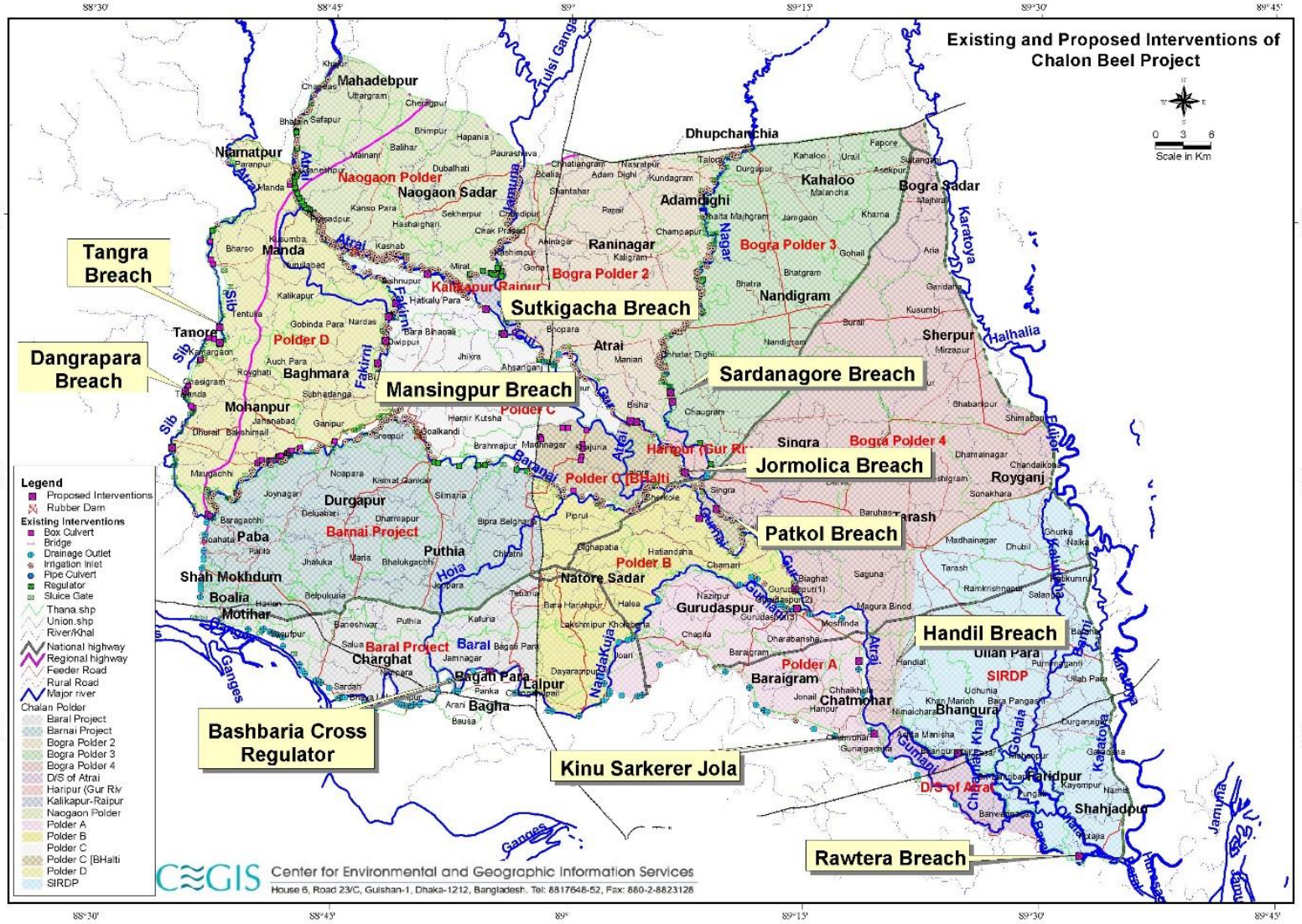
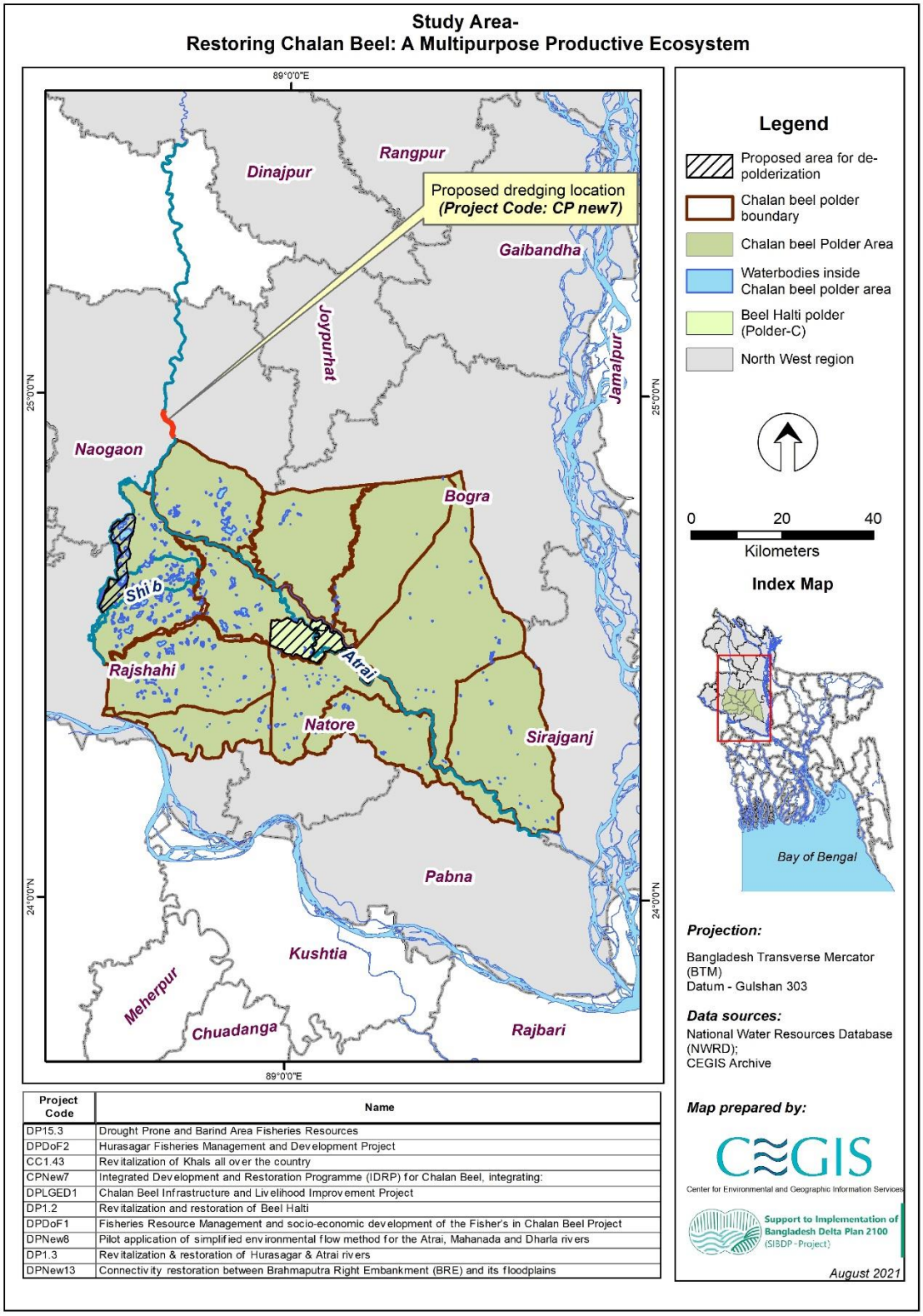


Figure DP 1.2. 2: Map showing proposed interventions under final option



Project Code	Name
DP15.3	Drought Prone and Barind Area Fisheries Resources
DPDoF2	Hurasagar Fisheries Management and Development Project
CC1.43	Revitalization of Khals all over the country
CPNew7	Integrated Development and Restoration Programme (IDRP) for Chalan Beel, integrating:
DPLGED1	Chalan Beel Infrastructure and Livelihood Improvement Project
DP1.2	Revitalization and restoration of Beel Halti
DPDoF1	Fisheries Resource Management and socio-economic development of the Fisher's in Chalan Beel Project
DPNew8	Pilot application of simplified environmental flow method for the Atrai, Mahanada and Dharla rivers
DP1.3	Revitalization & restoration of Hurasagar & Atrai rivers
DPNew13	Connectivity restoration between Brahmaputra Right Embankment (BRE) and its floodplains

Figure DP 1.2. 3: Study Area for Environment and Ecosystems Objective 2: Restoring Chalan Beel (including CP New7: Integrated Development and Restoration Programme for Chalan Beel)

A3: NW Agricultural Development Programme

A3.1 Existing Concept Notes (From BDP2100 Investment Plan)

Project Name: North Rajshahi Irrigation Project

DP 1.1

North Rajshahi Irrigation Project

Background

Farmers in North Rajshahi depend on rainfall and groundwater irrigation to cultivate boro and aman rice crops. During the boro season, farmers irrigate their boro crops using groundwater from deep tube wells. However, irrigation coverage is declining. Rainfall is proving insufficient for groundwater recharge, leading to a gradual depletion of the water table. As a result, boro rice yields have decreased by around 50 percent.

Project Description

This project involves the construction of a scheme to irrigate 74,800 hectares of land. It includes the construction of two pumping stations to draw water from the Ganges. The project also involves constructing hundreds of kilometers of main, secondary and tertiary canals as well as associated infrastructure, such as numerous bridges and culverts, and a new road. The project will likely follow from the Ganges Barrage Project, which will create a reservoir available for irrigation purposes.

The project has an estimated implementation period of 6 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Sustainably Intensifying Agricultural Production Systems, (ii) Promotion of Water Efficient Agricultural Practice as per the Crop Calendar.

Expected Benefits

The project is expected to increase agricultural output and improve food security. Total rice paddy protection is expected to increase by 211,050 tonnes, and cropped area is expected to increase by 27,000 hectares. Depending on project design, increased water availability may also broaden participation in agriculture as a livelihood for the poor.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

Bangladesh Water Development Board

Delta Plan Goal(s)

#2 *Ensure water security and efficiency of water usages*
#3 *Ensure sustainable and integrated river systems and estuaries management*
#4 *Conserve and preserve wetlands and ecosystems and promote their wise use.*

Financing

	Mil BDT	Mil USD
Capex	19,910	251
Opex	147	2

**Costs are estimated—to be refined through feasibility study.*

Project Area

- The North Rajshahi Irrigation Project is located in the north-west of Bangladesh
- The project area comprises 9 Upazilas of the Greater Rajshahi District:
- Chapai Nawabgonj Sadar, Nachole and Gomostapur Upazila of Chapai Nawabgonj District
- Godagari Tanore and Poba Upazila of Rajshahi District
- Niamatpur Manda and Porsha Upazilla in Naogon District

Source: GED, DP1.1 Project Concept Note

Finance and Delivery Modality

Large scale irrigation projects like this one have potential for PPPs. Unlike the water treatment and water supply sectors, irrigation does not have a long track record of PPPs. However, the sector has seen a few precedents in emerging markets. One successful example in Bangladesh is the Barind Multipurpose Development Authority, which collects upfront user fees for tube well irrigation using a prepaid card system to operate tube wells.

Project Name: Kurigram Irrigation Projects

DP 1.4/ 1.5 KURIGRAM IRRIGATION PROJECTS

BACKGROUND

The Kurigram region is affected by flooding during monsoons and insufficient water during the dry season. As a result of intensive use of groundwater for irrigation, groundwater levels have declined, and crop production has decreased.

An irrigation scheme will improve water availability during the dry season and decrease pressure on groundwater. This will lead to improved crop production and recovery of groundwater levels.

PROJECT DESCRIPTION

Both projects aim to provide full irrigation coverage to nearly 50,000 hectares of arable lands in Kurigram. Both projects involve the construction of main, secondary and tertiary canals as well as associated infrastructure, such as bridges, culverts, and a new road. DP 1.4 in Southern Kurigram also involves the construction of a barrage across the Dharla river, as well as improvements to 144 kilometers of flood embankments. DP 1.5 in Northern Kurigram involves the construction of two pump stations.

The project has an estimated implementation period of 5 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Extension of Dry Season Irrigation Coverage through Harnessing Water from Major Rivers, (ii) Afforestation and Reforestation.

EXPECTED BENEFITS

Both projects are expected to increase agricultural output and improve food security. Employment opportunities are expected to also increase. Both projects will also reduce the region's vulnerability to flood events and sea level rise.

The DP 1.4 project has an estimated economic benefit-cost ratio of 2.31 and DP 1.5 project has an estimated economic benefit-cost ratio of 1.86

RESPONSIBLE MINISTRY

Ministry of Water Resources

EXECUTING AGENCIES

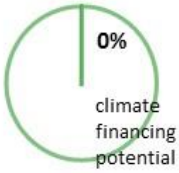
Bangladesh Water Development Board

DELTA PLAN GOAL(S)

#2 *Ensure water security and efficiency of water usages*

FINANCING

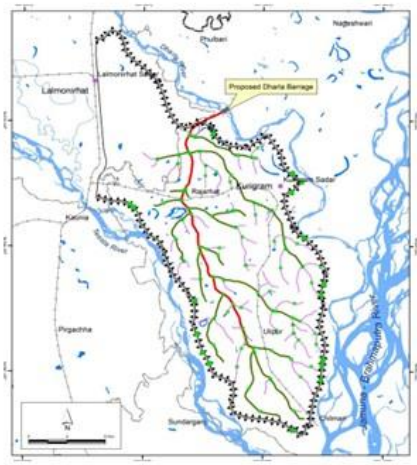
	Mil BDT	Mil USD
Capex	26,992	340
Opex	359	5



**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- The DP 1.4 project area is located in the southern part of the Kurigram district comprising Kurigram Sadar, Ulipur, Razarhat and Chimari Upazilas and part of Lalmonirhat Sadar Upazila of Lalmonirhat District.
- The DP 1.5 project area is located in the northern part of Kurigram district comprising parts of Fulbari, Nageswari, Bhurungamari and Kurigram Sadar Upazilas.



Source: GED, DP1.4 Project Concept Note

FINANCE AND DELIVERY MODALITY

Large scale irrigation projects have the potential to be developed as PPPs because the investment can be recovered through user charges. Bangladesh has had successful precedents for applying user-pay principles in irrigation. The Barind Multipurpose Development Authority (BMDA) collects upfront user fees for tube well irrigation using a prepaid card system to operate tube wells. Even if user charges are insufficient, there could be hybrid approaches to develop PPPs, such as co-financing.

Project Name: WMOs and Participatory Management Model for North Rajshahi Irrigation and Ganges Barrage

DP 25.1 WMOs and Participatory Management Model for North Rajshahi Irrigation and Ganges Barrage

Background

One reason for sub-optimal success of many flood and drainage projects is lack of community participation. Water Management Organisations (WMO) are designed to address this, but they are often only established after the infrastructure has been built, which results in lack of community ownership and reluctance to participate in operation and maintenance cost sharing. The construction of the Ganges Barrage provides an opportunity to ensure community participation from the beginning by establishing a WMO from the start.

Project Description

Establishment of a Water Management Organisation and cost-sharing mechanisms for the Ganges Barrage following community engagement, leading to community buy-in for the agreed cost recovery mechanisms.

The project has an estimated implementation period of 3 years. The project is linked to the Delta Plan strategy of Extension of Dry Season Irrigation Coverage through Harnessing Water from Major Rivers

Expected Benefits

Sustainable funding of the operation and maintenance (O&M) costs of the Ganges Barrage by achieving consensus among the community on cost recovery mechanisms.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

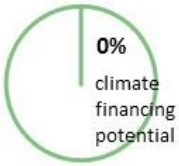
Bangladesh Water Development Board, North Rajshahi Irrigation Project

Delta Plan Goal(s)

#5 *Develop effective institutions and equitable governance for in-country and trans-boundary water resources management*

Financing

	Mil BDT	Mil USD
Capex	101	1
Opex	0	0



Project Area

- Chapai Nawabgonj, Nachole and Gomostapur Upazillas of Chapai Nawabgonj District
- Godagari, Tanore and Poba Upazillas of Rajshahi District
- Niamatpur, Manda and Parshu Upazillas of Naogon District

Source: Map data ©2017 Google

Finance and Delivery Modality

Since there is no private financing or climate financing potential, this project will have to be delivered by the public sector.

Project Name: WMOs and Cost Recovery for O&M for the Mahananda irrigation scheme

DP 25.2 WMOs and Cost Recovery for O&M for the Mahananda Irrigation Scheme

Background

One reason for sub-optimal success of many irrigation projects is lack of community participation. Water Management Organisations (WMO) are designed to address this, but they are often only established after the infrastructure has been built, which results in lack of community ownership and reluctance to participate in operation and maintenance cost sharing.

The Mahananda Irrigation Scheme covers 4,200 hectares, and an extension is planned. However, the extension has not been agreed with the owners/operators of the scheme's current low-lift pumps (LLP) used to extract water, who would be expected to bear operation and maintenance (O&M) costs.

Project Description

The project will create a layout of planned Water Management Organisations, lead a consultation with LLP owners/operators, and devise an agreed cost-sharing mechanism for O&M costs with LLP owners/operators for the Mahananda irrigation scheme extension.

The project has an estimated implementation period of 3 years. The project is linked to the Delta Plan strategy of Extension of Dry Season Irrigation Coverage through Harnessing Water from Major Rivers

Expected Benefits

The project will lead to sustainable funding of the operation and maintenance (O&M) costs of the Mahananda irrigation scheme extension, by achieving consensus among LLP owners/operators on cost recovery mechanisms.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

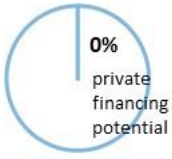
Bangladesh Water Development Board, Mahananda Irrigation Project and Barind Multipurpose Development Authority

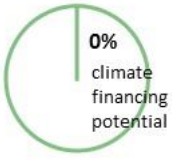
Delta Plan Goal(s)

#5 *Develop effective institutions and equitable governance for in-country and trans-boundary water resources management*

Financing

	Mil BDT	Mil USD
Capex	61	1
Opex	0	0





Project Area

- The project covers parts of Rajshahi and Chapai Nawabganj Districts
- It covers a part of Barind tract and Ganges flood plain
- It is located from the confluence of the Mahananda and Punarbhaba Rivers at Rohanpur to its confluence with the Ganges River

Source: Map data ©2017 Google

Finance and Delivery Modality

Since there is no private financing or climate financing potential, this project will have to be delivered by the public sector.

Project Name: WMOs and Participatory Management Model for O&M of Kurigram Irrigation Schemes (I & II)

DP 25.3 WMOs and Participatory Management Model for O&M of Kurigram Irrigation Schemes (I & II)

Background

One reason for sub-optimal success of many irrigation projects is lack of community participation. Water Management Organisations (WMO) are designed to address this, but they are often only established after the infrastructure has been built, which results in lack of community ownership and reluctance to participate in operation and maintenance cost sharing.

The establishment of Kurigram Irrigation schemes North and South requires community participation and support to maintain its physical infrastructure such as pump stations and canals.

Project Description

The project will establish a Water Management Organisation and cost-sharing mechanisms for the Kurigram Irrigation schemes North and South following community engagement, leading to community buy-in for the agreed cost recovery mechanisms.

The project has an estimated implementation period of 3 years. The project is linked to the Delta Plan strategy of Extension of Dry Season Irrigation Coverage through Harnessing Water from Major Rivers.

Expected Benefits

The project will lead to sustainable funding of the operation and maintenance (O&M) costs of the Kurigram Irrigation schemes North and South by achieving consensus among the community on cost recovery mechanisms.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

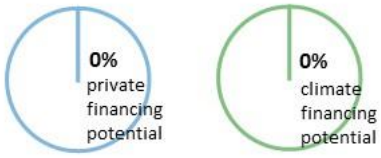
Bangladesh Water Development Board, Kurigram Irrigation Project I and II

Delta Plan Goal(s)

#5 *Develop effective institutions and equitable governance for in-country and trans-boundary water resources management*

Financing

	Mil BDT	Mil USD
Capex	102	1
Opex	0	0



Project Area

- Northern and southern Kurigram district: specifically, Kurigram Sadar, Ulipur, Razarhat, Chalmari, Fulbari, Nageswari
- Minor parts of Bhurungumari and Lalmonirhat Sadar Upazilas of Lalmonirhat District

Source: Map data ©2017 Google

Finance and Delivery Modality

Since there is no private financing or climate financing potential, this project will have to be delivered by the public sector.

Project Name: Managed Aquifer Recharge for Artificial Storage of Water to Improve Groundwater Table and Quality Conditions in Vulnerable

CC 1.46 MANAGED AQUIFER RECHARGE FOR ARTIFICIAL STORAGE OF WATER TO IMPROVE GROUNDWATER TABLE AND QUALITY CONDITIONS IN VULNERABLE AREAS

BACKGROUND

Uncontrolled abstraction of groundwater resources has resulted in salinity intrusion and degradation of the groundwater table, specifically in urban areas where demand for water is high and in coastal areas with higher salinity content. Managed Aquifer Recharge for Artificial Storage techniques facilitate additional water storage and reduce salinity in aquifers.

PROJECT DESCRIPTION

The project involves installation and monitoring of sustainable and appropriate recharge technologies to improve the groundwater table and reduce salinity.

The project has an estimated implementation period of 10 years. The project is linked to the Delta Plan strategy of Extension and Promotion of Efficient Water Supply and Sanitation Management System for Fully, Urban, Semi Urban, CHT and Rural Areas to Ensure Domestic Water Efficiency without Exhausting Natural Resources.

EXPECTED BENEFITS

The project will ensure fresh and safe water supply all year round; especially in areas vulnerable to salinity intrusion and groundwater depletion.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

RESPONSIBLE MINISTRY

Ministry of Water Resources

EXECUTING AGENCIES

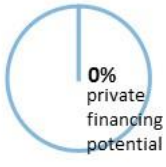
Bangladesh Water Development Board, Barind Multipurpose Development Authority, Bangladesh Agricultural Development Corporation, and various Water Supply and Sewerage Authorities (WASAs).

DELTA PLAN GOAL(S)

#2 *Ensure water security and efficiency of water usages*

FINANCING

	Mil BDT	Mil USD
Capex	1,334	17
Opex	133	2



**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- Country-wide

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

Since there is no private financing or climate financing potential, this project will have to be delivered by the public sector.

Project Name: Expansion and Modernization of Network and Tools for Groundwater Monitoring including Establishment of a National Coordination Mechanism

CC 1.45 EXPANSION AND MODERNIZATION OF NETWORK AND TOOLS FOR GROUNDWATER MONITORING INCLUDING ESTABLISHMENT OF A NATIONAL COORDINATION MECHANISM

BACKGROUND

Groundwater is the principal source of irrigation and potable water supply in Bangladesh. No systematic program exists for monitoring deep groundwater levels and quality with the exception of the recently implemented BWDB program for monitoring water levels and quality down to the depths of 350m in the coastal zone. This program needs to be extended to other parts of the country, considering the demand for deep groundwater. The Department of Public Health Engineering and the Bangladesh Agricultural Development Corporation have a groundwater monitoring network, but they have collected data only for few years, and the frequency of the data collection is not regular. Only BWDB has been collecting groundwater data once a week for more than 50 years.

PROJECT DESCRIPTION

This project aims to (i) review and expand the monitoring network to assess and control groundwater quantity and quality (ii) modernize and strengthen data collection, storage, analytical methods, and instruments (iii) provide institutional capacity building to appropriate monitoring organizations (iv) support preparation of a water budget and water allocation plans for sustainable development, management, and governance of the water resources

The project has an estimated implementation period of 10 years. The project is linked to the Delta Plan strategy of Extension and Promotion of Efficient Water Supply and Sanitation Management System for Fully, Urban, Semi Urban, CHT and Rural Areas to Ensure Domestic Water Efficiency without Exhausting Natural Resources.

EXPECTED BENEFITS

This project will provide guidelines for a sustainable use of the limited fresh water resources for drinking, and agricultural and industrial demand. It will also predict future changes that would provide valuable guidelines for planning an efficient water use in agriculture through model simulations under different hydrologic parameters. Groundwater users, farmers, planners, policymakers, scientists, and researchers will benefit from the data and analytical results of this project for sustainable development and management of groundwater.

RESPONSIBLE MINISTRY

Ministry of Water Resources

EXECUTING AGENCIES

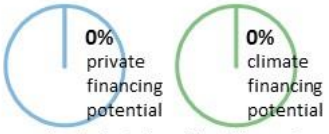
Bangladesh Water Development Board (BWDB)

DELTA PLAN GOAL(S)

#5 Develop effective institutions and equitable governance for in-country and transboundary water resources management

FINANCING

	Mil BDT	Mil USD
Capex	4,033	51
Opex	47	0.59



**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- All over Bangladesh, particularly in flood plains, and Barind and Coastal Deltaic Areas

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

Since there is no private or climate financing potential, this project will have to be delivered by the public sector.

A3.2 New Concept Notes

Project Name: Sustainable groundwater management

Project Title:	***Sustainable groundwater management***
Relevant Sector:	Environment
Location of the Project:	Northwest Basin, especially areas with groundwater over-abstraction like the Barind
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 2: Enhance water security and efficiency of water usages The project aims to protect groundwater resources and thereby contributes mostly to BDP goal 2 as it is focused on the sustainable availability of the groundwater. However, the project also contributes to all other objectives. Groundwater availability can help to alleviate the impact of droughts (Goal 1), to ensure enough water in rivers by reducing drainage of river water to the groundwater (Goal 3), to ensure enough water in wetlands and ecosystems (Goal 4) and to establish and maintain connectivity of water courses (Goal 6). The governance aspects of the project contribute to Goal 5.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge & Information and Institutional
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Up to 2030 to set-up, but to be continued long term.
Project Duration:	2 years 1 year to set-up monitoring, permitting and re-delineation of protection zones 1-year to implement the system Permanent execution of the system after implementation
Rationale (Justification) of the Project:	The main problem to be addressed by this project is the threat to the sustainable use of groundwater resources for domestic, industrial and agricultural use posed by over-extraction and contamination.
Objectives of the project:	The overall objective is to ensure the sustainable availability of groundwater for domestic, industrial and agricultural. The project purpose is to set-up a system of monitoring, permitting and groundwater protection zones to reduce the threat of over-abstraction and contamination. The specific objectives are to set-up a system to: • Systematically monitor the quantity and quality of groundwater resources; • Manage groundwater abstraction and reduce over-abstraction by making permits for abstractions obligatory and by enforcing this obligation. Payment for groundwater abstraction can be considered as an element of improving management, but the impacts on livelihoods of poor farmers should be considered; and • (Re-) delineate groundwater protection zones to establish different goals for different areas and to focus attention for monitoring and permitting to areas that are most in need of protection.

Please Link the result framework (RF) of the project of BDP-2100	
Expected socio-economic benefits (quantitative):	Not possible to determine this a priori quantitatively. Expected benefits are improved water security for domestic, industrial and agricultural, reduction in the impacts of droughts and increase in water available for rivers, wetlands and other groundwater dependent ecosystems affected by drainage to the groundwater. This increase in water availability will results in increased agricultural and industrial production, increased capture fish production, improved health conditions, enhanced water quality and nature, increased groundwater recharge.
Detailed description of the Project (Component wise):	• Mapping of the stakeholders and involve them in all project activities. • Review existing systems for monitoring, permitting and protection zones. • Review threat to sustainable groundwater use posed by over-abstraction and contamination including an inventory of subatcnes and contamination sources that potentially threaten groundwater quality • Prepare a draft plan for (re-)delineation of protection zones based on an analysis of the current state of the different aquifers, their importance for different kind of uses and the future threats to their quantity and quality. • Revise the draft protection zone plan based on input from all stakeholders and submit it for approval to the relevant authorities • Use the protection zones to differentiate the activities and proposed regulations regarding monitoring and permitting. • Prepare a draft monitoring plan for quantity and quality of groundwater depending as much as possible on existing wells and adding a limited number of wells, if required. The plan will cover the locations of the wells, the frequency of sampling and the parameters to be analysed. • Revise the draft monitoring plan based on input from all stakeholders and submit it for approval to the relevant authorities • Implement the monitoring plan • Annually prepare a report on the results of the monitoring including an analysis of the results to determine trends and threats and to decide whether additional activities regarding permitting, protection zones or other are required. • Prepare a draft plan for permitting of groundwater abstraction and the use and discharge of substances that could potentially threaten groundwater quality. The plan will also consider the advantages and disadvantages of introducing a pricing mechanism for (certain types of) groundwater abstraction as well as a mechanism to enforce permits and to collect fees (if introduced). • Revise the draft permitting plan based on input from all stakeholders and submit it for approval to the relevant authorities • Phased implementation of the permitting plan starting in the most threatened areas
Indicative cost: (in lac taka)	1,000 Lac Taka (1.0 M euro) in first two years
O&M cost:	Tk. 500 Lac Taka (0.5 M euro) per year for permanent monitoring, permitting, enforcement and reviewing
Lead Implementing Agency:	Ministry: MoWR and MoA
	Executing Agency: BMDA Partners: BADC, DoE, BWDB, DAE, LGED

Project Name: Development of NW-Agriculture Database and Management System

Project Title:	**Development of NW-Agriculture Database and Management System**
Relevant Sector:	Agriculture
Location of the Project:	Northwest Region
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 5: Develop effective institutions and equitable governance for in-country and trans-boundary water resources management. The project aims to develop a resourceful database exclusively on agricultural components for NW region of the country which will facilitate planners and policymaker to take projects based on the gaps and necessities found from the database of specific district/upazila level.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge & Information.
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Short term (up to 2030)
Project Duration: ***(during implementation)***	5 years A 2-year project for defining the information needs, make an inventory of existing data/information, new data and develop a GIS based database for agricultural components. The next 2/3 years to update the database with information/data, institutional setup with agencies related to Agriculture, to keep the system running and upto date with new information, train the required officials for handling the database, monitoring of the system.
Rationale (Justification) of the Project: (Background: Provide relevant information about project context Problem Statement: Main problem and Sub problems)	Database development and management system typically focus on organizational objectives such as improved performance, innovation, sharing of information, integration and continuous improvement of the selected sector. Northwest region of Bangladesh, considered as the food basket of the country, has the highest percentage of net cultivable area and shows most intensive use of groundwater. Drought is a common phenomenon for this region, and in recent years, there are serious concerns about the sustainability of groundwater use for irrigation as groundwater levels are falling in some parts of the region which may effect on the crop yield in future. Thereby, a compressive up to date database related to crop production, soil information, crop distribution, land type and evaluation, land degradation, availability of water and water demand, ground water availability and depletion rate, irrigation data etc. are needed to evaluate the state of the art scenario of areas under the region and to provide valuable information to the policy makers/planners to act for its future sustainability while taking new projects, rescaling exiting projects and facilitate farmer and young practitioner as well. The database will also store all the project related information in a single place for efficient management of the agriculture sector projects. The main aim of this study is to develop a web enable GIS based detailed database for the NW agricultural components based on the historical data (secondary

	sources) and field observations (primary data) and database management system /framework which will facilitate all level of planners, policy makers and users to be benefitted through it in respective fields of developing new projects, data updating, knowledge sharing, farmers community development, new experimental issuers under researches and young practitioners. This database can be further upscaled and integrated with the knowledge portal database of BDP2100 The success of the database development can be also replicated for other regions in future.
Objectives of the project:	The overall objective of the database is to aid the decision makers in the sustainable and integrated management of agricultural resources. Later this kind of project can be implemented for the other regions as well. **Specific objectives:** • Data collection in district and upazilla level for different components like crops, livestock, fisheries, environment and socio-economic conditions. • Agriculture data like farming practices, cropping patters, crop area, yields, irrigation related, water availability and demand, data on drought and flood, soil and water quality use of seeds, fertilizers, pesticides etc • Developing a GIS based data platform suitable for decision making. • Prepare a user-friendly institutional framework for data sharing for all implementing Govt and Non-Govt based projects and research. • Sharing information by inter organisational cooperation and efficient management of the projects • Establish an institutional set-up, training for managing the database to keep the information system running and updated. • Sharing the information with the local stakeholders.
Please Link the result framework (RF) of the project of BDP-2100	
Expected socio-economic benefits (quantitative):	Benefiting sectors will be the planner and policy makers on project planning, gap analysis, as well as researchers in formulating new research options and updating database with research and project database besides, local farmers and young practitioners will be benefitted with the information on agricultural components etc. Besides planning for crop diversity, selection of harvesting technology will create new opportunities. Overall, it will generate employment opportunities for the people and strengthen livelihood. In the long run, proper planning and timely implementation of these projects can bring socio economic benefits
Detailed description of the Project (Component wise):	The following activities are expected under this project: 1. Need assessment for the Agriculture database 2. Review of existing information/database 3. Data collection (primary and secondary) 4. Develop a prototype web enable GIS based database and fill it with existing data. 5. Set-up an institutional framework. 6. Linking the database with Knowledge portal of BDP2100 7. Training on data management and handling the database system. 8. Draft an implementation plan including tasks, responsibilities, and budgets.

Indicative cost: (in lac taka)	5000 Lac Taka
O&M cost:	Database management will require 100 Lac per year
Lead Implementing Agency:	Ministry: MoA, MoEF&CC, MoWR
	Executing Agency: Knowledge Institutes, BADC, DAE, BMDA, BWDB, LGED

Project Name: Water Retention in the northwest to lessen pressure on groundwater resources

Project Title:	***Water Retention in the northwest to lessen pressure on groundwater resources***
Relevant Sector:	water resouce
Location of the Project:	Northwest region, in which areas scarcity of groundwater at dry period
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 2: Enhance water security and efficiency of water usages; Goal 3: Achieve optimal and integrated use of land and water resources
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Infrastructure/ institutional
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	As a pilot project up to 2025; with upscaling to the NW basin up to 2030 and further upscaling depending on climate and land use
Project Duration:	3 years
Rationale (Justification) of the Project:	Climate change is resulting in intensification and irregularity of extreme climatic events. This is aggravating impacts of already prevalent natural hazards such as drought. Natural and small-scale measures for water retention can help to assuage the adversities of drought and to reap subsidiary benefits from wetland ecosystem. **Main problem:** Lowering of the groundwater table in the dry and monsoon season due to excess use of groundwater for irrigation.
Objectives of the project:	Objective: Enhance local water availability for agriculture production and water supply Project Purpose: • Maintaining availability of water for domestic use all-year round • Managing demand of water for irrigation in the dry season • Increasing water retention capacity of the soil • Ensuring sustainability of wetland ecosystem
Please Link the result framework (RF) of the project of BDP-2100	2B: Dry season irrigation coverage 2E: Rural population with safe drinking water access
Expected socio-economic benefits (quantitative):	• Enhanced food diversity • Enhanced income from kitchen gardening

	• Reduced collection time for drinking water provision • Reduced fuel cost for irrigation • Monetization of subsidiary services (e.g.- nutrient removal, Carbon credits) (subject to thorough economic assessment) from water retention ponds (and other measures) may lead to better policy making and utilization of resources
Detailed description of the Project (Component wise):	• Identification & Review of the most suitable technologies based on existing experience and best practices world-wide • Inventory, through satellite images and subsequent ground truthing of suitable perennial water sources; and local storage options (tanks, ponds, aquifer storage) for retention of surface water, including the potential volume to be harvested, using BMD data • Assessment for additional water demand & supply requirements for water supply and small scale (household level) irrigation, now and in future scenario conditions up to 2050 • Identification of potential locations for water retention • Drafting a long-term investment programme including CBA, financing options, permitting, O&M support and monitoring
Changed parameters in Metamodel	• Increasing Root Zone Storage • Increasing maximum infiltration rate • Closing regulators in dry season (Nov-Dec)
Expected output from Metamodel run	• Decrease in rice crop yield loss due to river and rainfall floods • Decrease in rice crop yield loss due to drought • Decrease in Waterlogged area • Increase in volume percolated to GW • Increase in Rice Production • Increase in Wheat Production
Interpretation of results	
Indicative cost: (in lakh taka)	Inventory and water resource potentiality analysis: 10 Lakh Taka Pilot application in the Barind, including monitoring: 2.5 lakh Taka
O&M cost:	1 lakh Taka per year
Lead Implementing Agency: BADC (MoA)	Ministry: MoA and MoEF&CC
	Executing Agency: BADC, DAE, BMDA, Local NGOs-Credit and Savings Unions (social banking), local government

Project Name: Research for upgradation of existing irrigation system for increasing water use efficiency

Project Title:	**Research for upgradation of existing irrigation system for increasing water use efficiency**
Relevant Sector:	Agriculture
Location of the Project:	Northwest region, in which areas scarcity of groundwater depletion rate is high
Relevant BDP Goal & Why this Project is BDP 2100 related:	Goal 2: Enhance water security and efficiency of water usages; Goal 3: Achieve optimal and integrated use of land and water resources
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Knowledge and Information, Research
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	Medium term (2030)
Project Duration:	5-10 years
Rationale (Justification) of the Project:	Irrigation consumes the huge amount of the water extracted from various sources (groundwater and surface water), and hence the efficiency of its use is very much critical. Fresh water is decreasing day by day. Improvement of irrigation infrastructure/system through modernization and automation have led to water savings. Water use efficiency can be increased by real-time controlling and optimisation of water use of the crop. Most importantly, irrigation timing is critical for crop to crop. Every crop has different life cycle and water requirement is different as well as the time of water requirement. That's why, it is important to provide irrigation at the time when crop needs water for physiological development. **Problem statement:** Groundwater level depletion due to excess use for irrigation and other uses.
Objectives of the project:	**Overall objective:** Main objective is increase water use efficiency. Also emphasis on how to increase surface water use in irrigation and other purposes rather than using groundwater. Another thing is to irrigate at the time of water need of the crops.
Please Link the result framework (RF) of the project of BDP-2100	
Expected socio-economic benefits (quantitative):	Expected benefits are improved water security for agriculture and other users, reduce pumping cost, improve environmental performance, increase potentiality of irrigating a larger area with a given volume of water

Detailed description of the Project (Component wise):	1. Baseline condition of the irrigation system assessment according to primary and available secondary data 2. Evaluation of the existing irrigation system 3. Identify the key issues of existing irrigation system Research on this issues for further improvement 4. Identify suitable technologies for increasing water use efficiency on different scheme and crops 5. Identify the critical stage for irrigation of rice and other crops 6. Develop an irrigation time frame according to the critical stage of crops. 7. Develop a pilot project for assessment of the research findings 8. After successful completion of the pilot, extension needed for other areas.
Indicative cost: (in lac taka)	5000 Lac Taka for piloting
O&M cost:	
Lead Implementing Agency:	Ministry: MoA,
	Executing Agency: BADC, BMDA, DAE, BWDB, NARS, Knowledge Institutes

Project Name: Crop Diversification, Production and Marketing for Nutrition and Food Security Project

Project Title:	***Crop Diversification, Production and Marketing for Nutrition and Food Security Project.***
Relevant Sector:	The Project is proposed to be implemented under Crops Sub-sector of Agricultural sector of planning commission of Bangladesh. The focus of the project is to strengthen of Crop Diversification, Food Security, Safe food production and Marketing.
Location of the Project:	Barind region (Bogura, Dinajpur, Naogaon, Nawabganj, Rajshahi & Rangpur district)
Relevant BDP Goal & Why this Project is BDP 2100 related:	
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Institutional
Timing: Short term (up to 2030)/ Medium term (2030-2050)/ Long term (>2050)	MediumTerm (up to 2050)
Project Duration:	20 Years
Rationale (Justification) of the Project:	Transformation to commercial and modern agriculture from traditional agriculture for nutrition and food security improvement of Bangladesh.
Objectives of the project:	i. Expansion of High Value Crops (HVCs) through training, technology transfer and extension. ii. Increase productivity of HVCs through adoption of modern technologies. iii. Post Harvest Management (PHM) support for HVCs and remunerative marketing of HVCs. iv. Agricultural Credit Distribution v. Create employment opportunities
Please Link the result framework (RF) of the project of BDP-2100	
Input for Metamodel (for 6 districts encompassing Barind Region only – Bogura, Dinajpur, Naogaon, Nawabganj, Rajshahi & Rangpur)	• Subtracting 2%, 5% & 10% Boro cultivation area (3 separate scenarios) • Adding 60 % of Reduced area for Boro cultivation to Wheat cultivation area for each scenario • Adding 40 % of reduced area for Boro cultivation to Maize (rabi) cultivation area for each scenario
Expected output from Metamodel	
Expected socio-economic benefits (quantitative):	
Detailed description of	

the Project (Component wise):	
Indicative cost: (in lac taka)	212500.00 lac BDT
O&M cost:	
Lead Implementing Agency:	Ministry: Ministry of Agriculture
	Executing Agency: DAE

A4: NW Water Supply and Sanitation Programme

A4.1 Existing Concept Notes (From BDP2100 Investment Plan)

Project Name: Piped Water Supply Project in 100 Pourashavas

CC 9.10 PIPED WATER SUPPLY PROJECT IN 100 POURASHAVAS

BACKGROUND

The rapid growth of Bangladesh's urban areas has resulted in demand outstripping the supply of safe drinking water. One hundred of Bangladesh's 320 secondary towns (Pourashavas) have been identified as having no piped water systems. The lack of safe water leads to the spread of water borne disease, compromising public health in these communities.

PROJECT DESCRIPTION

This project involves improvements to water supply infrastructure in 100 Pourashavas throughout Bangladesh There will also be investment in training and capacity building. Key planned investments include the installation of 400 production tube wells and pumps, treatment plants in one third of the Pourashavas, as well as the installation of 50 kilometers of pipelines in each Pourashava to transport water.

The project has an estimated implementation period of 10 years. The project is linked to the Delta Plan strategy Extension and Promotion of Efficient Water Supply and Sanitation Management System for Fully, Urban, Semi Urban, CHT and Rural Areas to Ensure Domestic Water Efficiency without Exhausting Natural Resources.

EXPECTED BENEFITS

The project is expected to provide improved access to safe drinking water across Bangladesh. As a result, overall public health and, therefore, living standards should improve.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

RESPONSIBLE MINISTRY

Ministry of Local Government, Rural Development and Co-operatives

EXECUTING AGENCIES

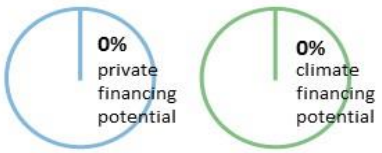
Department of Public Health Engineering, Selected Pourashavas

DELTA PLAN GOAL(S)

#2 *Ensure water security and efficiency of water usages*

FINANCING

	Mil BDT	Mil USD
Capex	25,031	315
Opex	240	3



**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- 100 Pourashavas throughout Bangladesh, which currently lack piped water

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

This project could potentially be designed, built, operated and maintained by private firms. However, given the low tariffs for water supply across Bangladesh, and the political and social issues surrounding collection of outstanding bills, it is unlikely that retail water supply operations will be financially viable in the near term. The project will need to be delivered by the public sector.

Project Name: Water Supply Project in the Urban Areas of Bangladesh (Secondary Towns)

CC 9.11 Water Supply Project in the Urban Areas of Bangladesh (Secondary Towns)

Background

The rapid growth of Bangladesh's urban areas has resulted in demand outstripping the supply of safe drinking water. The lack of safe water leads to the spread of waterborne disease, compromising public health in these communities.

150 of Bangladesh's 320 secondary towns (Pourashavas) have been identified as having unsatisfactory water supply systems. A further 100 Pourashavas have been identified as having no piped water systems, which a separate project will seek to address.

Project Description

This project involves improvements to water supply infrastructure in 150 Pourashavas throughout Bangladesh. There will also be investment in training and capacity building. Key planned investments include the installation of 350 production tube wells and pumps, 150 treatment plants, as well as the installation of 4,500 kilometers of pipelines.

The project has an estimated implementation period of 5 years. The project is linked to the Delta Plan strategy Extension and Promotion of Efficient Water Supply and Sanitation Management System for Fully, Urban, Semi Urban, CHT and Rural Areas to Ensure Domestic Water Efficiency without Exhausting Natural Resources.

Expected Benefits

The project is expected to provide improved access to safe drinking water across Bangladesh. As a result, overall public health and, therefore, living standards should improve.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

Responsible Ministry

Ministry of Local Government, Rural Development and Co-operatives

Executing Agencies

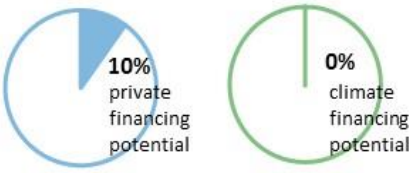
Department of Public Health Engineering, Selected Pourashavas

Delta Plan Goal(s)

#2 *Ensure water security and efficiency of water usages*

Financing

	Mil BDT	Mil USD
Capex	46,688	588
Opex	420	5



**Costs are estimated—to be refined through feasibility study.*

Project Area

- 150 Pourashavas throughout Bangladesh (50 at District level, and 100 at Upazila (sub-district) level)

Source: Map data ©2017 Google

Finance and Delivery Modality

This project could potentially be designed, built, operated and maintained by private firms. However, given the low tariffs for water supply across Bangladesh, and the political and social issues surrounding collection of outstanding bills, it is unlikely that retail water supply operations will be financially viable in the near term. Most of the project will be delivered by the public sector.

Project Name: Improvement of Sanitation System in Urban Areas of Bangladesh

CC 9.12 Improvement of Sanitation System in Urban Areas of Bangladesh

Background

Bangladesh's secondary towns (Pourashavas) have no facilities for centralized faecal sludge collection and treatment. In general, individual household septic tanks are emptied manually by private laborers or by the household itself. This untreated waste is then typically disposed directly into drains, holes or open spaces. The result is environmental pollution and the spread of waterborne disease. Recently, a programme has been implemented in 11 Pourashavas to improve septic tank, waste water, and sludge management. This programme should be implemented on a large scale throughout Bangladesh's Pourashavas.

Project Description

This project involves improvements to sanitation systems in 100 selected Pourashavas throughout Bangladesh. Key investments include 200 small bore sewage systems, two stabilization ponds and associated equipment, 1,000 community latrines and 500 public toilets. There will also be investment in training and capacity building.

The project has an estimated implementation period of 5 years. The project is linked to the Delta Plan strategy of Improvement of the Water Quality as per Local and International Standard by Reducing the Pollution of Water from Point and Non-point Sources of Pollution.

Expected Benefits

The project is expected to reduce the spread of waterborne diseases by improving access to proper sanitation facilities. This is expected to improve community health and living standards. Proper waste collection and treatment will also lead to improved environmental quality.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

Responsible Ministry

Ministry of Local Government, Rural Development and Co-operatives

Executing Agencies

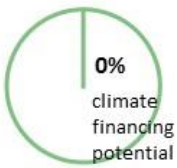
Department of Public Health Engineering, Selected Pourashavas

Delta Plan Goal(s)

#2 *Ensure water security and efficiency of water usages*

Financing

	Mil BDT	Mil USD
Capex	22,173	279
Opex	18	0.23



**Costs are estimated—to be refined through feasibility study.*

Project Area

- 100 selected Pourashavas throughout Bangladesh.

Source: Map data ©2017 Google

Finance and Delivery Modality

Since there is no private financing or climate financing potential, this project will have to be delivered by the public sector.

Project Name: Village Piped Water Supply System Project (phase I & II)

CC 9.13 VILLAGE PIPED WATER SUPPLY SYSTEM PROJECT (PHASE I & II)

BACKGROUND

Access to a safe water supply is one of the most important determinants of health and of economic development. Groundwater is the main source of water supply in urban and rural areas of Bangladesh. However, the availability of groundwater that is safe for human consumption is a problem throughout Bangladesh. Groundwater in around 277 sub-districts (Upazilas) has been contaminated by saltwater. Arsenic has also contaminated groundwater in 176 Upazilas. Some of the areas have both arsenic and salinity problems. More than 70 million people are affected by salinity and about 90 million people are affected by arsenic contamination. Identifying new water supply options is, therefore, a national priority.

PROJECT DESCRIPTION

This project aims to improve water supply infrastructure in 2,500 villages across Bangladesh. The project is expected to be completed in two phases. It will ultimately involve the installation of 5,000 tube wells, 1,820 electrified pumps and pump houses, 30,000 kilometers of water pipeline infrastructure, as well as treatment plants in one third of the villages. There will also be investment in training and capacity building.

The project has an estimated implementation period of 30 years. The project is linked to the Delta Plan strategy Extension and Promotion of Efficient Water Supply and Sanitation Management System for Fully, Urban, Semi Urban, CHT and Rural Areas to Ensure Domestic Water Efficiency without Exhausting Natural Resources.

EXPECTED BENEFITS

The project is expected to provide improved access to safe drinking water across Bangladesh. As a result, overall public health and, therefore, living standards should improve.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

RESPONSIBLE MINISTRY

Ministry of Local Government, Rural Development and Co-operatives

EXECUTING AGENCIES

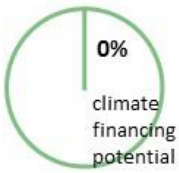
Department of Public Health Engineering

DELTA PLAN GOAL(S)

#2 *Ensure water security and efficiency of water usages*

FINANCING

	Mil BDT	Mil USD
Capex	53,376	673
Opex	1,200	15



**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- 500 villages in Phase I, and 2,000 villages in Phase II throughout Bangladesh

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

Since there is no private or climate financing potential, this project will have to be delivered by the public sector.

Project Name: Project for Improvement of Storm Water Drainage Facilities in Pourashavas (phase I)

CC 9.18 PROJECT FOR IMPROVEMENT OF STORM WATER DRAINAGE FACILITIES IN POURASHAVAS (PHASE I)

BACKGROUND

The Government of Bangladesh is emphasizing the importance of water supply, sanitation, solid waste management, and storm water drainage for the protection of environment and to enhance health outcomes. These sectors are high priorities areas for the Government. The storm water drainage systems in newly created pourashavas are not adequate to meet the minimum demand. Improved drainage facilities are needed.

PROJECT DESCRIPTION

The project will rehabilitate or re-excavate existing khals/drains to increase the carrying capacity. New primary, secondary and tertiary RCC drainage is also required. The project will also define outfalls and ensure proper maintenance.

The project has an estimated implementation period of 10 years. The project is linked to the following Delta Plan strategies: (i) Restoration of Severely Water Logged and Drainage Congested Areas in Coastal Region, (ii) Ensuring Fresh Water Flow in the Coastal Region.

EXPECTED BENEFITS

Reduced flooding, reduced damage to buildings, roads, vehicles and other property, as well as improved health and environmental outcomes.

A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

RESPONSIBLE MINISTRY

Ministry of LGRD and Co-operatives, Ministry of Water Resources

EXECUTING AGENCIES

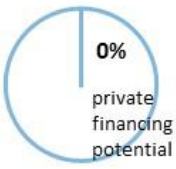
Department of Public Health Engineering

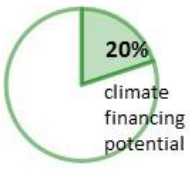
DELTA PLAN GOAL(S)

#1 *Ensure safety from floods and climate change related disasters*
#2 *Ensure water security and efficiency of water usage*

FINANCING

	Mil BDT	Mil USD
Capex	23,485	296
Opex	660	8





**Costs are estimated—to be refined through feasibility study.*

PROJECT AREA

- 55 district level Pourasavas throughout the country

Source: GED, MR1.2 Project Concept Note

FINANCE AND DELIVERY MODALITY

This project may attract climate finance and will also require government and/or development partner and NGO funding. It is unlikely to attract private financing.

A4.2 New Concept Notes

Project Name: Sanitation system development project in 37 district towns.

<table>
<tr><td>Project Title</td><td colspan="3">Sanitation system development project in 37 district towns all over the Country, out of whiich 12 districts towns of Rangpur and Rajshahi Divisions belongs to NW.</td></tr>
<tr><td>Relevant Sector</td><td colspan="3">Water Supply and Sanitation</td></tr>
<tr><td>Location of the Project</td><td colspan="3"><table>
<tr><th>Division</th><th>District</th><th>City Corporation/ Municipality / Upazila</th></tr>
<tr><td rowspan="8">Dhaka</td><td>Faridpur</td><td>Faridpur Municipality</td></tr>
<tr><td>Shariatpur</td><td>Shariatpur Municipality</td></tr>
<tr><td>Gopalganj</td><td>Gopalganj Municipality</td></tr>
<tr><td>Rajbari</td><td>Rajbari Municipality</td></tr>
<tr><td>Munshiganj</td><td>Munshiganj Municipality</td></tr>
<tr><td>Tangail</td><td>Tangail Municipality</td></tr>
<tr><td>Gazipur</td><td>Gazipur Municipality</td></tr>
<tr><td>Manikganj</td><td>Manikganj Municipality</td></tr>
<tr><td rowspan="4">Chattogram</td><td>Jamalpur</td><td>Jamalpur Municipality</td></tr>
<tr><td>Cox's Bazar</td><td>Cox's Bazar Municipality</td></tr>
<tr><td>Feni</td><td>Feni Municipality</td></tr>
<tr><td>Comilla</td><td>Comilla Municipality</td></tr>
<tr><td rowspan="2">Sylhet</td><td>Chandpur</td><td>Chandpur Municipality</td></tr>
<tr><td>Habiganj</td><td>Habiganj Municipality</td></tr>
<tr><td rowspan="8">Rangpur</td><td>Sunamganj</td><td>Sunamganj Municipality</td></tr>
<tr><td>Rangpur</td><td>Rangpur Municipality</td></tr>
<tr><td>Kurigram</td><td>Kurigram Municipality</td></tr>
<tr><td>Dinajpur</td><td>Dinajpur Municipality</td></tr>
<tr><td>Nilphamari</td><td>Nilphamari Municipality</td></tr>
<tr><td>Gaibandha</td><td>Gaibandha Municipality</td></tr>
<tr><td>Thakurgaon</td><td>Thakurgaon Municipality</td></tr>
<tr><td>Panchagarh</td><td>Panchagarh Municipality</td></tr>
<tr><td rowspan="4">Rajshahi</td><td>Lalmonirhat</td><td>Lalmonirhat Municipality</td></tr>
<tr><td>Bogura</td><td>Bogura Municipality</td></tr>
<tr><td>Pabna</td><td>Pabna Municipality</td></tr>
<tr><td>Naogaon</td><td>Naogaon Municipality</td></tr>
<tr><td rowspan="4">Barishal</td><td>Nawabganj</td><td>Nawabganj Municipality</td></tr>
<tr><td>Jhalakathi</td><td>Jhalakathi Municipality</td></tr>
<tr><td>Bhola</td><td>Bhola Municipality</td></tr>
<tr><td>Barguna</td><td>Barguna Municipality</td></tr>
<tr><td rowspan="6">Khulna</td><td>Patuakhali</td><td>Patuakhali Municipality</td></tr>
<tr><td>Magura</td><td>Magura Municipality</td></tr>
<tr><td>Narail</td><td>Narail Municipality</td></tr>
<tr><td>Meherpur</td><td>Meherpur Municipality</td></tr>
<tr><td>Satkhira</td><td>Satkhira Municipality</td></tr>
<tr><td>Kushtia</td><td>Kushtia Municipality</td></tr>
<tr><td>Chuadanga</td><td>Chuadanga Municipality</td></tr>
</table></td></tr>
<tr><td>Relevant BDP Goal & Why this Project is BDP 2100 related</td><td colspan="3">Goal-2: Enhance water security and efficiency of water uses and cross cutting issues.

Ensure good quality lives and livelihoods through safe, adequate, equitable, sustainable sanitation, hygiene facilities and services with a special focus on the urban poor women and children guided by City-wide Inclusive Sanitation (CWIS)</td></tr>
</table>

	approach.
Types of Project: Infrastructure/ Knowledge & Information/ Institutional	Infrastructure
Timing: Short Term (up to 2030)/Medium Term (2030-2050)/Long Term(>2050)Project Duration	Short Term (up to 2030)
Project Duration:	July 2021-June 2024
Rationale (Justification) of the Project: (Background: Provide relevant information about project context Problem Statement: Main Problem and Sub Problems)	Safe water and sanitation is a basic need and a human right declared by the United Nations. Safe drinking water and sanitation are directly and indirectly related to various water borne diseases and environmental pollution. Goal 8 of the "Global Goals for Sustainable Development" formulated by the United Nations is to ensure easy access to water and sanitation for all and sustainable management. The present government is committed to achieving adequate and sustainable sanitation and hygiene for all by 2030. One of the goals of the Department of Public Health Engineering is to build environment friendly and sustainable sanitation system to continue the overall development trend of the country as per the 8th Five Year Plan. The department is committed to fulfilling this goal. At present, according to the Rigach report, open defecation has come down to almost zero. Moreover, the utilization rate of high-quality sanitary toilets is 79%. Consistent solid waste and sewage management is essential to keep this improvement in the sanitation sector intact. Because most of the district towns of Bangladesh do not have good quality sewerage network. Moreover, building a sewerage system is expensive and time consuming. In this case, it will be conducive for a better environment if it can be treated by setting up sewage and solid waste treatment plants. Integrated solid waste management refers to strategically sustainable methods and collection from waste sources through maximum utilization of available resources, Disposal between transfer, segregation, sorting, purification, reuse and refining environment. Through the proposed project, integrated sanitation system will be introduced in 36 district towns by increasing the coverage of improved sanitation system, raising awareness among the people about improved sanitation system including sewage and solid waste management. It will be possible to play a helpful role in achieving the sustainable development goals by improving the health and quality of life of the people of 37 district towns.
Objective of the project:	**Overall objective** This project aims to ensure good quality lives and livelihoods through safe, adequate, equitable, sustainable sanitation, hygiene facilities and services, with a special focus on the urban poor women and children, guided by City-wide Inclusive Sanitation (CWIS) approach. **Project purpose** 1. To promote safe, innovative, inclusive and efficient sanitation, hygiene

<table>
<tr><td></td><td>infrastructures (climate & disaster resilient) and services at the city level with the introduction of innovative technologies, containment improvement and non-sewered sanitation (NSS) solutions to improve universal access specially for the poor & marginalized communities;
2. To establish systems that will advance clear mandates, empower the roles and strengthen accountability system
3. To institutionalize the livelihoods opportunities for the informal sanitation workers and private sector through viable business models and with the focus on occupational safety and health measures;
4. To improve the economic & social resilience in poor communities through gender equality and women empowerment (GEWE) and digital financial inclusion;
5. To improve the public health, environmental and clean energy outcomes including reduction of water and land pollution;
6. To develop risk informed sanitation infrastructure and services, risk communication and community engagement (RCCE) process to build better preparedness, response and recovery from disasters.</td></tr>
<tr><td>Please link the result framework (RF) of the project of BDP-2100</td><td>The project aim for Construction of 100 nos Shared/Public Latrine, Construction of 192500 nos Containment System including land cost, Construction of 25 nos small scale biogas digestion plant(different size) including land cost, Construction of 25 nos planted dying bed fecal sludge treatment plant (FSTP) different size including land cost, Construction of 25 nos non-planted dying bed fecal sludge treatment plant (FSTP) different size) including land cost, 75 nos Solid Waste Composting System (different size) including land cost. This is link to Delta Plan Goal 2 and cross cutting issues.</td></tr>
<tr><td>Expected socio-economic benefits</td><td>• Established adequate sanitation infrastructures which is also climate change and disaster resilient
• Developed the safe, sustainable, inclusive and efficient sanitation services;
• Improved access to safe, affordable sanitation infrastructure and services to all the poor and marginalized population;
• Implemented the FSM IRF at the city level;
• Developed successful entrepreneurs, cooperatives from LICs/ sanitation workers community that supported with efficient sanitation service delivery at last mile for LICs thus promoting good quality lives and livelihoods
• Institutionalized the revolving development fund at LGI level to promote innovation, GEWE and livelihood for smart, efficient and sustainable sanitation services;
• Increased participation of women in the LGI staff, cooperatives, and sanitation planning/decision making platforms; and reduced burden on women by improving sanitation services and access to them;
• Enhanced capacity of all relevant stakeholders to ensure sustainable sanitation services;
• Improved risk preparedness and capacities of LGIs and vulnerable communities to reduce risks, respond and mitigate risks related to WASH;
• Improved health and environmental outcomes at city level particularly in LIC areas and slums.</td></tr>
<tr><td>Detailed description of the project (component</td><td><table><tr><th>(a) Revenue Component</th><th>Unit</th><th>Quantity</th></tr><tr><td>Pay of Officers</td><td>person</td><td>8</td></tr></table></td></tr>
</table>

wise)		Pay of Establishment	person	10
		Awareness and Capacity Building	LS	
		Operation & Management Cost	LS	
		Project Management Cost	LS	
		Integrated Information Management System, Smart Digital Inclusive financing systems and other software components	LS	
		Consultancy & Supervision Cost	LS	
		Jeep (4WD, 5 door, Min 2500 cc)	nos.	1
		Pick-up (Double Cabin :4WD, With Carry boy, Min 2400 cc)	nos.	1
		Micro Bus (Min 2500 cc)	nos.	1
		Desludging Truck (1000/2000L)	nos.	100
		Truck (3 ton capacity)	nos.	75
		Different Types of Equipment, Furniture & Fixtures, Computer & Accessories, Computer Software	LS	
		Construction of Shared/Public Latrine	nos.	100
		Construction of Containment System including land cost	nos.	192500
		Construction of small scale biogas digestion plant(different size) including land cost	Unit	25
		Construction of planted dying bed fecal sludge treatment plant (FSTP) different size including land cost	Unit	25
		Construction of non-planted dying bed fecal sludge treatment plant (FSTP) different size) including land cost	Unit	25
		Solid Waste Composting System (different size) *including land cost*	Unit	75
		Construction of community Bin	nos.	500
		Construction of Transfer Station	nos.	50
		Rickshaw Van	nos.	500
		Hand Trolley	nos.	500
Indicative Cost: (in lac taka)	**219541.00 Lakh Taka**			
O & M cost	-			
Lead Implementation Agency	**Ministry:** Ministry of Local Government, Rural Development & Cooperatives			
	Executive Agency: Department of Public Health Engineering (DPHE)			

Project Name: Integrated waste management Project in 25 priority towns in Bangladesh.

<table>
<tr><td>Project Title</td><td>Integrated waste management Project in 25 priority towns in Bangladesh, out of which 9 distric towns are from NW, SN 17 to 25 below.</td></tr>
<tr><td>Relevant Sector</td><td>Water Supply and Sanitation</td></tr>
<tr><td>Location of the Project</td><td>
<table>
<tr><th>SN</th><th>District Name</th><th>Division</th></tr>
<tr><td>1</td><td>Chandpur</td><td>Chandpur</td></tr>
<tr><td>2</td><td>Feni</td><td>Feni</td></tr>
<tr><td>3</td><td>Khagrachhari</td><td>Khagrachhari</td></tr>
<tr><td>4</td><td>Noakhali</td><td>Noakhali</td></tr>
<tr><td>5</td><td>Rangamati</td><td>Rangamati</td></tr>
<tr><td>6</td><td>Kishoreganj</td><td>Kishoreganj</td></tr>
<tr><td>7</td><td>Netrokona</td><td>Netrokona</td></tr>
<tr><td>8</td><td>Shariatpur</td><td>Shariatpur</td></tr>
<tr><td>9</td><td>Sherpur</td><td>Sherpur</td></tr>
<tr><td>10</td><td>Tangail</td><td>Tangail</td></tr>
<tr><td>11</td><td>Chuadanga</td><td>Chuadanga</td></tr>
<tr><td>12</td><td>Jessore</td><td>Jessore</td></tr>
<tr><td>13</td><td>Jhenaidah</td><td>Jhenaidah</td></tr>
<tr><td>14</td><td>Magura</td><td>Magura</td></tr>
<tr><td>15</td><td>Meherpur</td><td>Meherpur</td></tr>
<tr><td>16</td><td>Satkhira</td><td>Satkhira</td></tr>
<tr><td>17</td><td>Bogra</td><td>Bogra</td></tr>
<tr><td>18</td><td>Joypurhat</td><td>Joypurhat</td></tr>
<tr><td>19</td><td>Naogaon</td><td>Naogaon</td></tr>
<tr><td>20</td><td>Natore</td><td>Natore</td></tr>
<tr><td>21</td><td>Gaibandha</td><td>Gaibandha</td></tr>
<tr><td>22</td><td>Lalmonirhat</td><td>Lalmonirhat</td></tr>
<tr><td>23</td><td>Nilphamari</td><td>Nilphamari</td></tr>
<tr><td>24</td><td>Panchagarh</td><td>Panchagarh</td></tr>
<tr><td>25</td><td>Thakurgaon</td><td>Thakurgaon</td></tr>
</table>
</td></tr>
<tr><td>Relevant BDP Goal & Why this Project is BDP 2100 related</td><td>Goal-2: Enhance water security and efficiency of water uses and cross cutting issues

Ensure good quality lives and livelihoods through small scale community based water supply system and safe, adequate, equitable, sustainable sanitation, hygiene facilities and services with a special focus on the urban poor women and children guided by City-wide Inclusive Sanitation (CWIS) approach.</td></tr>
<tr><td>Types of Project: Infrastructure/Knowledge & Information/ Institutional</td><td>Infrastructure</td></tr>
<tr><td>Timing: Short Term (up to 2030)/Medium Term (2030-2050)/Long Term(>2050)Project Duration</td><td>Short Term (up to 2030)</td></tr>
</table>

Project Duration:	January 2021-June 2024
Rationale (Justification) of the Project: (Background: Provide relevant information about project context Problem Statement: Main Problem and Sub Problems)	Bangladesh has around 163 million people living in less than 147,570 sq. km. Thus Bangladesh has one of the world's highest population densities. Bangladesh has experienced faster urbanisation than most countries in South Asia between 2000 and 2010. As of 2019, about 37.4% of total population are urban population, out of which about 55% are slum population who are living in extremely poor conditions. The census of slum areas report indicated that in 2014 there were 13,935 slum clusters in urban areas of Bangladesh which was only 2,991 in 1997. The recent JMP data (WHO/UNICEF, 2019) showed that nearly 98% of households in Bangladesh have access to basic drinking water facilities with 99% urban households have access to such facilities. While the access to drinking water is relatively good, the quality of drinking water is often poor due to microbiological contamination. The MICS 2019 survey (Bangladesh Bureau of Statistics (BBS) and UNICEF Bangladesh, 2019) found that 81.9% of household drinking water samples have feacal contamination and 80% of tested urban household drinking water samples were found to be microbiologically contaminated. Faecal contamination level in drinking water at slum areas could be even higher due to the poor sanitary conditions and unhygienic behaviors. Most often the poor sanitary conditions at slum areas are attributed due to unhygienic toilets, unsafe disposal of faecal sludge and solid waste. The high level of microbiological contamination of drinking water can potentially result in increased incidences of water-borne diseases such as diarrhea, typhoid, and cholera. Most urban households use onsite sanitation facilities and services in Bangladesh. The recent MICS study showed that almost 99.6% of urban households have access to toilets out of which 29.5% of households are connected to sewerage system (only in Dhaka) and remaining 70% urban households are using on-site sanitation systems such as pit latrines and septic tanks. The access to toilet facilities is good in urban Bangladesh and the promotion of onsite sanitation systems has greatly reduced open defecation. However, several evidences showed that without solutions to maintain functionality of on-site sanitation systems through appropriate Faecal Sludge Management (FSM), it has resulted in numerous cases in a sludge management crisis, having significant impacts on human and environmental health (Strande, Ronteltap, & Brdjanovic, 2014). Onsite sanitation systems and technologies can represent viable and more affordable options, but only if the entire service chain, including collection, transport, treatment and safe endues or disposal, is managed adequately. Moreover, to realize the SDG6.2 targets it is essential to ensure safely managed sanitation facilities and services are functional, which is only possible only if the entire sanitation service chain is properly managed. The major problems associated with on-site sanitation systems in slum and informal settlements in Bangladesh are presented below: Toilets without containment: Most of the pour-flush toilets are directly

	connected to drains and/or openly discharged to the water bodies, without any form of onsite containment (Goufrane , Waliul , & Akhtaruzzaman, 2017). This results in the pervasive contamination of the environment by pathogens and is not providing a protective barrier to human contact and hence protection of public health. Toilets without standard containment: Due to lack of proper design guideline and regulation, the onsite containments are not constructed as per the standard design. The faecal sludge deposited into this inferior quality of containments often lead to groundwater pollution due to leakages. The data suggests that almost 52% of urban slum households in Bangladesh use tube wells to extract shallow groundwater for drinking water (Bangladesh Bureau of Statistics, 2014) which could be easily contaminated by the leakages from inferior quality of onsite containments. Unsafe and unregulated desludging services: Manual emptying, a service usually performed by "sweepers" from low-income communities, is widespread and informal (Goufrane, Waliul, & Akhtaruzzaman, 2017). Manual emptying is often done without considering occupational and health safety measures; therefore, these manual scavengers are in high risks of sanitation related diseases. While some private operators are providing mechanical desludging services, the business is mostly unregulated and occupational and health safety measures are of great concern. In the absence of proper business plan, the sustainability of desludging services is questionable. Unsafe disposal of faecal sludge: With an increasing population density and increasing levels of water use, septic tanks are commonly overloaded and discharge large volumes of untreated effluent directly into the local environment, via dysfunctional soak ways, or by deliberate direct discharge to informal surface drains or formal storm water drains (Goufrane, Waliul, & Akhtaruzzaman, 2017). In low-income areas, different types of pit latrines prevail, and are often fill up quickly and require frequent emptying. These emptied faecal sludge are dumped indiscriminately into rivers, drains and low-lying areas without any treatment, posing public health and environmental hazards. Urban poor population, particularly women and children, are in higher risks of water borne diseases attributed to unsafe drinking water and poor sanitation and hygiene conditions in slums and informal settlements. With these adverse health impacts, the unsafe disposal of feacal sludge, solid waste and wastewater has been also causing environmental pollution in the slums and informal settlements. Considering these facts, the Government of Bangladesh has prioritized urban sanitation including FSM interventions as one of the key development priorities and has approved the Institutional and Regulatory Framework (IRF) for Fecal Sludge Management (FSM), on 2017. A "National Action Plan" for implementation of the IRF-FSM has been developed that clearly specifies the roles and responsibilities of stakeholders at different levels (e.g., national/local) with an objective of rapid implementation of IRF for effective

	implementation of FSM by 2030. Under this directive, "Citywide Inclusive Sanitation (CWIS)-FSM Support Cell" has been recently set up within Department of Public Health Engineers (DPHE), to support and facilitate the overall planning, development, implementation, practice, and monitoring and evaluation of FSM and Solid Waste Management adopting the CWIS approach. The proposed project has been designed to support Government of Bangladesh in scaling up implementation of FSM and solid waste management guided by CWIS approach in Urban Poor communities and to promote hygiene behaviors in preventing water-borne diseases.
Objective of the project:	**Overall objective** This project aims to ensure good quality lives and livelihoods through safe, adequate, equitable, sustainable sanitation, hygiene facilities and services, with a special focus on the urban poor women and children, guided by City-wide Inclusive Sanitation (CWIS) approach. **Project purpose** 1. To promote safe, innovative, inclusive and efficient sanitation, hygiene infrastructures (climate & disaster resilient) and services at the city level with the introduction of innovative technologies, containment improvement and non-sewered sanitation (NSS) solutions to improve universal access specially for the poor & marginalized communities 2. To establish systems that will advance clear mandates, empower the roles and strengthen accountability system 3. To institutionalize the livelihoods opportunities for the informal sanitation workers and private sector through viable business models and with the focus on occupational safety and health measures 4. To improve the economic & social resilience in poor communities through gender equality and women empowerment (GEWE) and digital financial inclusion 5. To improve the public health, environmental and clean energy outcomes including reduction of water and land pollution 6. To develop risk informed sanitation infrastructure and services, risk communication and community engagement (RCCE) process to build better preparedness, response and recovery from disasters.
Please link the result framework (RF) of the project of BDP-2100	This project aims for construction of 175 nos small scale community based water supply system(H. Connection, Water Point, Street Hydrant, Construction of 100 nos Shared/Public Latrine, Construction of 192500 nos Containment System including land cost, Construction of 25 units of small scale biogas digestion plan2t(different size) including land cost, Construction of 25 units of planted dying bed fecal sludge treatment plant (FSTP) different size including land cost, 75 units of Solid Waste Composting System (different size) including land cost which is linked to Delta Plan 2100 and cross cutting issues.
Expected socio-economic benefits	• Established adequate sanitation infrastructures which is also climate

<table>
<tr><td></td><td>change and disaster resilient
• Developed the safe, sustainable, inclusive and efficient sanitation services;
• Improved access to safe, affordable sanitation infrastructure and services to all the poor and marginalized population;
• Implemented the FSM IRF at the city level;
• Developed successful entrepreneurs, cooperatives from LICs/ sanitation workers community that supported with efficient sanitation service delivery at last mile for LICs thus promoting good quality lives and livelihoods
• Institutionalized the revolving development fund at LGI level to promote innovation, GEWE and livelihood for smart, efficient and sustainable sanitation services;
• Increased participation of women in the LGI staff, cooperatives, and sanitation planning/decision making platforms; and reduced burden on women by improving sanitation services and access to them;
• Enhanced capacity of all relevant stakeholders to ensure sustainable sanitation services;
• Improved risk preparedness and capacities of LGIs and vulnerable communities to reduce risks, respond and mitigate risks related to WASH;
• Improved health and environmental outcomes at city level particularly in LIC areas and slums.</td></tr>
<tr><td>Detailed description of the project (component wise)</td><td>
<table>
<tr><th>(a) Revenue Component</th><th>Unit</th><th>Quantity</th></tr>
<tr><td>Pay of Officers</td><td>person</td><td>8</td></tr>
<tr><td>Pay of Establishment</td><td>person</td><td>10</td></tr>
<tr><td>Awareness and Capacity Building</td><td>LS</td><td></td></tr>
<tr><td>Operation & Management Cost</td><td>LS</td><td></td></tr>
<tr><td>Project Management Cost</td><td>LS</td><td></td></tr>
<tr><td>Integrated Information Management System, Smart Digital Inclusive financing systems and other software components</td><td>LS</td><td></td></tr>
<tr><td>Consultancy & Supervision Cost</td><td>LS</td><td></td></tr>
<tr><td>Jeep (4WD, 5 door, Min 2500 cc)</td><td>nos.</td><td>1</td></tr>
<tr><td>Pick-up (Double Cabin :4WD, With Carry boy, Min 2400 cc)</td><td>nos.</td><td>1</td></tr>
<tr><td>Micro Bus (Min 2500 cc)</td><td>nos.</td><td>1</td></tr>
<tr><td>Desludging Truck (1000/2000L)</td><td>nos.</td><td>100</td></tr>
<tr><td>Truck (3 ton capacity)</td><td>nos.</td><td>75</td></tr>
<tr><td>Different Types of Equipment, Furniture & Fixtures, Computer & Accessories, Computer Software</td><td>LS</td><td></td></tr>
<tr><td>Construction of Shared/Public Latrine</td><td>nos.</td><td>100</td></tr>
<tr><td>Construction of small scale community based water supply system(H. Connection, Water Point, Street Hydrant</td><td>Unit</td><td>175</td></tr>
<tr><td>Construction of Containment System including land cost</td><td>nos.</td><td>192500</td></tr>
<tr><td>Construction of small scale biogas digestion plant (different size) including land cost</td><td>Unit</td><td>25</td></tr>
</table>
</td></tr>
</table>

		Construction of planted dying bed fecal sludge treatment plant (FSTP) different size including land cost	Unit	25
		Construction of non-planted dying bed fecal sludge treatment plant (FSTP) different size) including land cost	Unit	25
		Solid Waste Composting System (different size) *including land cost*	Unit	75
		Construction of community Bin	nos.	500
		Construction of Transfer Station	nos.	50
		Rickshaw Van	nos.	500
		Hand Trolley	nos.	500
Indicative Cost: (in lac taka)	**219541.00**			
O & M cost	-			
Lead Implementation Agency	Ministry: Ministry of Local Government, Rural Development & Cooperatives			
	Executive Agency: Department of Public Health Engineering (DPHE)			

Project Name: Water Supply, Sanitation, Drainage, Solid Waste and Faecal Sludge Management for Small Size Pourashavas (Municipalities) in Bangladesh.

<table>
<tr><td>Project Tiltle</td><td>Water Supply, Sanitation, Drainage, Solid Waste and Faecal Sludge Management for Small Size Pourashavas (Municipalities) in Bangladesh.</td></tr>
<tr><td>Relevant Sector</td><td>Water Supply and Sanitation, in 25 Pouroshovas all over tthe country, out of which15 Pouroshovas are from NW.</td></tr>
<tr><td>Location of the Project</td><td>
<table>
<tr><th>Sl. No</th><th>Name of District</th><th>Name of Pouroshova</th></tr>
<tr><td>1</td><td>Jessore</td><td>Bagherpara</td></tr>
<tr><td>2</td><td>Rangpur</td><td>Badarganj</td></tr>
<tr><td>3</td><td rowspan="2">Netrokona</td><td>Durgapur</td></tr>
<tr><td>4</td><td>Kendua</td></tr>
<tr><td>5</td><td rowspan="2">Pabna</td><td>Faridpur</td></tr>
<tr><td>6</td><td>Sujanagar</td></tr>
<tr><td>7</td><td rowspan="3">Rajshahi</td><td>Kakonhat</td></tr>
<tr><td>8</td><td>Mundumala</td></tr>
<tr><td>9</td><td>Keshorhat</td></tr>
<tr><td>10</td><td>Joypurhat</td><td>Kalai</td></tr>
<tr><td>11</td><td>Gazipur</td><td>Kaliganj</td></tr>
<tr><td>12</td><td>Shirajganj</td><td>Kazipur</td></tr>
<tr><td>13</td><td>Narail</td><td>Lohagora</td></tr>
<tr><td>14</td><td>Pirojpur</td><td>Mathbaria</td></tr>
<tr><td>15</td><td rowspan="2">Cox Bazar</td><td>Maheshkhali</td></tr>
<tr><td>16</td><td>Teknaf</td></tr>
<tr><td>17</td><td rowspan="2">Natore</td><td>Naldanga</td></tr>
<tr><td>18</td><td>Tanore</td></tr>
<tr><td>19</td><td>Chittagong</td><td>Rangunia</td></tr>
<tr><td>20</td><td rowspan="5">Bogra</td><td>Sariakandi</td></tr>
<tr><td>21</td><td>Sonatola</td></tr>
<tr><td>22</td><td>Nandigram</td></tr>
<tr><td>23</td><td>Talora</td></tr>
<tr><td>24</td><td>Dhunot</td></tr>
</table>
</td></tr>
<tr><td>Relevant BDP Goal & Why this Project is BDP 2100 related</td><td>Goal-2: Enhance water security and efficiency of water uses.

Improve the health and living standard of people of 24 pourashavas of the country by increasing access to safe water supply and Sanitation System and help them in achieving sustainable development targets by expanding the integrated sanitation system.</td></tr>
<tr><td>Types of Project: Infrastructure/ Knowledge & Information/Institutional</td><td>Infrastructure</td></tr>
<tr><td>Timing: Short Term (up to 2030)/Medium Term (2030-2050)/Long Term(>2050)Project Duration</td><td>Short Term (up to 2030)</td></tr>
</table>

Project Duration : (during Implementation)	July, 2020-June, 2023
Rationale (Justification) of the Project: (Background: Provide relevant information about project context Problem Statement: Main Problem and Sub Problems)	Safe water and sanitation is a basic necessity and a human right declared by the United Nations. Safe drinking water and sanitation are directly and indirectly related to various diseases and ecological diseases caused by water. Bangladesh is growing in a densely populated country, especially in urban areas where the number of people is increasing in search of employment. Considering the benefits of safe water supply, sanitation, solid waste and fecal sludge management, etc., the quality of city-centric living is not adequate. The Bangladesh government has emphasized on the provision of water supply and sanitation for the development of health and environmental protection. This sector is considered to be the highest priority. Government has decided to introduce piped water supply facilities integrated with environmental sanitation gradually in the small (Thana & Growth Centre) pourashavas. But development of safe source has been emerged as challenging issues due to identification of wide spread arsenic contamination in groundwater in the late nineties. The blanket screening of arsenic in 271 upazilas concluded in 2004 suggested a contamination level of about 30% of the water supply sources. It was estimated that around 30 million people out of 130 million are drinking arsenic contamination water (>50ppb) in absence of alternative water supply options. In this situation, regarding piped water supply project in the pourashavas (having no piped water supply system) the independent expert committee formed as per instruction of the National Policy on Arsenic Mitigation, 2004 implementation Guidelines, decided to undertake a study project for detailed survey and investigation for the 148 small pourshavas located at Thana (Sub-district) Headquarters and Growth Centers. A meeting of the above mentioned expert committee was held on 16 October 2005 in the Local Govt. Division of the Ministry of Local Government, Rural Development & Cooperatives under the chairmanship of the Secretary. Secretary, Local Government Division is the Vice-Chairman of the National Policy implementation Committee for Arsenic Mitigation. Accordingly, a Technical Project Proposal (TPP) titled "Ground Water Management and TPP for Survey, Investigation and Feasibility Study in Upazila and Growth Center Level Pourshavas having no Piped Water Supply System" has been undertaken for 148 Pourashavas to prepare a master plan for water supply, sanitation, drainage and solid waste management system through intensive survey & investigation. The study was conducted in 4 phases; 1st phase-12 nos, 2nd phase- 37 nos, 3rd phases-50 nos, 4th phase- 49 nos . The Master Plan has been prepared considering short, medium and long term implementation plan:- Short term (2010-2015), Medium term (2015-25), and long term (2025-40). The PDPP titled "Water Supply, Sanitation, Drainage, Solid Waste and Faecal Sludge Management for Small Size Pourashavas (Municipalities) in Bangladesh" has been formulated based on medium term Implementation plan. Moreover, Globally, Bangladesh stands out as a country that has made

	remarkable progress in eliminating the scourge of open defecation. However, this success has created a 'second-generation' sanitation challenge of how to deal safely with the faecal sludge collected from pit latrines and septic tanks. As on-site sanitation solutions develop, the question of sustainable and inclusive waste and faecal sludge management (FSM) is now at the heart of the challenge in Bangladesh. The 6th goal of "Global Target for Sustainable Development", established by the United Nations, is to ensure easy and sustainable management of water and sewage treatment for all. By 2030, the current government is committed to achieving adequate and sustainable sanitation and hygiene for all. According to the 7th Five Year Plan, one of the main goals of the Department of Public Health Engineering is to create an environmentally friendly and sustainable sanitation system to continue the overall development of the country. The Directorate is firmly committed to meet this goal. According to the JMP report, the percentage of open defecation has dropped to almost zero. Moreover, the use of improved sanitary toilets is 69%. Difficulty and unavoidable arrangements for maintaining this improvement in the sanitation sector are very important. Because most of the district cities of Bangladesh do not have high quality sewer network. Besides, the construction of the sanitation system is costly and time-consuming. If it is refined by the installation of solid and fecal sludge treatment plants, then it will be helpful for the environment. Sustained waste management refers to the strategic sustainable method and disposal, transfer, separation, sorting, refining, recycling and disposal of waste through optimum utilization of available resources and disposing of it in the environment. Through the proposed project, integrated sanitation system will be introduced by increasing awareness of improved sanitation system, improving sanitation system among the people, including fecal sludge and solid waste management in 24 district cities. It will be possible to play a positive role in achieving sustainable development goals by improving the quality of health and life-travel of the people of 24 districts. Due to lack of proper water supply and sanitation system, health problems are occurring among the people of the proposed areas and at the same time environmental degradation is occurring. In the meantime, the project has been prepared for the development of water supply facilities and environmental sanitation system in 24 district cities, so that the quality and travel of life of people of these cities has improved.
Objective of the project:	**Overall objective** The overall objective of the project is to improve the health and living standard of people of 24 pourashavas of the country by increasing access to safe water supply and Sanitation System and help them in achieving sustainable development targets by expanding the integrated sanitation system. **Project purpose**

<table>
<tr><td></td><td>

- Introduce piped water supply system in the project pourashavas.
- Improvement of overall sanitation system by introduction of fecal sludge and solid waste management in the project area.
- Improvement of drainage system.
- Awareness and capacity building of the municipalities people about sanitation system.

</td></tr>
<tr><td>Please link the result framework (RF) of the project of BDP-2100</td><td>The project aims for installation of 48 nos Production Tubewell ,construction of 48 nos pump house with electrical works and pump, Construction of 6 nos Iron Removal Plant, Construction of 2 nos Surface Water Treatment Plant,728 km Distribution Line (HDPE Pipe), 88908 nos House Connection, 2005 nos Water Point Source, 328 nos Street Hydrant, Construction of198 nos Public Toilet with Bathing Facilities,533 nos Community Latrine, 24 nos Feacal Sludge Treatment Facilities, 210 km RCC Drain and construction of 24 nos Solid Waste Land-fill System. These activities enhance to achieve Delta Plan Goal 1 and also look after in cross cutting issues.</td></tr>
<tr><td>Expected socio-economic benefits</td><td>The project will contribute to fulfill government's commitment to provide safe water and sanitation for all. This project will provide increased supply of safe water to the people of the project areas. Environmental sanitation activities such as public & community toilets, desludging equipment, drainage, solid waste management will be carried out to improve the living standard of the inhabitants of project Pourashavas. Moreover, training, awareness building campaign will also be conducted to develop skill of service providers for proper O&M and for beneficiaries to enable them to handle the constructed facilities efficiently.</td></tr>
<tr><td>Detailed description of the project (component wise)</td><td>
<table>
<tr><td>Production Tubewell</td><td>48</td><td>no</td></tr>
<tr><td>Construction of pump house with electrical works and pump</td><td>48</td><td>no</td></tr>
<tr><td>Construction of Iron Removal Plant (200 m3/hr)</td><td>2</td><td>no</td></tr>
<tr><td>Construction of Iron Removal Plant (300 m3/hr)</td><td>4</td><td>no</td></tr>
<tr><td>Construction of Surface Water Treatment Plant (200 m3/hr)</td><td>1</td><td>no</td></tr>
<tr><td>Construction of Surface Water Treatment Plant (300 m3/hr)</td><td>1</td><td>no</td></tr>
<tr><td>Transmission Line (HDPE Pipe)</td><td>17.68</td><td>km</td></tr>
<tr><td>110 mm Distribution Line (HDPE Pipe)</td><td>589.48</td><td>km</td></tr>
<tr><td>160 mm Distribution Line (HDPE Pipe)</td><td>80.20</td><td>km</td></tr>
<tr><td>225 mm Distribution Line (HDPE Pipe)</td><td>40.50</td><td>km</td></tr>
<tr><td>250 mm Distribution Line (HDPE Pipe)</td><td>9.48</td><td>km</td></tr>
<tr><td>315 mm Distribution Line (HDPE Pipe)</td><td>8.37</td><td>km</td></tr>
<tr><td>House Connection</td><td>88908</td><td>no</td></tr>
<tr><td>Point Source</td><td>2005</td><td>no</td></tr>
<tr><td>Street Hydrant</td><td>328</td><td>no</td></tr>
<tr><td>Construction of Public Toilet with Bathing Facilities</td><td>198</td><td>no</td></tr>
<tr><td>Community Latrine</td><td>533</td><td>no</td></tr>
<tr><td>Feacal Sludge Treatment Facilities</td><td>24</td><td>no</td></tr>
<tr><td>Construction of Primary RCC Drain</td><td>37.74</td><td>km</td></tr>
</table>
</td></tr>
</table>

	Construction of Secondary RCC Drain	172.38	km	
	Construction of Tertiary Brick Drain	134.904	km	
	Community Bin (Type-A)	861	no	
	Community Bin (Type-B)	177	no	
	Construction of Solid Waste Land-fill System	24	no	
Indicative Cost: (in lac taka)	228400.00			
O & M cost	-			
Lead Implementation Agency	Ministry: Ministry of Local Government, Rural Development & Cooperatives			
	Executive Agency: Department of Public Health Engineering (DPHE)			

Project Name: Surface Water Based Water Supply System in 18 District Towns of Bangladesh.

Project Tiltle	***Surface Water Based Water Supply System in 18 District Towns of Bangladesh.***
Relevant Sector	Water Supply
Location of the Project	18 District Towns of Bangladesh.
Relevant BDP Goal & Why this Project is BDP 2100 related	Goal-2: Enhance water security and efficiency of water uses. This project will ensure improved surface water supply for the city dwellers of 18 District Towns. This will assure water security and efficiency of water uses.
Types of Project: Infrastructure/Knowledge & Information/Institutional	Infrastructure
Timing: Short Term (up to 2030)/Medium Term (2030-2050)/Long Term(>2050)Project Duration	Short Term (up to 2030)
Project Duration :	January 2021-June 2025
Rationale (Justification) of the Project:	Safe water is a basic necessity and a human right declared by the United Nations. Safe drinking water is directly and indirectly related to various diseases and ecological diseases caused by water. Bangladesh is growing in a densely populated country, especially in urban areas where the number of people is increasing in search of employment. Considering the benefits of safe water supply the quality of city-centric living is not adequate. The Bangladesh government has emphasized on the provision of water supply for the development of health and environmental protection. This sector is considered to be the highest priority. The living situation of the urban centers is sub-standard with grossly inadequate service facilities like safe water supply, sanitation, etc. The water supply in district towns is not adequate and appropriate according to the demand of the dwellers. On the other hand, due to excessive uses of ground water the water table is lowering day by day. So, it is needed to develop the upgraded and sustainable water source options and feasible technology for supply network in district towns. Government has decided to introduce piped water supply facilities integrated with environmental sanitation gradually in the small (Thana & Growth Centre) towns. But development of safe source has been emerged as challenging issues due to identification of wide spread arsenic contamination in groundwater in the late nineties. The blanket screening of arsenic in 271 upazilas concluded in 2004 suggested a contamination level of about 30% of the water supply sources. Besides, Salinity intrusions from seawater deep into the land in the southwest are rendering groundwater unfit for consumption. Urban areas are facing the problem of receding water table due to heavy groundwater extraction. Now a day, it is an emergency to make dependency on other sources of water specially surface water option as the supply water for dwellers daily uses in the urban areas. To improve the situation Department of Public Health Engineering (DPHE) previously carried out numerous feasibility study projects to identify the problems,

<table>
<tr><td></td><td>probable solution and feasible recommendations in water supply and sanitation sector. In continuation of this DPHE proposes to initiate a new project including necessary study named “Surface Water Based Water Supply System in 18 District Towns of Bangladesh”. Through this project sustainable and topographically feasible surface water supply system will be introduced in the 18 district towns (Narail, Faridpur, Chapai Nawabganj, Habiganj, Manikganj, Madaripur, Jhalakathi, Moulvibazar, Munshiganj, Kurigram, Kushtia, Sirajganj, Narsingdi, Patuakhali, Sunamganj, Pirojpur, Jamalpur and Rajbari) of Bangladesh.</td></tr>
<tr><td>Objective of the project:</td><td>Overall objective

Improve the health and living standard of people of 18 district towns of the country by increasing access to safe water supply and help them in achieving sustainable development targets by expanding the surface water supply system.

Project purpose

• introduce piped water supply system in the 18 district towns.
• Improvement of overall water supply system in the project area.
• achieve the overall coverage of pipe water supply from 24% to 56%.
• reduce the usage of ground water by using surface water sources.</td></tr>
<tr><td>Please link the result framework (RF) of the project of BDP-2100</td><td>This project aims for construction of 36 nos Surface water treatment plant ,36 nos Overhead water tank,1440 km Supply pipeline of different diameter (HDPE) and 144000 nos house connections. These activities are linked with Delta Plan 2100 Goal -1</td></tr>
<tr><td>Expected socio-economic benefits</td><td>• Overall piped water supply coverage in 18 district town areas would be increased from 24% to 56% through introduction of piped water supply system.
• Surface water source based piped water supply system in the 18 district towns will be introduced.
• Improvement of overall water supply system in the project area.
• The usage of ground water will be reduced by using surface water sources.</td></tr>
<tr><td>Detailed description of the project (component wise)</td><td>
<table>
<tr><td>Land Acquisition</td><td>7200</td><td>Decimal</td></tr>
<tr><td>Portable drinking water career</td><td>18</td><td>Nos</td></tr>
<tr><td>Surface water treatment plant (400m3)</td><td>36</td><td>Nos</td></tr>
<tr><td>Overhead water tank with boundery wall</td><td>36</td><td>Nos</td></tr>
<tr><td>Generator Purchase and installation</td><td>36</td><td>Nos</td></tr>
<tr><td>Centrifugal pump Purchase and installation</td><td>36</td><td>Nos</td></tr>
<tr><td>Suction Pipeline (315mm, HDPE)</td><td>94</td><td>Km</td></tr>
<tr><td>Supply pipeline of different diameter (HDPE)</td><td>1440</td><td>Km</td></tr>
<tr><td>House connection</td><td>144000</td><td>Nos</td></tr>
</table>
</td></tr>
<tr><td>Indicative Cost: (in lac taka)</td><td>204747.00</td></tr>
<tr><td>O & M cost</td><td>-</td></tr>
<tr><td rowspan="2">Lead Implementation Agency</td><td>Ministry: Ministry of Local Government, Rural Development & Cooperatives</td></tr>
<tr><td>Executive Agency: Department of Public Health Engineering (DPHE)</td></tr>
</table>

Project Name: Groundwater aquifer recharge with rain/storm and pond water at coastal belt and drought areas of the country.

Project Tiltle	***Groundwater aquifer recharge with rain/storm and pond water at coastal belt and drought areas of the country***
Relevant Sector	Water Supply and Sanitation
Location of the Project	Coastal belt and drought areas
Relevant BDP Goal & Why this Project is BDP 2100 related	**Goal 1: Ensure safety from flood and climate change related disasters** **Goal 2: Enhance water security and efficiency of water usages** This project is related to BDP 2100 due to the following strategies being considered: ***Strategy FR 3: Safeguarding Livelihoods of Vulnerable Communities.*** - Sub-strategy 3.4: Development of flood proof water supply and improved drainage system ***Strategy FW 1: Ensure Water Availability by Balancing Supply Demand for Sustainable and Inclusive Growth.*** - Sub-strategy FW 1.1: Ensure optimum water resource management in the country following basin wide management along with construction of necessary embankments - Sub-strategy 1.3: Excavation of local water reservoirs (canals, ponds and baors) for restoration of waters and rainwater harvesting. - Sub-strategy 1.7: Preserving groundwater level by restricting on excessive extraction of ground water ***Strategy FW 2: Maintaining Water Quality for Health, Livelihoods and Ecosystems*** -Sub-strategy FW 2.3: Action research for improved ecosystem services.
Types of Project: Infrastructure/Knowledge & Information/Institutional	Infrastructure
Timing: Short Term (up to 2030)/Medium Term (2030-2050)/Long Term(>2050)Project Duration	Mid Term
Project Duration: (during Implementation)	January, 2030-June, 2035
Rationale (Justification) of the Project:	In coastal regions of Bangladesh, the scarcity of safe drinking water makes the lives of coastal people challenging with lots of sufferings. During monsoon, rainwater is the only safe source due to pond water being bacteriologically polluted and groundwater exhibiting high levels of salinity and arsenic contamination. Besides many communities are depended on groundwater for drinking and small-scale irrigation purposes. During the dry season when rainfall halts, safe and reliable groundwater supply is key to the livelihoods and socio-economic development of a large part of the rural population. Managed aquifer recharge (MAR) could potentially provide safe drinking water by storing abundant freshwater from the wet season in aquifers for year-round use. Between 2011, UNICEF funded Action Research demonstrated the basic technical feasibility of collecting, treating and storing the abundant surface water during the

	monsoon and storing it underground in saline aquifers for later withdrawal for potable use by rural communities. Though challenges remain the system is proving popular with users and produces water that is both of superior microbiological quality, is more reliable than existing sources, and is resilient to disasters.
Objective of the project:	**Overall objective** To improve the health and living standards of the people of coastal belt and drought areas by ensuring the availability of safe and potable water during dry season. Project purpose • Increase safe water supply coverage in coastal areas. • Installation of sustainable technology secure the supply and availability of safe water. • Ensuring safe drinking water by enhancing the skills of local government institutions and the general public in the management and maintenance of constructed facilities. **Additional specific objectives:** • Preserving groundwater level. • Research and development for improved ecosystem
Please link the result framework (RF) of the project of BDP-2100	**Goal 1: Ensure safety from flood and climate change related disasters** • 1A: Drought (extreme) free area • 1A: Dry season salinity intrusion free area **Goal 2: Enhance water security and efficiency of water usages** • 2A: Dry season flow availability • 2E: Rural population with safe drinking water access
Expected socio-economic benefits	The project will assure the availability of bacteriologically safe water supply especially during dry season and also during floods. As a result, the health, quality of lives and livelihoods of the coastal people will improve. Reduction of waterborne diseases will reduce the expenditures regarding treatment and furthermore, available groundwater will open opportunities for small-scale irrigation which will enhance the living standard of the people.
Detailed description of the project (component wise)	• Caretaker Training • Embankments development of ponds • Manage Aquifer Recharge (MAR) (550 nos)
Indicative Cost: (in Lac taka)	10000.00
O & M cost	-
Lead Implementation Agency	Ministry: Ministry of Local Government, Rural Development & Cooperatives
	Executive Agency: Department of Public Health Engineering (DPHE)
Co-lead agency	BMDA

Annex B: Integrated Metamodel Assessment of BDP2100 Investment Plan projects for the NW Basin (JCP Technical Note 13, 2021)

B.1: Revitalization & restoration of Hurasagar and Atrai rivers (DP 1.3)

This project suggests to (from BDP2100 project sheets):

I. Dredge the Hurasagar and Atrai rivers to increase discharge capacity in the wet season and navigability in the dry season

II. Apply 30 km of river bank protection works along the Atrai River to protect growth-centers against erosion

Figure B-1 shows the translation of this information into input for the Metamodel. The dredging is translated into an overall adjustment of the water levels for the whole Atrai river with 1.20 m, as a result of dredging. NB. Embankments along the Atrai river have (not yet) been 'raised' in the model by 1 m, representing the stronger embankments.

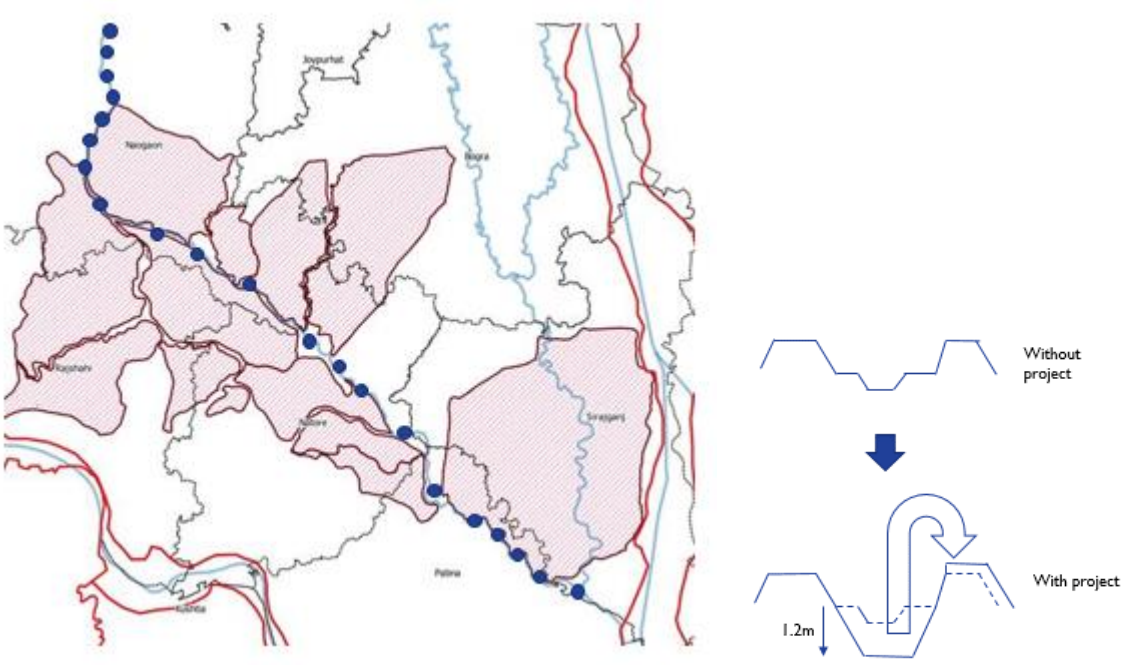


Figure B 1: Suggested project location, interventions, translated into input for Bangladesh Metamodel

The summary scorecard, in Table B 1, shows that the intervention will reduce (river) flooding extent (and duration) in the current situation. Under climate change, the intervention partly compensates for the additional flooding. GWL trends are not substantially influenced by the project; while climate change is expected to lead to higher groundwater recharge and as such lower GWL declines.

Table B 1: Scorecard with summary of main impacts from the project 'Revitalization & restoration of Hurasagar and Atrai rivers' for the Rajshahi division; the percentages for the different water system state indicators are relative to the 2020 base case.

Indicator	Unit	Without	With	Without project 2050		With project 2050	
		2020	2020	LCC/LEC	HCC/HEC	LCC/LEC	HCC/HEC
Rice production	Mtonnes / year	5.1	+0.5 %	-6 %	-13 %	-5 %	-12 %
Damage due to river and rainfall floods	Cr. BDT / year	5,059	-7 %	+649 %	+1922 %	+597 %	+1747 %
Agricultural damage due to river and rainfall floods	Cr. BDT / year	12,179	-2 %	+32 %	+71 %	+27 %	+65 %
Damage due to river floods	Cr. BDT / year	1,045	-37 %	+1527 %	+5530 %	+1219 %	+4493 %
Population affected due to river and rainfall floods	People / year	621,029	- 6 %	+147 %	+282 %	+136 %	+262 %
Sustainable groundwater use	cm / year	- 9	- 8	-6	-3	-4	-2
River flood extent	ha / year	86,358	-47 %	+91 %	+221 %	+35 %	+130 %
Rainfall and river flood extent	ha / year	759,618	-0.5 %	+12 %	+25 %	+12 %	+24 %

The project does reduce river flood extent but has less impact on rainfall floods (drainage congestion), and as such the project will only lead to minor reductions in flood damages - both to agriculture as to infrastructure and buildings – and flood losses, in terms of affected population. Increased flooding and societal impacts under the BDP2100 scenarios are only for a small part compensated for with this intervention. The measures' main intention to make the Atrai navigable again is theoretically possible but should include more than dredging the rivers; e.g. each road, bridge and other construction should be made passable.

B.2: Kurigram irrigation projects – 2nd phase (DP 1.4 & DP 1.5)

Both Kurigram irrigation projects have two main objectives (from BDP2100 project sheets):

Objective I: development of a large irrigation scheme of 42,800 ha to improve water availability during the dry season and decreasing the pressure on groundwater. Such an improved water availability will lead to higher crop production and recovery of groundwater levels.

Objective II: the district's FCDI-project area is currently protected by 144 km flood control embankments, which is however breached at many locations due to river erosion. The improvement of existing embankments is also included in the projects. Further, drainage capacity is increased by excavating khals and restoring natural drainage channels.

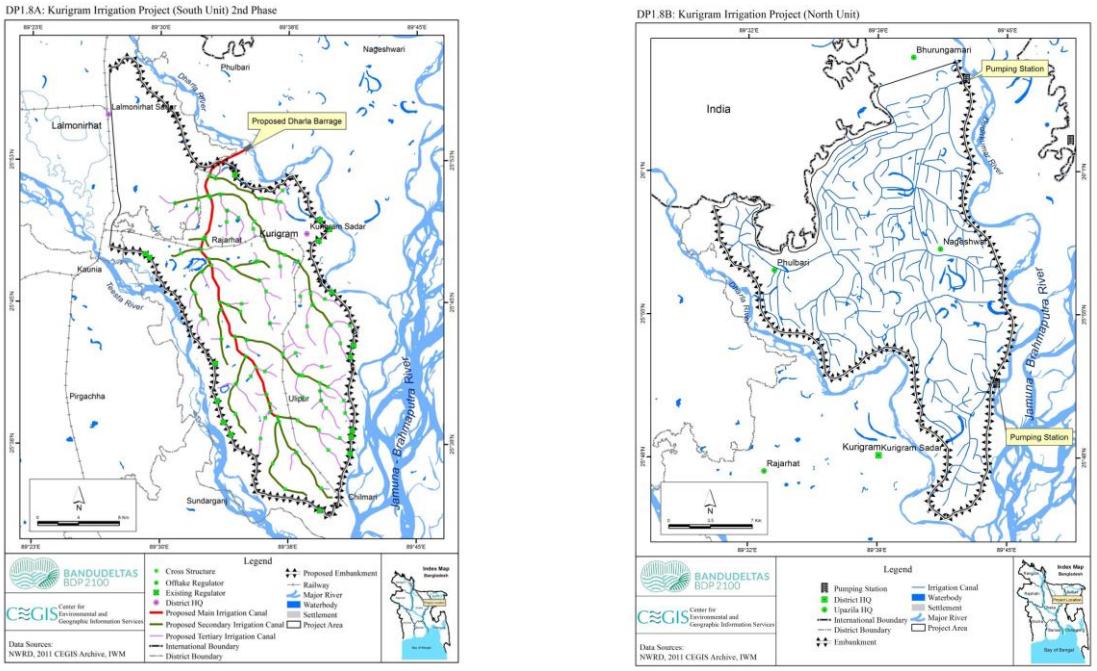


Figure B 2: Locations of planned largescale SW irrigation schemes in Kurigram district: southern unit (left) and northern unit (right)

The project for the Southern unit is around 22,400 ha, where the Dharla Barrage (resulting in a reservoir) is planned to divert water into the area. Irrigation from surface water in this area would be completely driven by gravity. The Dharla river is relatively shallow and has a very wide active floodplain with average discharges around 60 m^3/s in the dry season up to 3200 m^3/s in the wet season (discharge information from detailed modelling results, input for MM). It is projected that under extreme climate change the low flows can go down under 50 m^3/s. Estimations with the metamodel show that pumps with maximum capacity of 50 m^3/s (for Southern unit) and 30 m^3/s (for Northern unit) can provide up to 60% of the total water demand under current climate (Figure B-4). It is unclear what the downstream environmental impacts will be when extracting around a third of its water flow.

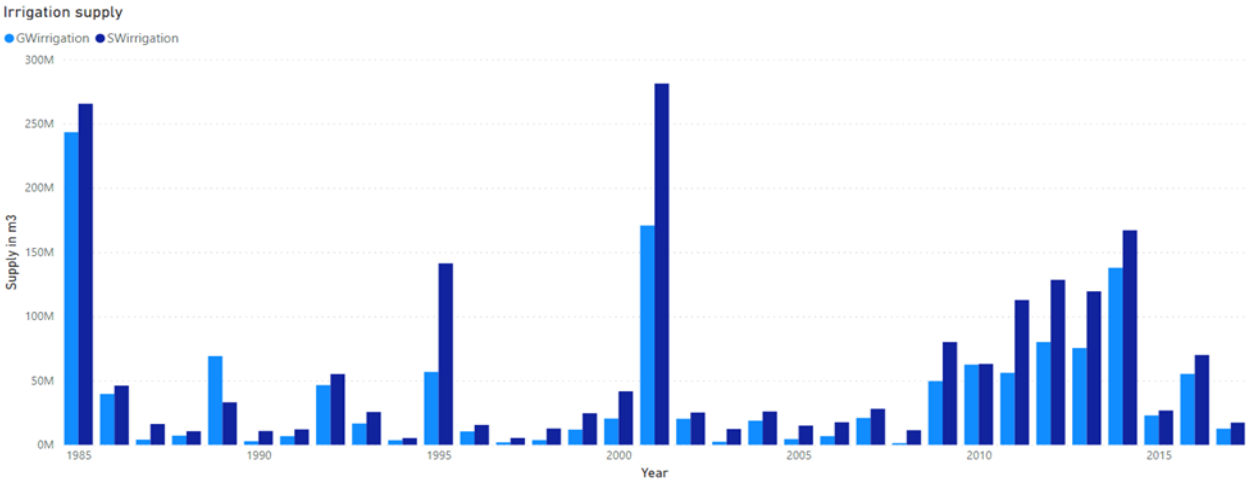


Figure B 3: Conjunctive irrigation water supply for total Kurigram district, after implementation of both SW irrigation systems

The project for the Northern unit is planned for an area of around 20,000 ha, with surface water supplied from the Dudhkumar river by two large pumping stations. The Dudhkumar river is relatively shallow and has a wide active floodplain, with average discharges ranging between 20 m^3/s and 3800 m^3/s in the dry and wet season, respectively. It is projected that under extreme climate change, low flows may go below 13

m^3/s (discharge information from detailed modelling results, input for MM). Furthermore, it is unclear what the downstream environmental impacts will be with more than two thirds of total low flow abstracted.

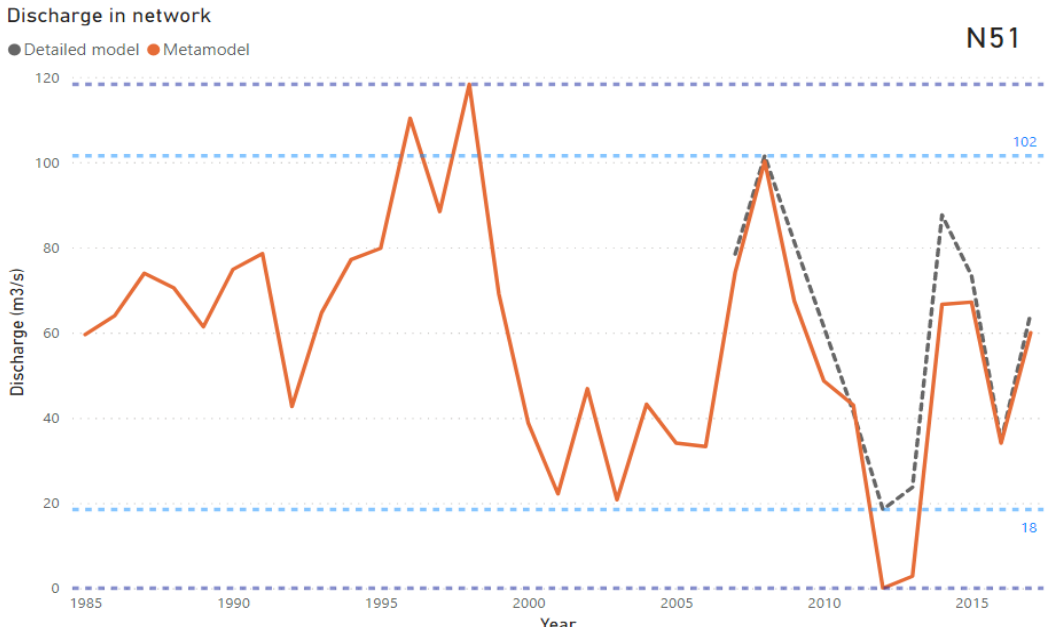


Figure B 4: Estimated annual lowest flow for transboundary Dudkhumar river

Source: IWM detail models/Bangladesh Metamodel) under current climate conditions

Although, river bank erosion is not directly visible on satellite images, both rivers are very active in sediment transport, and as such show shifting behavior of their main channels. Embankments are under high erosion risk and should be improved and further protected to reduce future erosion risk. Barrages and SW irrigation pump stations in such active rivers may be risky, leading on the longer term to sedimentation problems upstream, as well as pump lines falling dry.

Table B 2: Scorecard with summary of main impacts from the project 'Kurigram irrigation projects – 2nd phase' for the Kurigram district; the percentages for the different water system state indicators are relative to the 2020 base case.

Indicator	Unit	Without	With	Without project 2050		With project 2050	
		2020	2020	LCC/LEC	HCC/HEC	LCC/LEC	HCC/HEC
Rice production	Mtonnes/ year	0.6	+7 %	-7 %	-16 %	-1 %	-9 %
Damage due to river and rainfall floods	Cr. BDT/ year	164	-45 %	+363 %	+969 %	+272 %	+807 %
Agricultural damage due to river and rainfall floods	Cr. BDT / year	251	-22 %	+22 %	+53 %	+2 %	+30 %
Damage due to river floods	Cr. BDT / year	0	0 %	+3 %	+10 %	+1 %	+5 %
Population affected due to river and rainfall floods	People / year	136,320	-56 %	+87 %	+196 %	+36 %	+154 %
Sustainable groundwater use	cm / year	-2	+6	0	+1	+7	+7
River flood extent	ha / year	4,322	-54 %	+113 %	+343 %	-41 %	+33 %
Rainfall and river flood extent	ha / year	116,302	-6 %	+5 %	+10 %	+2 %	+8 %

The major source of flooding, experienced in the southeastern part of the anticipated project areas, seems to be due to impeded drainage after rainfall flooding. The project includes heightening of the embankment, as well as substantially improving the local drainage capacity (by excavating khals and sufficient drainage under roads). If the surface water irrigation system is successfully built and maintained, groundwater levels can sustainably recover with current extraction rates. In order to improve waterlogging problems in future situations, it should be considered to implement pumped drainage.