Part 2
Appendices A-H

Appendix A: One-Page Project Detail Sheets

This appendix presents one-page project detail sheets providing an overview of each project in the Investment Plan.

CZ 1.8/ 1.21 West Gopalgonj Integrated Water Management Project

Background

The land level of the project area is very close to sea level due to historical formation through marine deposits. As a result, most of the area remains under water throughout the monsoon season. However, people cannot make the best use of their lands in the dry period because of scarce water for irrigation. The crops cultivated on the periphery of the depression pockets are also vulnerable to early floods due to accumulated rain water and flash floods from the peripheral rivers. In certain areas, high-salinity waters from spring tide flooding damages standing crops prior to harvest. Due to slow drainage following monsoons, farmers cannot plant rice crops early. The project aims to address the livelihood security of the people of the area by protecting standing crops from early flooding and addressing the intrusion of saline water.

Project Description

This project will develop flash food protection, increase agricultural production, provide irrigation facilities for the dry season, increase surface water for irrigation, and reduce soil salinity in West Gopalgonj.

The project has an estimated implementation period of 3 years and an operating period of 30 years. The project is linked to the Delta Plan strategy of Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders.

Expected Benefits

Crop production will be increased (rice production is expected to increase by 48,577 metric tones and total incremental agricultural benefit is expected to be 557 million BDT) by increasing the area's cropping intensity by 20 25%, and increasing the use of surface water for irrigation to reduce irrigation costs by 30-40%.

The project has an estimated economic benefit-cost ratio of 2.6.

Responsible Ministry

Ministry of Water Resources

Executing Agency

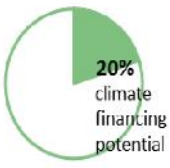
WARPO, LGED, DoE, NGOs, Local Bodies, WMO

Delta Plan Goal(s)

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

Financing

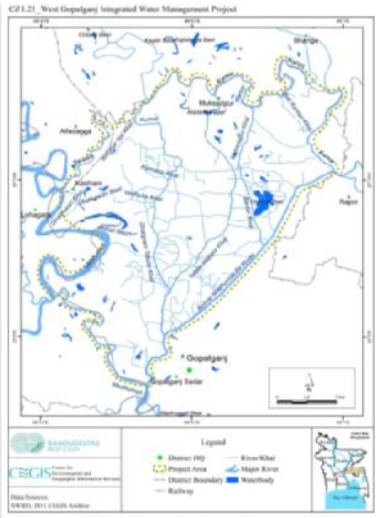
	Mil BDT	Mil USD
Capex	2,735	34
Opex	68	1



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

Project Area

- Gopalgonj District
- Gopalgonj, Sadar, Kashiani, and Muksudpur Upazillas



Source: GED, CZ1.21 Project Concept Note

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.

CZ 1.11/ 1.38 Improved Drainage in the Bhabadha Area

Background

During the dry season of 2005, the Beel Kedaria Tidal Basin experienced drainage congestion because land owners of the *beel* (lake-like wetlands) closed the Bhabodah regulator, which meant there was no tidal movement into the Beel Kedaria Tidal Basin Land owners did this because they were cultivating boro crop on a portion of land inside the tidal basin, which they wanted to protect from saline tidal water.

In the following year, the Bhabodah area experienced social, environmental, and economic degradation, including severe water logging and a substantial loss of agricultural production. Solving the problem requires a comprehensive plan focusing on the management of the tidal rivers of Bhabodah.

Project Description

This project aims to reduce drainage congestion and floods by constructing an embankment along the river, which wi rehabilitate Bhabodah's regulator and increase drainage capacity. It also aims to use tidal river management to allow natura tidal movement into embanked low-lying *beels* for sediment management and increased tidal prism.

The project has an estimated implementation period of 5 years and an operating period of 30 years. The project is linked to the Delta Plan strategy of Restoration of Severely Water Logged and Drainage Congested Areas in Coastal Region.

Expected Benefits

The project will reduce water logging and floods, and therefore reduce their negative impacts on agricultural lands an agricultural production. Improved agricultural conditions will improve cropping intensity and yields, thereby contributing to reduced poverty.

The project has an estimated economic benefit-cost ratio of 2.43.

Responsible Ministry

Ministry of Water Resources

Executing Agency

Bangladesh Water Development Board

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*
#6 *Achieve optimal and integrated use of land and water resources*

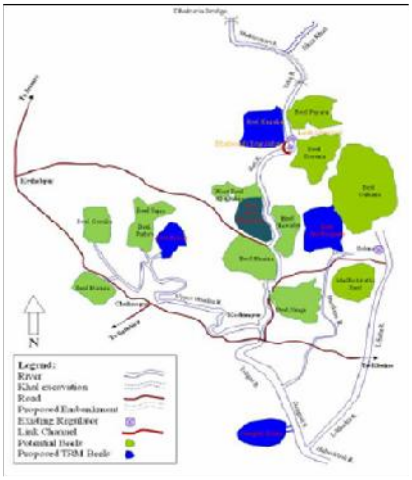
Financing

	Mil BDT	Mil USD
Capex	1,557	20
Opex	42	0.53

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

Project Area

- Khulna Division
- Abhaynagar, Manirampur, Keshabpur, and Jessor
- Upazillas of Jessere District
- Phultala Upazilla of Khulna District



Source: GED, CZ1.38 Project Concept Note

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.

CZ 1.26 Development of Water Management Infrastructure in Bhola Island

Background

Bhola is an island (90 km long and 10-25 km wide) in the delta of Bangladesh with major environmental and poverty problems. The island is situated in one of the poorer parts of Bangladesh and is characterized by a subsistence-level agricultural and fishing society. It is surrounded by major branches of the Lower Meghna, which carries the combined flow of the Ganges, Brahmaputra and Meghna Rivers. However, the land is highly vulnerable to river bank erosion and flooding. The river morphology at Bhola, in particular along its East coast, was of a magnitude requiring major civil works to address the aspect of 'reinforcing embankments'. But as rehabilitating embankments would only provide a temporary solution, river bank protection is also of the highest priority. Without a proper river bank protection, an embankment is not safe and investing in embankment construction and other water management infrastructure would be a poor use of resources.

Project Description

This proposed project is developed to safeguard the East coast of Bhola near Dalautkhan from future flooding, storm surges, and cyclones, which is likely to intensify with growing climate change. The project will protect the area from bank shifting and erosion, and safeguard local livelihood. Moreover, the early warning system will reduce the extent of loss of property, and subsequently reduce poverty levels.

The project has an estimated implementation period of 4 years and an operating period of 25 years. The project is linked to the following Delta Plan strategies: (i) Integrated Flood Management against Extreme Flood, (ii) Protect against Coastal Erosion.

Expected Benefits

The project is expected to reduce erosion of coastal land and prevent flood damages for a period of 25 years, thereby improving livelihoods and reducing levels of displacement.

The project has an estimated economic benefit-cost ratio of 1.05.

Responsible Ministry

Ministry of Water Resources (MoWR), Department of Environment (DOE)

Executing Agency

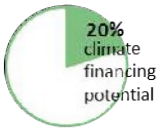
Bangladesh Water Development Board, NGOs, Embankment Maintenance Groups

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

Financing

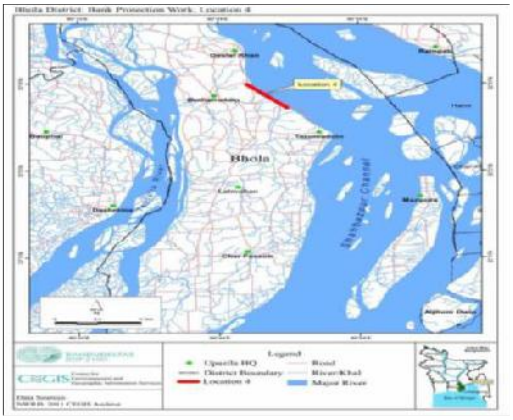
	Mil BDT	Mil USD
Capex	14,651	184
Opex	281	3.5



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

Project Area

- East coast of Bhola near Dalautkhan



Source: GED, CZ1.26 Project Concept Note

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.

CZ 1.3 CHAR DEVELOPMENT AND SETTLEMENT PROJECT –V (CDSP)

BACKGROUND

The coastlines of Bangladesh are constantly moving. In the estuary of the Bay of Bengal, natural hydro-morphological dynamics of the rivers combined with human intervention are continuously forming new land (*char land*) used for human habitation and agriculture. However, this land is unprotected against floods.

Three feasibility studies have been undertaken to identify char lands suitable for flood protection and development. After a rigorous selection process, a cluster of chars were chosen in Noakhali District for a set of interventions that will contribute to the overall objective of reducing poverty, and enhance people's quality of life.

PROJECT DESCRIPTION

This project is a multi-sectoral and multi-agency development programme involving the Government of Bangladesh, other government agencies and NGOs/private partners. The programme plans to cover the sectors of water management, internal infrastructure, land settlement, agriculture, livestock, fisheries and social forestry.

The project has an estimated implementation period of 4 years and an operating period of 20 years. The project is linked to the following Delta Plan strategies: (i) Improved Protection against Extreme Flood, (ii) Protection against Coastal Erosion, (ii) Increase Resilience of Agricultural Production Systems.

EXPECTED BENEFITS

Climate-resilient infrastructure will improve people's livelihood by protecting them from land erosion, floods, and surges. The project will provide access to safe water, health and sanitation facilities, as well as increase access to education and legal aid services to the inhabitants of the newly accreted chars.

The project has an estimated economic benefit-cost ratio of 1.93.

RESPONSIBLE MINISTRY

Ministry of Water Resources (MoWR)

EXECUTING AGENCY

Bangladesh Water Development Board, Department of Fisheries, Department of Agricultural Extension, BRDB

DELTA PLAN GOAL(S)

#1 *Ensure safety against water and climate change related disasters*

#3 *Ensure integrated river systems and estuaries management*

FINANCING

	Mil BDT	Mil USD
Capex	1,138	14
Opex	23	0.29

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

PROJECT AREA

- Noakhali district
- Subarnachar Upazila, Mohammadpur Union: Char Kandaker, Char Mozammel, Char Banni, Char Akramuddin, Char Alauddin, and Char Torab Ali
- Companiganj Upazila, Char Elahi Union: Char Pollabi and Char Gangchil

Source: GED, CZ1.3 Project Concept Note

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 will be likely funded by climate financing.

CZ 1.48 Implementation of Rationalized Water Interventions in Gumti-Muhuri Basin

Background

The Gumti-Muhuri basin is in the South East hydrological region. The region has an inland zone with widespread irrigation, and a coastal zone with serious cyclone risk, drainage congestion, and salinity intrusion problems. Moreover, it is severely affected by arsenic contamination of groundwater, with a high risk of arsenic entering the food chain. Bank erosion by the Meghna is serious around Chandpur and other areas, and there is major land accretion along the southern shores of the region.

Project Description

This project will use water cycle management processes and agricultural drainage management principles to modernize existing water infrastructure, and to rationalize water resources management practices. It also aims to reduce bank erosion, improve the drainage systems, introduce flood proofing systems in the Charlands and low-lying areas, and increase the conveyance capacity to mitigate flooding.

The project has an estimated implementation period of 10 years. The project is linked to the following Delta Plan strategies: (i) Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders, (ii) Ensuring Fresh Water Flow in Coastal Region, (iii) Promotion of Efficient Irrigation Techniques for Sustainable for Different Hotspots.

Expected Benefits

The project is expected to provide flood protection for the eastern part of Dhaka City, which will decrease the loss of lives during flood events and help limit economic damage. The project will also improve the transportation network, providing time and cost savings for drivers, creating employment opportunities, and improving the overall social, environmental, and economic conditions in greater Dhaka.

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 Agency

Bangladesh Water Development Board, Delta Commission

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 river and estuaries management*
#4 *Conserve and preserve wetlands and ecosystems and promote their wise use*

Project Area

- Gumti-Muhuri Basin

Source: Map data ©2017 Google

Financing

	Mil BDT	Mil USD
Capex	13,988	175
Opex	240	3

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

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.

CZ 1.41 Implementation of Rationalized Water Related Interventions in Gorai-Passur Basin

Background

The Gorai Passur basin is in the South West hydrological region. Groundwater over abstraction to cultivate high yield rice is depleting the ground water table. Moreover, occasionally high tidal surge hits these areas and saline water enters and destroys standing crops.

Water logging is a severe problem. As a result of inefficient drainage systems and siltation of rivers/canals, permanent water logging has been created. Beel Dakatia in Jessore and Khulna and Bhutiar Beel in Bagerhat are the main drainage channels of the region, which are completely silted up, causing severe water logging.

Project Description

This project will use water cycle management processes and agricultural drainage management principles to modernize existing water infrastructure, and rationalize water resources management practices. It will reduce bank erosion, improve drainage systems, introduce flood-proofing systems in the Charlands and Low lying areas, and increase conveyance capacity to mitigate flooding.

The project has an estimated implementation period of 10 years. The project is linked to the following Delta Plan strategies: (i) Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders, (ii) Ensuring Fresh Water Flow in Coastal Region, (iii) Increase Resilience of Agricultural Production Systems.

Expected Benefits

The project is expected to provide flood protection, increase agricultural productivity, fisheries production, livestock production, fresh water supply, and sanitation facilities.

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 Agency

Bangladesh Water Development Board

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 river and estuaries management*
#4 *Conserve and preserve wetlands and ecosystems and promote their wise use*

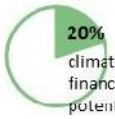
Project Area

- South West, Gorai Possur Basin, Khulna Division

Source: Map data ©2017 Google

Financing

	Mil BDT	Mil USD
Capex	14,570	184
Opex	250	3



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

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.

CZ 1.44 Rationalization of Polders in Baleswar-Tentulia Basin

Background

The Baleswar-Tentulia Basin contains 54 polders (reclaimed pieces of land). These polders were conceived in the year of 1960 under the Coastal Embankment Project and completed in 1971-72. The original purpose was to protect agricultural lands from salinity intrusion caused by tidal inundation from the river.

Considering the polders vulnerability and environmental degradation, it is important that the existing environmental standards of the coastal polders are improved by rehabilitation, and that coastal polders have improved disaster protection.

Project Description

The objective of the project is to improve the socio-economic conditions of the project area by overcoming the problems of floods and drainage, and increasing agricultural production.

The project has an estimated implementation period of 15 years. The project is linked to the following Delta Plan strategies: (i) Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders, (ii) Ensuring Fresh Water Flow in the Coastal Region, (iii) Improved protection against Normal Flooding.

Expected Benefits

This project will reduce the loss of assets, crops and livestock from cyclone and storm surges, reduce salt water intrusion into the polders, and ensure fresh water flow in the rivers and canals. The project will also reduce agricultural production loss by protecting the lands from erosion, remove drainage congestion in rural and urban areas, facilitate navigation in the project area through strategic dredging, improve institutional coordination between agencies, and improve cooperation between the government and water management organizations (WMOs).

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 Agency

Bangladesh Water Development Board

Project Area

- Barguna Pataukhali
- Bhola Districts

Source: Map data ©2017 Google

Financing

	Mil BDT	Mil USD
Capex	158,501	1,997
Opex	2500	31.5

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

Delta Plan Goal(s)

#1 *Ensure safety from floods 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*
#5 *Develop effective institutions and equitable governance for in-country and trans-boundary water resources management*

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.

CZ 1.40 Rationalization of Polders in Gorai – Passur Basin

Background

The Gorai-Passur Basin contains 45 polders (low-lying areas of reclaimed land). These polders were conceived in 1960 under the Coastal Embankment Project and completed in 1971-72. The original purpose of these polders was to protect the agricultural lands from salinity intrusion due to tidal inundation from the river.

Considering the polders' vulnerability and environmental degradation, it is important that the coastal polders be improved by rehabilitation and become equipped with improved disaster protection features.

Project Description

The overall objectives of the project are to improve socio-economic conditions in the project area, to overcome the problems of floods and drainage, and to increase agricultural production.

The project has an estimated implementation period of 15 years. The project is linked to the following Delta Plan strategies: (i) Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders, (ii) Ensuring Fresh Water Flow in the Coastal Region, (iii) Improved protection against Normal Flooding, (iv) Increasing Resilience of Agriculture Production Systems.

Expected Benefits

This project will reduce the loss of assets, crops and livestock from cyclone and storm surges, reduce salt water intrusion in the polder, and ensure fresh water flow in the rivers and canals. It will reduce agricultural production losses by protecting lands from erosion, remove drainage congestion in rural and urban areas, facilitate river navigation through strategic dredging, improve institutional coordination between agencies, and improve cooperation between the government and water management organisations.

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 Agency

Bangladesh Water Development Board

Project Area

- Gorai Passur Basin

Source: GED, CZ1.40 Project Concept Note

Financing

	Mil BDT	Mil USD
Capex	106,604	1,332
Opex	1,800	23

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

Delta Plan Goal(s)

#1 *Ensure safety from floods 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*
#5 *Develop effective institutions and equitable governance for in-country and trans-boundary water resources management*

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.

CZ 1.45 Implementation of Rationalized Water Interventions in Baleswar-Tentulia Basin

Background

The Baleswar-Tetulia basin is in the South-Central region. Water in the region has dangerously high levels of arsenic, and the area is also vulnerable to cyclonic storm surges and associated damage to infrastructure, agriculture and aquaculture.

Rationalization of the existing water resource development projects with sustainable and efficient water resource management becomes very important for reducing flood and drought damage and increasing irrigation facilities, food production and economic growth.

Project Description

This project will use water cycle management processes and agricultural drainage management principles to modernize existing water infrastructure, and rationalize water resources management practices. It will reduce bank erosion, improve drainage systems, introduce flood-proofing systems in the Charlands and Low lying areas, and increase conveyance capacity to mitigate flooding.

The project has an estimated implementation period of 10 years. The project is linked to the following Delta Plan strategies: (i) Integrared Flood Management against Extreme Flood, (ii) Promotion of Efficient Irrigation Techniques Suitable for Different Hotspots, (iii) Improvement of Conveyance Capacity and Navigability of the Rivers.

Expected Benefits

The project is expected to provide flood protection, increase agricultural productivity, fisheries production, livestock production, fresh water supply, and sanitation facilities.

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*

Financing

	Mil BDT	Mil USD
Capex	8,800	110
Opex	880	12

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

Responsible Ministry

Ministry of Water Resources

Executing Agency

Bangladesh Water Development Board, Delta Commission

Project Area

- Baleswar-Tentulia Basin
- Districts: Barisal, Faridpur, Patuakhali, Shariatpur

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.

CZ 1.47 RATIONALIZATION OF POLDERS IN GUMTI-MUHURI BASIN

BACKGROUND

The Gumti-Muhuri Basin contains 10 polders (low-lying reclaimed land). These polders were conceived in the year of 1960 under the Coastal Embankment Project and completed in 1971-72. The original purpose was to protect agricultural lands from salinity intrusion caused by tidal inundation from the river.

Considering the polders vulnerability and environmental degradation, it is important that the existing environmental standards of the coastal polders are improved by rehabilitation, and that coastal polders are equipped with improved disaster protection features.

PROJECT DESCRIPTION

The objective of the project is to improve the socio-economic conditions of the project area by overcoming the problems of floods and drainage, and increasing agricultural production.

The project has an estimated implementation period of 10 years. The project is linked to the following Delta Plan strategies: (i) Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders, (ii) Ensuring Fresh Water Flow in the Coastal Region, (iii) Improved protection against Normal Flooding, (iv) Increasing Resilience of Agriculture Production Systems.

EXPECTED BENEFITS

This project will reduce the loss of assets, crops and livestock from cyclone and storm surges, reduce salt water intrusion into the polders, and ensure fresh water flow in the rivers and canals. The project will also reduce agricultural production loss by protecting the lands from erosion, remove drainage congestion in rural and urban areas, facilitate navigation in the project area through strategic dredging, improve institutional coordination between agencies, and improve cooperation between the government and water management organizations (WMOs).

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*
#4 *Conserve and preserve wetlands and ecosystems and promote their wise use*
#5 *Develop effective institutions and equitable governance for in-country and trans-boundary water resources management*

FINANCING

	Mil BDT	Mil USD
Capex	64,328	811
Opex	1,100	14

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

RESPONSIBLE MINISTRY

Ministry of Water Resources

EXECUTING AGENCY

Bangladesh Water Development Board

PROJECT AREA

- Gumti-Muhuri Basin
- Noakhali, Laxmipur and Feni Districts

Source: GED, CZ1.47 Project Concept Note

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.

CZ 1.30 Rehabilitation of Water Management Infrastructure in Bhola District

Background

Bhola island is the largest island in the Bangladesh delta. Geological processes and climate change have caused substantial land erosion in the area. The strong currents of the Meghna river have eroded the island's eastern coastline and caused land erosion at a rate of five to ten square kilometers every year. As a result, thousands of people living in the area have lost their homes and livelihoods. Further, existing embankments and flood control structures are damaged due to frequent flooding.

Project Description

The project involves reconstruction and rehabilitation of existing embankments and hydraulic structures like sea dykes, interior dykes, and sluices. It will also reduce drainage congestion by re-excavating drainage khals (waterways).

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) Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders, (ii) Protection and Improvement of Major River Banks against Erosion, (iii) Restoration of Severely Water Logged and Drainage Congested Areas in Costal Region.

Expected Benefits

The project will protect the island from erosion, cyclonic storm surges and saline water intrusion. It will also reduce vulnerability to natural disasters, and protect and improve livelihoods.

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 Agency

Bangladesh Water Development Board, Local Government Engineering Department (LGED)

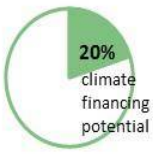
Delta Plan Goal(s)

#1 *Ensure safety against water and climate change related disasters*

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

Financing

	Mil BDT	Mil USD
Capex	23,419	295
Opex	1,988	25



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

Project Area

- Main island of Bhola district known as Polder 56/57
- Situated in the southern coastal area under Barisal Division
- Includes Bhola Sadar, Daulatkhan, Burhanuddin, Charfesson, Lalmohan and Tajunuddin Upazillas
- Total project area is 1440 km²

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.

CZ 12.6 INTEGRATED COASTAL ZONE LAND USE PLANNING IN BANGLADESH USING GIS AND RS TECHNOLOGY

BACKGROUND

Bangladesh's coastal zone has a unique combination of ecosystems upon which the livelihoods of several million people are dependent, however it faces pressures from tidal flooding, storm surge, erosion-accretion, salinity intrusion, unplanned urbanization, poldering effects, and sea level rise.

The coastal zone in Bangladesh has been heavily populated due to its abundance of natural resources derived from intertidal flood plains, accreted mud flats, sand dunes, beaches, mangroves, and fisheries, as well as numerous water ways. Therefore, a detailed land use plan is needed, in line with strategic documents like BDP2100, SDG and ICZMP, to ensure sustainable management of coastal land resources.

PROJECT DESCRIPTION

This project will ensure sustainable and integrated management of land resources for the coastal zone of Bangladesh through development of a guide detailing different land uses in coastal zones, in line with relevant planning documents including the Bangladesh Delta Plan (BDP) 2100 and sustainable development goals (SDG). It will ensure development is planned and will have a special focus on urban areas. It will promote "action areas" that will focus development on areas requiring special attention.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) Protection against Coastal Erosion, (ii) Conservation and Prevention of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs.

EXPECTED BENEFITS

Coastal zone development guided by an integrated plan can ensure increased production of crops, thereby enhancing economic growth. The livelihoods of coastal populations is expected to improve and provide more opportunities for employment. Infrastructure development and environmental conservation can enhance resilience to natural hazards.

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

RESPONSIBLE MINISTRY

Ministry of Agriculture; Ministry of Water Resources

EXECUTING AGENCY

LGED, DAE, UDD, WARPO, DOE, DOF

DELTA PLAN GOAL(S)

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

#6 *Achieve optimal and integrated use of land and water resources*

PROJECT AREA

- 19 Coastal Districts

Source: GED, CZ12.6 Project Concept Note

FINANCING

	Mil BDT	Mil USD
Capex	899	11
Opex	0	0

FINANCE AND DELIVERY MODALITY

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

CZ 1.39 Morphological Dynamics of Meghna Estuary for Sustainable Char Development

Background

There is continuous river bank erosion at Sandwip Channel in the northwest of Bangladesh, and a consequential loss of embankments in Char Nangulia and Caring Char. The information available is insufficient to understand the causes, solutions or implications for char development projects in the estuary.

Project Description

This project aims to provide better understanding of the overall hydraulic and morphodynamic processes in the estuary, increase the sustainability of char development, and to define remedial measures for the erosion at Char Nangulia and Caring Char.

The project has an estimated operating period of 1 year. The project is linked to the Delta Plan strategy of Char Development and Protection against Natural Calamities.

Expected Benefits

This project will increase the knowledge about river bank erosion, which ultimately will result in smarter interventions to reduce embankment erosion, reduce loss of life, and improve livelihoods and the economy.

Responsible Ministry

Ministry of Water resources

Executing Agency

Bangladesh Water Development Board

Delta Plan Goal(s)

#3 *Ensure Sustainable and Integrated river systems and estuaries management*

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

#6 *Achieve optimal use of land and water*

Financing

	Mil BDT	Mil USD
Capex	72	0.91
Opex	0	0

Project Area

- Meghna Estuary
- Char Nangulia and the southern part of Caring Char

Source: Map data ©2017 Google

Finance and Delivery Modality

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

CZ 1.52 LAND BEYOND LAND: EFFORTS TO RECLAIM LANDS AT NEAR COAST

BACKGROUND

Bangladesh has in the past made efforts in artificial land reclamation and secured 1000km² of land area in Noakhali District through the construction of cross dams. Later, efforts moved from dam-building to facilitating natural land accretion processes.

Recent studies have identified a total of 18 cross dams with the potential to reclaim a further 600km² of new land. This requires a comprehensive plan for continuous land reclamation, which could include the construction of important infrastructure such as an international airport to connect and service three sea ports or more.

PROJECT DESCRIPTION

This project will reclaim land at the coast to support economic activities and economic growth. It will generate new surveys, studies, and modelling required for detailed engineering design for land reclamation, taking account of risk from rising sea levels and possible earthquakes.

The project has an estimated implementation period of 8 years. The project is linked to the Delta Plan strategy of Large-scale Land Reclamation Program in the Meghna Estuary.

EXPECTED BENEFITS

This project will contribute as input to later phases, hence there is no direct socio-economic benefit to communities. However, the cost-benefit analysis to be done under this project will lead to efficient and effective future investments.

RESPONSIBLE MINISTRY

Ministry of Water Resources

EXECUTING AGENCY

Bangladesh Water Development Board

DELTA PLAN GOAL(S)

#1 *Ensure safety from floods and climate change related disasters*

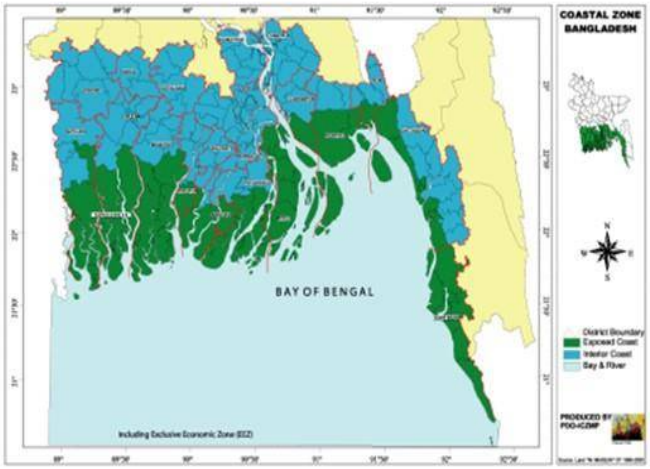
#3 *Ensure integrated river systems and estuaries management*

FINANCING

	Mil BDT	Mil USD
Capex	927	11.68
Opex	0	0

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

PROJECT AREA



Source: GED, CZ1.52 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.

CZ 1.53 Structural Interventions for Managing Sea-level Rise: Preparatory Surveys & Studies

Background

Bangladesh's coastal zones are extremely vulnerable to on-going and projected sea level rise and storm surges. Hence, Bangladesh has already built several kilometers of sea dykes to protect from storm surges and the present level of sea water. However, these sea dykes are not adequate to protect Bangladesh over the timeframe covered by the Bangladesh Delta Plan (BDP). It is projected that sea level rise will increase by 80-100cm by 2100, or in extreme cases by over 2 meters. Coastal defense systems needs to be ready by the time destructive impacts of sea level rise become evident.

Project Description

This project aims to generate surveys, studies, the modelling to develop the detailed engineering design of dykes and storm surge barriers, and a feasibility study (including cost estimates). It also aims to make Bangladesh safer from sea level rise by building elevated (multi-purpose) sea dykes and river barriers.

The project has an estimated implementation period of 15 years. The project is linked to the Delta Plan strategy of Protection against Coastal Erosion.

Expected Benefits

This study project will contribute as input to later phases, hence there is no direct socio-economic benefit to communities. However, the cost-benefit analysis will lead to more efficient and effective future infrastructure investments.

Responsible Ministry

Ministry of Planning, Ministry of Water Resources

Executing Agency

Delta Commission, WARPO, BIWTA, BWDB, Bangladesh Navy

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

Financing

	Mil BDT	Mil USD
Capex	1,024	13
Opex	0	0

Project Area

- Coastal Zones Area

Source: Map data ©2017 Google

Finance and Delivery Modality

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

CZ 4.1 Development of Climate Smart Integrated Coastal Resources Database (CSICRD)

Background

The coastal zone is highly vulnerable to disasters resulting from climate change such as coastal flooding, storm surge, cyclones, erosion, salinity intrusion, subsidence and sea level rise.

A sound knowledge-base study with detailed information on climate variability and the impact of climate change (e.g. salinity intrusion, sea level rise, erosion, groundwater and surface water condition) is required to make projects in the coastal zone adaptive to climate change.

Project Description

This project aims to create a database to aid decision makers in the sustainable and integrated management of coastal resources. It will provide up-to-date information on the coastal zone, information related to climate change impacts and vulnerability, and aid decision makers in project planning, implementation and management.

The project has an estimated implementation period of 12 years. The project is linked to the following Delta Plan strategies: (i) Integrated Flood Management against Extreme Flood, (ii) Conservation and Prevention of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs.

Expected Benefits

The database will aid in the implementation of climate change adaptive plans and projects. It will also help attain better quality of life through sustainable management of coastal resources.

Responsible Ministry

Ministry of Water resources

Executing Agency

WARPO

Delta Plan Goal(s)

#1 *Ensure water security and efficiency of water usages*
#5 Ensure safety against water and climate change related disaster
#6 *Achieve optimal use of land and water*

Financing

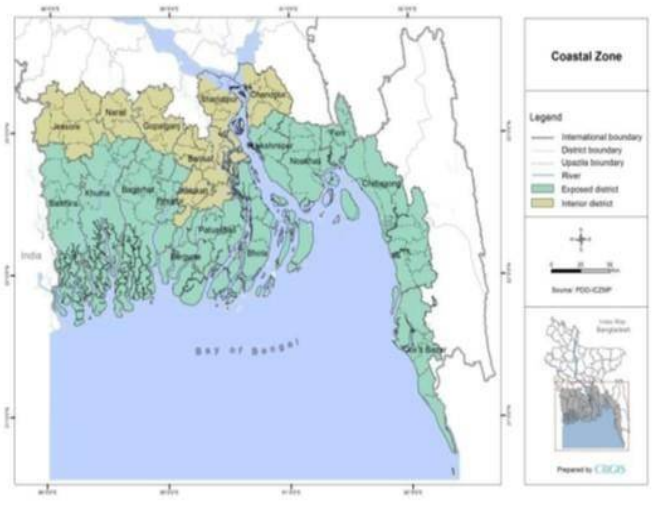
	Mil BDT	Mil USD
Capex	122	2
Opex	0	0

private financing potential

climate financing potential

Project Area

- 19 Coastal Districts



Source: GED, CZ4.1 Project Concept Note

Finance and Delivery Modality

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

CZ 1.4 Study on Integrated Management of Drainage Congestion for Greater Noakhali

Background

Drainage congestion and water logging are common problems in the Southeast region of Bangladesh, particularly on the coast. Heavy rainfalls in the monsoon period lead to deep flooding as the drainage channels and the existing regulators are unable to drain off the excess water. There are five major outfalls to drain out the whole area, three of which have gated regulators while the other two are open. The three outfalls with a regulator are currently overloaded due to extra drainage discharge from the newly formed lands. Moreover, siltation and illegal encroachment of the drainage channels have reduced the drainage capacity to a great extent. At the moment, there is a lack of data and hydrological models on water flows, the drainage capacity, potential integrated solutions.

Project Description

This project involves collecting information on the drainage congestion in the Greater Noakhali area. The knowledge gained through the project will help in deciding on the optimal solutions for the problems identified, and help build structural interventions. The project will also identify the canals that have lost a regular flow of water because of siltation and the canals that need dredging to enhance navigability.

The project has an estimated implementation period of 1.5 years. The project is linked to the Delta Plan strategy Restoration of Severely Water Logged and Drainage Congested Ares in Coastal Region.

Expected Benefits

The project will help manage the drainage congestion of the Greater Noakhali area, identify critical locations where structural interventions are necessary, provide information on the interventions needed to solve the drainage problem in the Greater Noakhali area. This study project will contribute as input to later phases, hence there is no direct socio-economic benefit to communities. However, the cost-benefit analysis will lead to more efficient and effective future infrastructure investments.

Responsible Ministry

Department of Forest and Ministry of Land

Executing Agency

Bangladesh Water Development Board

Delta Plan Goal(s)

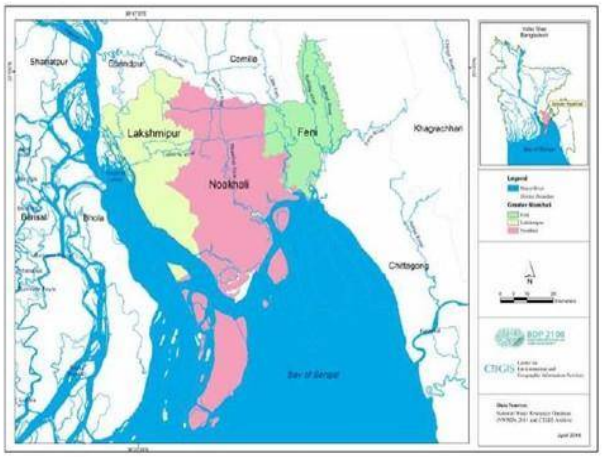
#1 *Ensure safety against water and climate change related disaster*
#5 *Ensure water security and efficiency of water usages*
#6 *Achieve optimal use of land and water*

Financing

	Mil BDT	Mil USD
Capex	16	0.2
Opex	0	0

Project Area

- Greater Noakhali Area



Source: GED, CZ1.4 Project Concept Note

Finance and Delivery Modality

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

CZ 1.5 STUDY ON TIDAL RIVER MANAGEMENT

BACKGROUND

In the early 1960s, polders have been built to protect the low lying coastal areas from salinity intrusion, cyclonic storms, and tidal surges. The polders' objective was to improve the agricultural production while providing resistance to salinity intrusion and a safe habitat. Two decades after the implementation of these polders, water-logging began to emerge as a severe problem. Tidal influx caused sedimentation in the peripheral rivers within and around the polders. This resulted in the erosion of the polders and in blocking the mouth of the regulators raising the bed level of the internal khals. The tidal action of the rivers and the rain caused inundation in these areas and prolonged water-logging. To alleviate this problem, local people carried out in a number of waterlogged/poldered areas the indigenous idea of Tidal River Management (TRM). No environmental and social impact assessment study has so far been carried out to investigate the impacts of the TRM programme.

PROJECT DESCRIPTION

This study aims to evaluate the environmental and social impacts of the TRM programme, and to develop a suitable institutional arrangement for a proper management of polders.

The project has an estimated implementation period of 3 years. The project is linked to the following Delta Plan strategies: (i) Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders, (ii) Restoration of Severely Water Logged and Drainage Congested Areas in Coastal Region.

EXPECTED BENEFITS

The study will provide (i) a detailed understanding of the socio-economical impacts of the TRM, (ii) policy makers a tool to use the natural sedimentation process for water resource management in the selected beels, and (iii) a road map to improve institutional strength of the Bangladesh Water Development Board in dealing with the TRM.

RESPONSIBLE MINISTRY

Ministry of Water Resources (MoWR)

EXECUTING AGENCY

Bangladesh Water Development Board (BWDB)

DELTA PLAN GOAL(S)

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

#6 *Achieve optimal use of land and water*

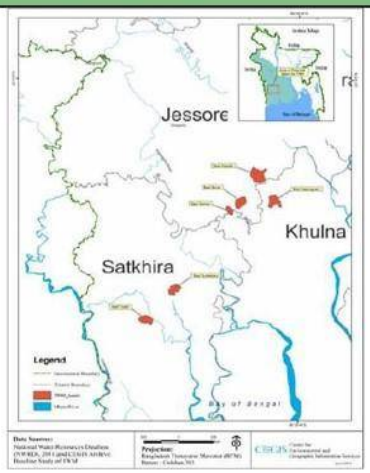
FINANCING

	Mil BDT	Mil USD
Capex	1,250	16
Opex	0	0

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

PROJECT AREA

- Four Districts: Khulna, Jessore, Satkhira, and Bagerhat



Source: GED, CZ1.5 Project Concept Note

FINANCE AND DELIVERY MODALITY

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

CZ 1.7 URIRCHAR-NOAKHALI CROSS DAM PROJECT

BACKGROUND

About 9 km² of land at the mouth of the Bay of Bengal could be reclaimed every year due to natural accretion from transport sediment. Structural intervention can accelerate the rate of land reclamation for agricultural and habitation purposes. Two cross dams have already been successfully constructed in Meghna Estuary, and three more have been shortlisted with the objective of accelerating the natural processes of land accretion. The cross dam connecting Urir Char and Noakhali main is being considered for construction first.

PROJECT DESCRIPTION

Construction of a cross dam connecting Urir Char and Noakhali main to accelerate the natural processes of accretion in the area between Urir char and the main land from Noakhali.

The project has an estimated implementation period of 4 years and an operating period of 50 years. The project is linked to the following Delta Plan strategies: (i) Large-scale Land Reclamation Program in the Meghna Estuary, (ii) Char Development and Protection against Natural Calamities.

EXPECTED BENEFITS

The project will accelerate land reclamation, which will allow landless individuals to be resettled, agriculture to be introduced, and a road to be constructed between Urir Char and the Noakhali mainland, providing economic benefits.

The project has an estimated economic benefit-cost ratio of 0.21.

RESPONSIBLE MINISTRY

Department of Forest and Ministry of Land

EXECUTING AGENCY

Bangladesh Water Development Board (BWDB)

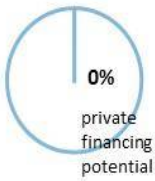
DELTA PLAN GOAL(S)

#1 *Ensure safety against water and climate change related disasters*

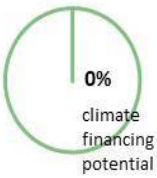
#3 *Ensure integrated river systems and estuaries management*

FINANCING

	Mil BDT	Mil USD
Capex	4,353	55
Opex	87	1



private financing potential

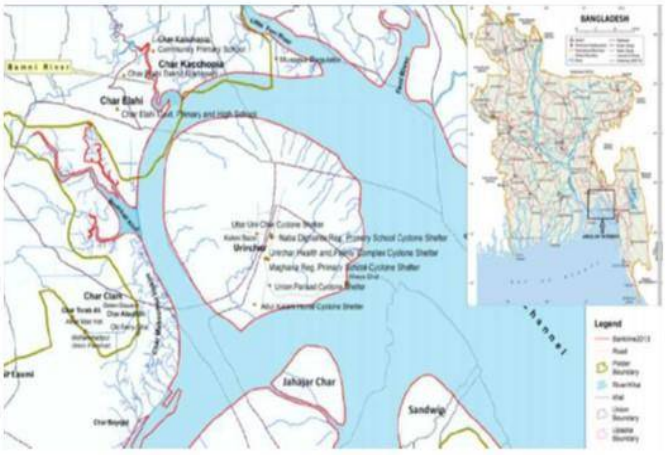


climate financing potential

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

PROJECT AREA

- Project area consists of southern Noakhali, Urir Char, Sandwip Island and its surrounding areas
- The proposed cross dam will connect the Urir Char with southern Noakhali
- The project area is located in Companigonj Upazilla, Noakhali District



Source: GED, CZ1.7 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.

CZ 1.6 Integrated Land Reclamation Project of Hatiya-Dhamar Char-Nijhum Dwip

Background

The area surrounding the Nijhum Dwip and Hatiya Island is morphologically very active due to various forces and their interactions such as upland flow, tide and wave. This makes the area vulnerable to high waves, salinity, tidal flood and surge which is detrimental to life and property, agriculture, culture fisheries and human development activities. People left landless due to erosion in the north Hatiya take shelter on embankment land administered by the Bangladesh Water Development Board (BWDB) or on newly accreted lands, creating risk to their lives and properties. The only solution to resettle landless people is through new reclaimed lands, that can be accelerated through physical interventions like the cross dam.

Project Description

This project involves the construction of a cross dam between Hatiya and Nijhum Dwip, the construction of a dam between Hatiya and Nijhum Dwip, and the construction of a peripheral dyke in Nijhum Dwip.

The project has an estimated implementation period of 3 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Large-scale Land Reclamation Program in the Meghna Estuary, (ii) Increasing Resilience of Agricultural Production Systems.

Expected Benefits

The cross dam between Hatiya and Nijhum Dwip will stimulate socio-economic development by facilitating new agriculture and fisheries, while the cross dam between Hatiya and Nijhum Dwip will reclaim land for resettlement purposes. The peripheral dyke in Nijhum Dwip will help to re-settle landless people and boost agriculture and fish production in the area.

The project has an estimated economic benefit-cost ratio of 2.73.

Responsible Ministry

Department of Forest and Ministry of Land, Ministry of Water Resources

Executing Agency

Bangladesh Water Development Board

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

#3 *Ensure integrated river systems and estuaries management*

Financing

	Mil BDT	Mil USD
Capex	550	7
Opex	12	0.15

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

Project Area

- Hitiya Upazila, Noakhali District

Source: GED, CZ1.6 Project Concept Note

Finance and Delivery Modality

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

CZ 12.8 SOUTHERN AGRICULTURAL IMPROVEMENT PROJECT (SAIP)

BACKGROUND

About 45 percent of the Southern Region of Bangladesh is available for cultivation. Half of this available land was single-cropped with a cropping intensity of 169 percent in 2013-2014, but about 1 million hectares of cultivable land in the region remains fallow due to salinity from tidal flooding.

The agriculture in this region is beset with a wide range of vulnerabilities from tidal flood, water logging, cyclones, tidal surges, river erosion, and salinity. The frequency of these extreme events will increase due to climate change. The adverse impact of climate events will lead to lower crop productivity and less cropping intensity.

PROJECT DESCRIPTION

This project aims to increase agricultural productivity through better management and utilization of land and water resources. It also aims to promote climate change technologies in the southern region of Bangladesh.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) Coping with Uncertainty in Developing Responses, (ii) Sustainably Intensifying Agricultural Production Systems.

EXPECTED BENEFITS

Better management and utilization of land and water resources will increase crop productivity and intensity. Innovative agricultural practices will be introduced through technology development and dissemination. The project will also increase the quality of seed production, processing, and storage capacity at farmers' level. Finally, it will provide working opportunities to empower women in Bangladesh.

RESPONSIBLE MINISTRY

Department of Agriculture Extension

EXECUTING AGENCY

Department of Agriculture Extension, Agriculture Research Institutes, DLS, DOF, BADC, BWDB

DELTA PLAN GOAL(S)

#2 *Ensure safety against water and climate change related disasters*

#6 *Achieve optimal and integrated use of land and water resources*

FINANCING

	Mil BDT	Mil USD
Capex	39,184	494
Opex	0	0

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

PROJECT AREA

- 14 districts: Barguna, Barisal, Bhola, Jhalokati, Patuakhali, Pirojpur, Chittagong, Cox's Bazar, Feni, Lakshmipur, Noakhali, Bagerhat, Khulna and Satkhira

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

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

CZ 17.1 Exploration of the Production Potential of Coastal Saline Soils of Bangladesh

Background

In the coastal region of the country, about 37 percent of total arable land is affected by varying degrees of salinity. About 30 thousand hectares of new land was affected by salinity between 2000 and 2009. Climate change is expected to intensify the impacts of salinity in the future, further damaging the environment and agroecosystems.

The area of the coast is mainly mono-cropped with wet land rice, which has a low yield. Most of the land remains fallow in the dry season due to soil salinity, lack of good quality irrigation water and inadequate drainage facilities. The intrusion of saline water is creating new risks for crop production.

Project Description

This project aims to optimize the use of agricultural land by applying GIS technology, which will provide information to farmers on the appropriate crops, cropping patterns, or technologies to use to increase food production and maximize income.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) Conservation and Preservation of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs, (ii) Sustainably Intensifying Agricultural Production Systems, (iii) Afforestation and Reforestation.

Expected Benefits

This project is expected to increase cropping intensity and crop production as soil salinity decreases in cropping areas, and as rice and non-rice crops are introduced to currently fallow lands during the dry season.

Responsible Ministry

Ministry of Agriculture and Ministry of Water Resources

Executing Agency

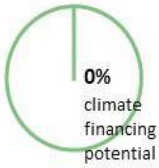
CEGIS, SRDI, BRRI, BARI, BINA, DAE, BWDB

Delta Plan Goal(s)

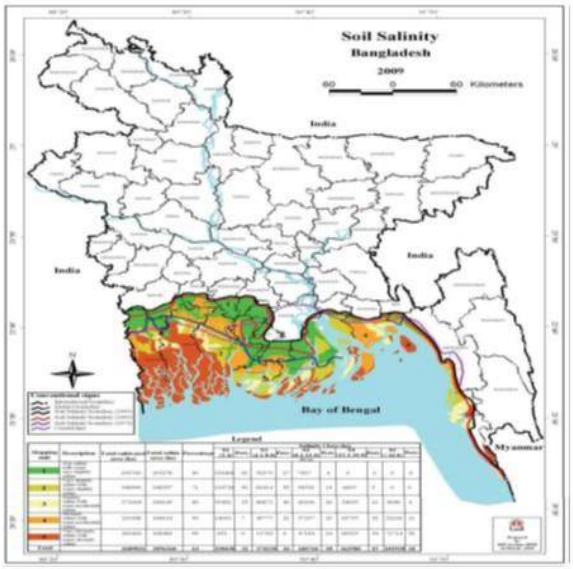
#1 *Ensure safety from floods and climate change related disasters*
#2 *Ensure safety against water and climate change related disasters*
#6 *Achieve optimal and integrated use of land and water resources*

Financing

	Mil BDT	Mil USD
Capex	98	1
Opex	0	0



Project Area



Source: GED, CZ17.1 Project Concept Note

Finance and Delivery Modality

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

CZ 1.1 CONSTRUCTION OF PADMA BARRAGE AND ANCILLARY WORKS

Background

The Ganges is one of three major rivers that provides water for Bangladesh's agricultural sector. In the dry season, the Ganges discharges less water due to increased water extractions upstream in India, resulting in increased salt water intrusion.

The main objectives of the project are to increase irrigation facilities, restore ecological balance, and increase livelihood opportunities of the Ganges Dependent Area. Specific objectives of the project are to properly manage use of the water to be available under the Ganges Water Sharing Treaty of 1996, increase flow and navigability of rivers and channels dependent on the Ganges, and reduce salinity level of the GDA.

Project Description

This project involves the construction of a barrage and hydro power plant across the Ganges River, upstream of the confluence of the Ganges and the Jamuna. The barrage will create a reservoir available for irrigation.

The project has an estimated implementation period of 7 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Improvement of Conveyance Capacity and Navigability of the Rivers, (ii) Combating Coastal Inundation and Salinity Intrusion through Effective Management of Existing Sea Facing Polders, (iii) Restoration of Severely Water Logged and Drainage Congested Areas in Coastal Region.

Expected Benefits

The main expected benefit is increased agricultural output from reduced salinity and increased irrigation. Other expected benefits include new power generation, increased fish catch and forestry output, improved river navigability and road transport.

The project has an estimated economic benefit-cost ratio of 1.53.

Responsible Ministry

Ministry of Water Resources

Executing Agency

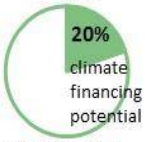
Bangladesh Water Development Board

Delta Plan Goal(s)

#2: *Ensure water security and efficiency of water usages*
#6: *Achieve optimal and integrated use of land and water resources*

Financing

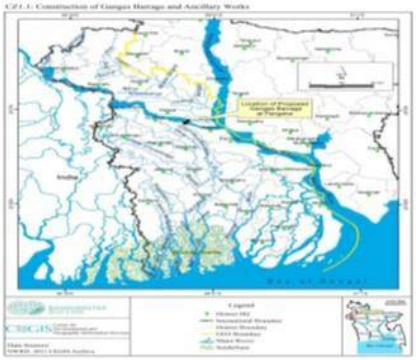
	Mil BDT	Mil USD
Capex	408,713	5,150
Opex	9,904	125



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

Project Area

- The Ganges Barrage is on the Ganges River, upstream of the confluence of the Ganges and the Jamuna, at Pangsha Upazilla, Rajbari District.



Source: GED, CZ1.1 Project Concept Note

Finance and Delivery Modality

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

MR 1.2 Pre-Feasibility Study on Integrated River System Management and Protection of Accreted Land

Background

During the last 40 years the width of the major rivers (the Ganges, the Padma and the Jamuna) has increased. Furthermore, some of the major distributaries of the past, such as Dhaleshwari, Old Brahmaputra, Gorai, have declined due to siltation at their offtakes. These problems along with floods, river bank erosion, and reduction in navigability are hampering the proper use of the river resources. Bangladesh is hungry for land for rapid industrialization and urbanization. Narrowing the width of the major rivers through channelization and revitalizing the distributaries will facilitate overall navigation and the land reclamation process.

Project Description

The project aims to generate knowledge and information on the hydrological and socio-economic processes, and on the Integrated River Management system of the rivers in Bangladesh. It also aims to produce insights on policy options, institutional arrangements, and the cost of alternative policy interventions.
The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) Protection and Improvement of Major River Banks against Erosion, (ii) Improvement of Conveyance Capacity and Navigability of the Rivers.

Expected Benefits

The project will provide insights on the functioning of the river hydrologic and sedimentation systems, and on the policy options available, and their costs. The project will also inform policy makers on best practices for flood and drought management, erosion mitigation, interventions for land reclamation, enhancement of agricultural and fisheries productions, and improved navigation.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

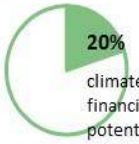
Bangladesh Water Development Board (BWDB)

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*
#5 *Develop effective institutions and equitable governance for intra and trans-boundary water resources management*

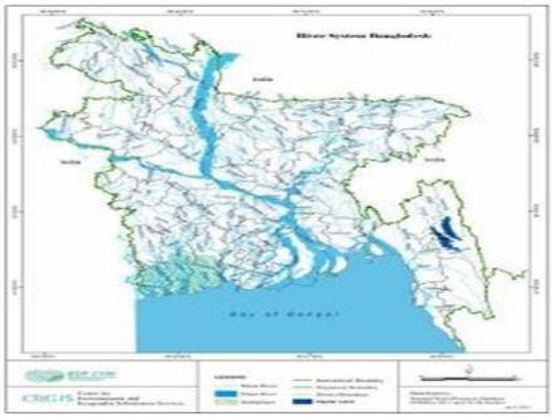
Financing

	Mil BDT	Mil USD
Capex	3,854	49
Opex	0	0



Project Area

- Entire River System within Bangladesh



Source: GED, MR1.2 Project Concept Note

Finance and Delivery Modality

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

MR 1.5 Study for Harnessing the Waters of the Brahmaputra River

Background

Bangladesh is significantly dependent on the Brahmaputra's water. Thus, a study is essential to harness the waters of the Brahmaputra, taking into consideration ways to rejuvenate the old Brahmaputra, manage its sediments, while improving the agricultural environment, fisheries, navigation of the river dependent area. The agricultural potential could not be exploited in absence of a proper study.

Project Description

This project aims to provide insights on the hydro-morphological dynamics of the Brahmaputra River, the size and nature of any problems (hydro-morphological, flow, silting, pollution, fish habitat) of the river.
The project has an estimated implementation period of 3 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) Improvement of Conveyance Capacity and Navigability of the Rivers.

Expected Benefits

This project is expected to provide knowledge for harnessing the waters of the Brahmaputra River to improve the socio-economic development of the country. It will also provide insights for relevant policies.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

Bangladesh Water Development Board (BWDB)

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*
#2 *Ensure water security and efficiency of water usage*
#5 *Develop effective institutions and equitable governance for intra and trans-boundary water resources management*

Financing

	Mil BDT	Mil USD
Capex	435	5
Opex	0	0

Project Area

- Brahmaputra River dependent Area

Source: GED, MR1.5 Project Concept Note

Finance and Delivery Modality

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

MR 1.1 River Bank Improvement Program

Background

The 150-kilometer Jamuna Right Embankment in Greater Dhaka protects around 300,000 hectares of the grain-growing North-Western Region from flooding. River bank erosion in this area has continuously displaced the floodplain population since 1973.

The risk of riverbank erosion and major flooding has a strong negative impact on riparian residents, who generally have high poverty levels, with restricted access to civic amenities and roads. The challenge is to stop river bank erosion and the forced retirement of embankments, which would otherwise disrupt the livelihoods of long-established communities.

Project Description

This project involves the construction of an embankment as well as upgrades to existing river bank protection infrastructure. The project also involves the construction of a 150km long road. The project will be implemented over three phases.

The project has an estimated implementation period of 10 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Protection and Improvement of Major River Banks against Erosion, (ii) Improvement of Conveyance Capacity and Navigability of the Rivers.

Expected Benefits

The project is expected to reduce erosion along 150km of the Jamuna Right Embankment. It will provide flood protection for vital infrastructure in Dhaka and adjacent areas by strengthening and creating a reliable embankment. The road, to be built in the third phase of the project, is expected to produce significant time savings and economic benefits.

The project has an estimated economic benefit-cost ratio of 2.24.

Responsible Ministry

Ministry of Water Resources

Executing Agency

Bangladesh Water Development Board

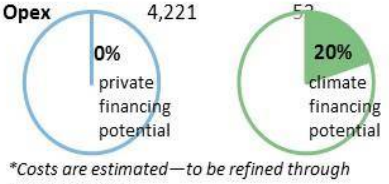
Delta Plan Goal(s)

#1: *Ensure safety against water and climate change related disasters*

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

Financing

	Mil BDT	Mil USD
Capex	140,694	1,773
Opex	4,221	53



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

Project Area

- The project covers the North Central and Central part of the Jamuna Right Embankment in the Sirajganj, Bogra, and Gaibandha Districts and, in future, can be extended to the Kurigram Irrigation projects

Source: Map data ©2017 Google

Finance and Delivery Modality

The flood protection works are not suitable for PPPs because there are no direct revenue streams attached to these projects, and because of the construction costs and risks involved. The project will be delivered by the public sector, but there is potential for climate financing of a portion of the project works.

MR 1.46 Integrated Jamuna-Padma Rivers Stabilization and Land Reclamation Project

Background

Land accretion is a continuous and gradual natural process in the Jamuna and Padma region. It is necessary to get better benefits from this natural process of rivers' stabilization. This river stabilization project has five development objectives: (i) to stabilize the rivers to reduce flood and erosion risks, (ii) to reclaim the lost floodplain, (iii) to capture the developmental value in the study area resulting from the stabilized river environment, (iv) to restore navigation, and (v) to restore riverine ecology.

Project Description

This project aims to control the river bank erosion along the bank of Jamuna-Padma, and to reclaim land by protecting the Geo-bag—this will result in around 150,000 hectares of reclaimed land, enough to settle at least 1.8 million people. This project will also build flood embankments to reduce flood risk, and protect livelihoods and enable urbanization of the area. Finally, the project will build off-takes to stabilize the distributaries rivers.

The project has an estimated implementation period of 20 years and an operating period of 50 years. The project is linked to the following Delta Plan strategies: (i) Protection and Improvement of Major River Banks against Erosion, (ii) Stabilization of Major Rivers.

Expected Benefits

The project is expected to reduce the poverty level, and enhance agricultural productivity and industrialization. It will also restore navigation to support mass scale container barge, feeder vessels, and tourist cruise boat traffic, Finally, the project is expected to create employment, and restore the riverine ecology.

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

Responsible Ministry

Ministry of Water Resources (MoWR)

Executing Agencies

Bangladesh Water Development Board (BWDB)

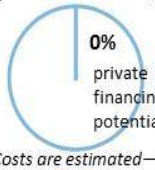
Delta Plan Goal(s)

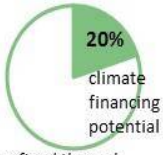
#3 *Ensure Sustainable and Integrated River Systems and Estuaries Management*

#6 *Achieve optimal and integrated use of land and water resources*

Financing

	Mil BDT	Mil USD
Capex	289,800	3,651
Opex	28,980	365

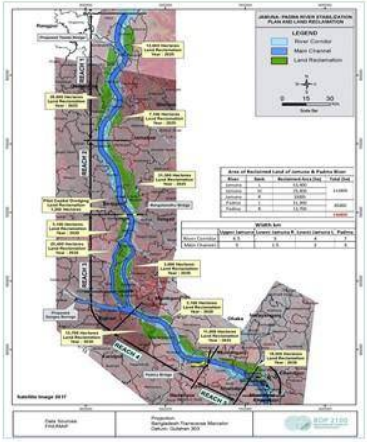




**Costs are estimated—to be refined through feasibility study.*

Project Area

- On both banks of the Jamuna River from Ulipur to Aricha and on both banks of the Padma River from Aricha to Chandpur



Source: GED, MR1.46 Project Concept Note

Finance and Delivery Modality

Since there is no private financing potential, this project will have to be delivered by the public sector. A portion of the project may be climate financed.

MR 3.1 Sustainable Restoration of Connectivity of Major Navigation Routes

Background

Inland waterways are an important mode of transport in Bangladesh, and contribute to socio-economic development. However they are gradually deteriorating due to increased rates of siltation. This leads to poorer navigability because of reduced navigation draft (the vertical distance between the waterline and the bottom of the ship's hull), reduced water flow rates, reduced cross-border flow, the silting-up of off-takes, and a reduction of tidal volume.

Project Description

This project proposes dredging 24 inland waterways, and opening up around 2,500km of waterways. The Bangladesh Inland Water Transport Authority (BIWTA) will dredge 20 million cubic meters, and private dredgers will dredge 81 million cubic meters.

The project has an estimated implementation period of 6 years and an operating period of 25 years. The project is linked to the following Delta Plan strategies: (i) Improvement of Conveyance Capacity and Navigability of the Rivers, (ii) Stabilization of Major Rivers.

Expected Benefits

This project will provide greater economic integration by improved navigability of inland water ways. The project has an estimated economic benefit-cost ratio of 1.17.

Responsible Ministry

Ministry of Shipping; Ministry of Water Resources

Executing Agencies

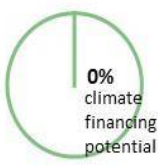
Bangladesh Inland Water Transport Authority (BIWTA)

Delta Plan Goal(s)

#6 *Achieve optimal and integrated use of land and water resources*

Financing

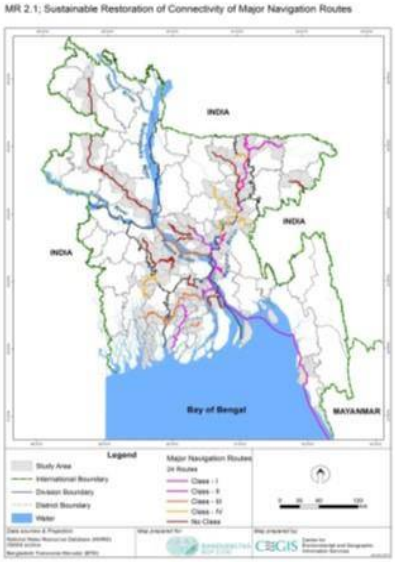
	Mil BDT	Mil USD
Capex	22,948	289
Opex	688	9



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

Project Area

- Nationwide, covering 24 important waterways over 149 Thanas



Source: GED, MR3.1 Project Concept Note

Finance and Delivery Modality

The World Bank has offered to finance this project, and the Government of Bangladesh has approved this offer.

MR 1.6 Development of Chandana-Barasia River Basin System

Background

The Chandana-Barasia river system is an offshoot of the Ganges. It faces water management challenges from the effects of sedimentation, and seasonal water flow.
The off-take of the river has suffered gradual sedimentation over the past two decades due to shifting river course and landscape changes. Sedimentation of the river is exacerbated during the dry season because of the reduced flow of the Ganges. The river's seasonal water flow means the river is liable to overspill during the monsoon, while remaining dry during the winter.

Project Description

The project involves providing irrigation facilities to a gross area of 29,155 hectares for increasing agricultural production, establishing a freshwater reservoir into the Chandana-Barasia River for domestic purposes, and dredging the river's off-take canals to increase freshwater flow.
The project has an estimated implementation period of 3 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Promotion of Efficient Irrigation Techniques Suitable for Different Hotspots, (ii) Restoration of Major Rivers and Their Off-takes through Enhanced Regional Cooperation for Dry Season Flow Augmentation, (iii) Effective Sediment Management.

Expected Benefits

The project is expected to provide irrigation facilities for increasing agricultural production, supply freshwater for domestic purposes and supplementary irrigation, and increase freshwater flow by dredging/excavating the off-take canals.

The project has an estimated economic benefit-cost ratio of 2.31.

Responsible Ministry

Department of Agricultural Extension (DAE), Fisheries Department for Fisheries Development and Extension Services, Ministry of Water Resources

Executing Agencies

Bangladesh Water Development Board (BWDB)

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*
#2 *Ensure water security and efficiency of water usages*

Financing

	Mil BDT	Mil USD
Capex	461	6
Opex	11	0.14

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

Project Area

- Catchment area: Ganges-Gorai-Modhumoti river system, South-West Bangladesh
- Includes parts of: Rajbari, Faridpur and Gopalganj Districts
- Starts at: Gautampur, Pangsha Upazilla, Rajbari District
- Ends at: The Modhumati River, near Bhatiapara Bazar, Kashiani Upazilla, Gopalganj District

Source: GED, MR1.6 Project Concept Note

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.

MR 12.1 Enhancement of Agricultural Productivity towards Food Security in Char Lands

Background

The coastlines of Bangladesh are constantly moving; newly accreted land is known as *char land*. The inhabitants of the Char areas are the poorest people of the country, and face multiple challenges because the char lands are unstable, prone to annual flooding, and have poor soils making agriculture difficult. These challenges lead to food insecurity, inaccessibility to services, and susceptibility to climatic shocks (flash floods, droughts, cyclones, and river erosion). This has stagnated the agricultural productivity and production in the char areas.

Project Description

The objective of the project is to ensure food security by boosting agricultural production and improving income generating opportunities. To this end, around 20,000 small and marginal farm households will be provided with improved varieties of seeds, agricultural machinery, fertilizers, irrigation equipment, poultry birds, fish fry, and capacity-building training.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) Char Development and Protection against Natural Calamities, (ii) Improved Protection against Normal Flooding.

Expected Benefits

The project will lead to food security, improved nutritional status and reduced poverty of marginal and small farmers living in the Char lands.

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

Responsible Ministry

Ministry of Agriculture

Executing Agencies

Department of Agriculture Extension

Delta Plan Goal(s)

#5 *Develop effective institutions and equitable governance for water resources management*
#6 *Achieve optimal and integrated use of land and water resources*

Financing

	Mil BDT	Mil USD
Capex	15,039	189
Opex	1,504	19

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

Project Area

- The project will apply to Char lands that have developed in the three major rivers in Bangladesh, and their tributaries: Brahmaputra, Ganges and Meghna

Source: GED, MR12.1 Project Concept Note

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.

UA 1.3 Drainage Improvement of Dhaka-Narayanganj-Demra (DND) Project Phase 2

Background

The DND Project was initially executed in 1982-68 as a flood control, drainage and irrigation project to protect nearby towns and cropland, but was subsequently turned into an irrigation project. However, the area has continued to develop as an unplanned residential, commercial and industrial area. The result is water-logging even with moderate rain, because the DND project's drainage system was designed for paddy, not urban areas, and it cannot pump out rain water fast enough. This leads to problems growing crops, constructing buildings and roads, and dumping sewage safely.

Project Description

This project aims to improve drainage management by constructing a pump station, pump plant, bridges, and culverts as well as improving a drainage canal and heightening a flood wall.

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) Improve Drainage and Prevent Water Logging in Chittagong and Barisal and Other Large Urban Cities with High Economic Density, (ii) Dhaka-Narayanganj-Demara Area.

Expected Benefits

The project is expected to improve drainage management of the DND project area and mitigate flooding, thereby restoring higher living standards to people in the area.

The project has an estimated economic benefit-cost ratio of 1.55.

Responsible Ministry

Ministry of Water Resources, Department of Environment

Executing Agencies

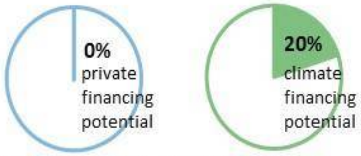
Bangladesh Water Development Board (BWDB), DWASA, RAJUK, RHD, DCC, LGED and FD

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*
#2 *Ensure water security and efficiency of water usages*
#6 *Achieve optimal and integrated use of land and water resources*

Financing

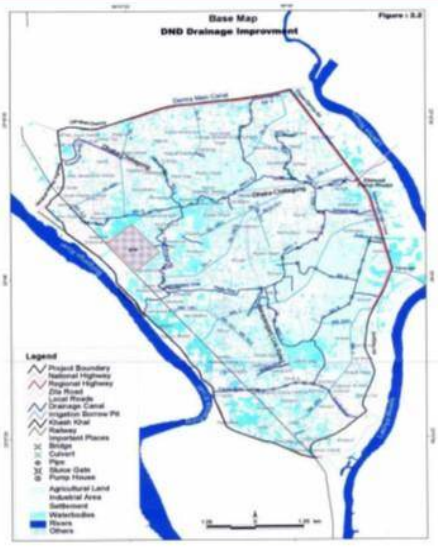
	Mil BDT	Mil USD
Capex	5,711	72
Opex	92	1



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

Project Area

- Division: Dhaka
- District: Dhaka & Narayanganj
- Upazila/Thana: Narayanganj, Demra, Jatrabari & Shampur



Source: GED, UA1.3 Project Concept Note

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.

UA 10.1 Improvement of Drainage Congestion & Flood Control for Chittagong City Corporation Area

Background

The City of Chittagong suffers from severe draining congestion. About 34 khals (waterways), totalling about 110km in length, run through the city. These khals have been silted up by the runoff from the hills and from the solid waste dumped by the city dwellers. There is no formal sewage waste collection system in Chittagong. Moreover, the khals have been narrowed down due to a lack of regular maintenance, unplanned urbanization, and encroachment. The result is drainage congestion and frequent flooding.

Project Description

This project has has four main components: (i) sewerage (expansion of collection system, interceptors, land acquisition) (ii) faecal sludge management (expansion of treatment plant), (iii) drainage (investment in cleaning of khals, conversion of drains, sluice gates, wall/roadside/embankments), and (iv) solid waste management (replacement of waste bins, source separation of waste, container trucks) . The project will be implemented in three phases.

The project has an estimated implementation period of 15 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) 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 main benefits of the project are expected to be improved health and environmental outcomes from the improved sanitation systems. The project is also expected to reduce flooding throughout Chittagong.

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, Road and Highways Department, Dhaka WASA, DCC, LGED, RAJUK

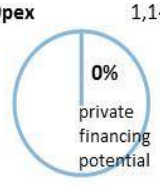
Delta Plan Goal(s)

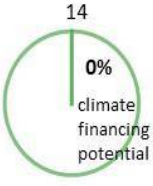
#1 *Ensure safety from floods and climate change related disasters*

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

Financing

	Mil BDT	Mil USD
Capex	30,805	388
Opex	1,140	14





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

Project Area

- Chittagong City Corporation Area

Source: GED, UA10.1 Project Concept Note

Finance and Delivery Modality

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

UA 11.1 Improvement of Drainage, Canal Dredging and Flood Control for Barisal CC area

Background

One million people live in Barisal District and around 400,000 people live in the area administered by the Barisal City Corporation (BCC). This city is crisscrossed by a number of canals and rivers. The city is subjected to seasonal flooding and severe drainage congestion caused mainly by siltation and reduction of the internal canals. The khals (waterways) have been gradually silted up through runoff and dumping of solid waste, and narrowed down due to the absence of regular maintenance, unplanned urbanization, and encroachment.

Project Description

This project involves improving drains, raising/heightening key roads, re-excavating canals, improving solid waste collection, raising plots and increasing housing resilience, improving water supply and sanitation, and conducting town protection works.

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) Improve Drainage and Prevent Water Logging in Chittagong and Barisal and Other Large Urban Cities with High Economic Density, (ii) Improved Protection against Normal Flooding.

Expected Benefits

The project is expected to make Barisal more climate resilient by reducing flooding depth, duration and frequency, which in turn leads to reduced damage to assets, reduced business interruption, and reduced loss of land during a flood event.

The project has an estimated economic benefit-cost ratio of 1.55.

Responsible Ministry

Ministry of Water Resources, Department of Public Health Engineering

Executing Agencies

Barisal City Corporation (BCC), Bangladesh Water Development Board (BWDB), Local Government Engineering Department (LGED)

Delta Plan Goal(s)

#1 *Ensure safety against water and climate change related disasters*
#2 *Ensure water security and efficiency of water usages*
#6 *Achieve optimal and integrated use of land and water resources*

Financing

	Mil BDT	Mil USD
Capex	4,522	57
Opex	150	2

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

Project Area

- Barisal City Cooperation Area, Barisal, Southern Bangladesh

Source: GED, UA11.1 Project Concept Note

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.

UA 3.1 Improvement of Drainage Network, Flood Control, & Solid Waste Management for Khulna City

Background

Khulna City suffers from regular water logging. During each rainy season, about 52,000 houses become inundated in city areas, damaging buildings and roads and disrupting lives. Waterlogging results from excessive rainfall and from overflow of the river. The problem is exacerbated by limited drainage capacity. The canals within the city area are affected from siltation and encroachments. The city's drains also suffer from breakages and blockages. Solid waste dumping is a major cause of blockages. The existing sluice gates are too narrow or silted up to drain out excessive storm water.

Project Description

This project involves several measures to improve drainage and solid waste management in Khulna City. These measures include the construction of an effluent treatment plant, pump houses and new culverts as well as investment in improved drains.

The project has an estimated implementation period of 29 years and an operating period of 35 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) 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, (iii) Improved Protection against Normal Flooding.

Expected Benefits

The project is expected to improve public health through reduced water logging and improved sanitation. Reduced flooding will also reduce damage to buildings and road infrastructure, and the costs associated with repairs. Reduced flooding is also expected to improve business confidence in Khulna, leading to increased investment in the commercial and tourism sectors.

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

Khulna City Corporation (lead), Bangladesh Water Development Board, Khulna WASA, Khulna Development Agency

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

#6 *Achieve optimal and integrated use of land and water resources*

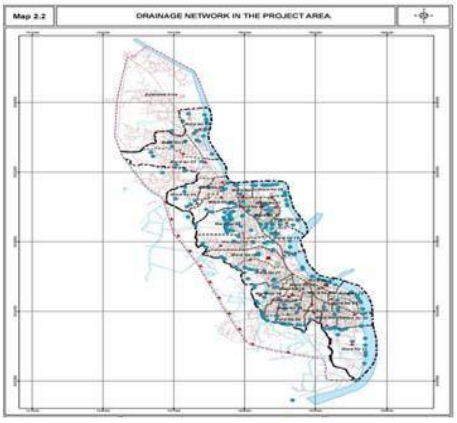
Financing

	Mil BDT	Mil USD
Capex	73,226	923
Opex	15	0.19

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

Project Area

- Khulna City Corporation Area



Source: GED, UA3.1 Project Concept Note

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.

UA 9.3 Project for Improvement of Storm Water Drainage in the City Corporation Area

Background

Bangladesh has been repeatedly exposed to severe flooding. In the city regions, flooding is generally caused by heavy rainfall and/or flooding from the surrounding rivers and canals. When high rainfall coincides with high river levels, stormwater cannot naturally flow through the drainage system. Retention areas are supposed to mitigate flooding and pumping stations have been set up to evacuate floodwater. However, encroachment of natural runoff retention areas, lack of maintenance of storm sewers and pumps, and a lack of coordination among responsible organizations hamper efforts at flood management in the cities. Also, construction of embankments through low-lying areas without providing adequate drainage facilities causes localised flooding.

Project Description

This project involves rehabilitating and re-excavating the existing khals (waterways) and drains to increase carrying capacity, and building new primary, secondary and tertiary drains to drain out storm water.

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) 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 improve the environment of the city, ensure easy and quick disposal of storm and domestic waste water to protect city infrastructure, and reduce diseases from stagnant water.

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-operative

Executing Agencies

Department of Public Health Engineering

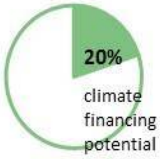
Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

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

Financing

	Mil BDT	Mil USD
Capex	11,545	145
Opex	150	2



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

Project Area

- This project will affect Barisal, Sylhet, Rangpur, Comilla and Mymensingh City Corporation areas

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.

UA 1.2 Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road

Background

The eastern part of Dhaka City is highly vulnerable to flooding and drainage congestion. Increasing use of low lands for housing developments to accommodate Dhaka's growing population has increased flood risks. The area also suffers from severe traffic congestion due to increased traffic demand and the lack of a bypass road for inter-district traffic. This project was first conceptualized in 1990 as part of the Flood Action Plan. The most recent project study was completed in July 2006.

Project Description

This project involves the construction of an embankment along the Balu River, with a bypass road on it. The project is expected to be completed in three phases, with each phase creating a discrete flood protected area.

The project has an estimated implementation period of 12 years and an operating period of 30 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) Dhaka-Narayanganj-Demara Area, (iii) Improvement of Conveyance Capacity and Navigability of the Rivers.

Expected Benefits

The project is expected to provide flood protection for the eastern part of Dhaka City, which will decrease the loss of lives during flood events and help limit economic damage. The project will also improve the transportation network, providing time and cost savings for drivers, creating employment opportunities, and improving the overall social, environmental, and economic conditions in greater Dhaka.

The project has an estimated economic benefit-cost ratio of 1.76.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

Bangladesh Water Development Board, Road and Highways Department, Dhaka WASA, DCC, LGED, RAJUK

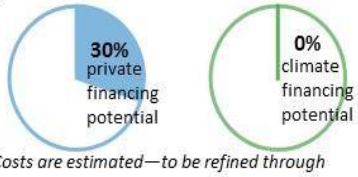
Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

#6 *Achieve optimal and integrated use of land and water resources*

Financing

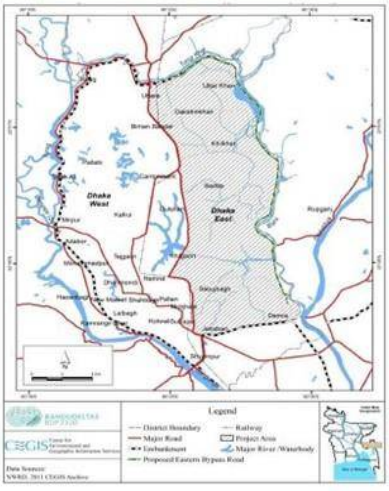
	Mil BDT	Mil USD
Capex	58,060	732
Opex	372	5



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

Project Area

- Uttara, Gulshan, Badda, Khilgaon, and Sabujbag Thanas of Dhaka District
- Demra Thana of Naryanganj District
- 124 km² total project area bounded by Tongi Khal to the north, by Old Demra Road to the south, by Balu River to the east, and by Bishwa, DIT, and Dhaka-Mymensingh roads to the west



Source: GED, UA1.2 Project Concept Note

Finance and Delivery Modality

This project could potentially be designed, built, operated, maintained, and financed by a private firm, with revenues from tolls. If toll revenues are insufficient, public funds may be needed to meet the balance. The PPP Office can draw from previous experience developing PPPs for bypass roads, such as the PPP for a BDT 2.37 billion Dhaka Bypass (Joydevpur-Debgram-Bhulta-Modonpur Road).

UA 20.1 Greater Dhaka Integrated Water and Sewage Improvement Project

Background

Dhaka's water and sewage systems face several challenges. First, Dhaka's water supply relies heavily on groundwater. However, heavy use of groundwater is contributing to the ongoing decline of the water table. If groundwater supplies are depleted, Dhaka's supply of drinking water will be threatened. Second, the current sewage systems only covers a minority of Dhaka's population. As a result, untreated sewage is currently discharged into lakes and other water bodies, polluting the water systems in and around the city.

Project Description

This project aims to secure a supply of safe drinking water by expanding surface water treatment plant capacity. The project also plans to expand access to the sanitation network to all households and private/public facilities in Dhaka by 2035, either through expanding the public sewage system or by improving onsite facilities. The existing sewage network will be rehabilitated and provision made for safely collecting and treating sludge from existing septic tanks and latrines.

The project has an estimated implementation period of 20 years and an operating period of 50 years. The project is linked to the following Delta Plan strategies: (i) 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, (ii) Dhaka-Narayanganj-Demara Area.

Expected Benefits

The project aims to provide complete access to safe water and sanitation across Dhaka, which will improve overall wellbeing. The project should also realize several environmental benefits. Increased use of surface water instead of groundwater will allow the water table to recover. A total sanitation system will also see environmental quality 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 & Co-operatives (LGRD)

Executing Agencies

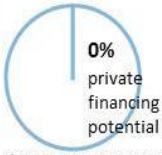
Dhaka Water Supply and Sewerage Authority (DWASA)

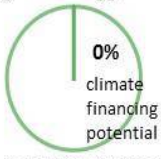
Delta Plan Goal(s)

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

Financing

	Mil BDT	Mil USD
Capex	378,000	4,763
Opex	7,560	95

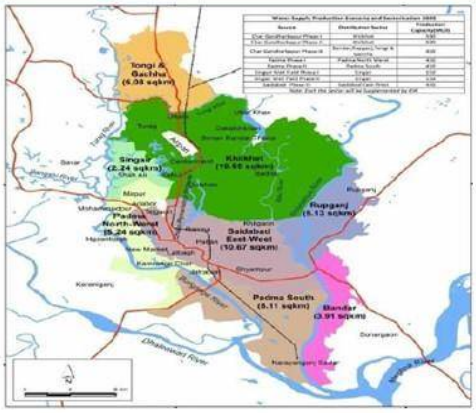




**Costs are estimated—to be refined through feasibility study.*

Project Area

- Greater Dhaka Area



Source: GED, UA9.1 Project Concept Note

Finance and Delivery Modality

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

UA 9.1 Water Supply Project for City Corporation Areas in Bangladesh (Phase I & II)

Background

Water supply and sanitation systems in Bangladesh's City Corporations are under pressure due to rapid population growth and urbanization.

Bangladesh has 11 City Corporations. Of these, six have established water authorities to provide safe drinking water and sanitation services (Dhaka North, Dhaka South, Narayanganj, Chittagong, Khulna, and Rajshahi). However, the remaining five (Sylhet, Barishal, Comilla, Rangpur, and Gazipur) have inadequate infrastructure and governance structures.

Project Description

This project involves the construction of eight water treatment plants with pump houses across five City Corporations. One thousand kilometers of pipeline infrastructure will also be built. Another feature of the project is capacity building to ensure that the new water infrastructure is appropriately maintained and operated.

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's main benefit is expected to be the supply of safe drinking water, which will reduce disease and improve living standards. The project is also expected to reduce environmental degradation.

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 & Co-operatives (LGRD)

Executing Agencies

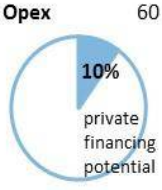
Department of Public Health Engineering (DPE), Relevant City Corporations

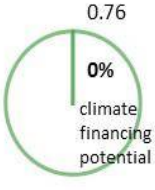
Delta Plan Goal(s)

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

Financing

	Mil BDT	Mil USD
Capex	31,255	394
Opex	60	0.76





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

Project Area

- Sylhet City Corporation
- Barishal City Corporation
- Comilla City Corporation
- Rangpur City Corporation
- Gazipur City Corporation

Source: Map data ©2017 Google

Finance and Delivery Modality

This project could potentially be designed, built, operated, maintained, and partially financed by a private firm. Revenues could come from water tariffs or from a contract for bulk water with the public water utility. PPPs are likely to be cheaper on a lifecycle cost basis since the projects are more likely to be maintained properly, leading to lower replacement costs.

UA 23.2 Financial Performance Improvement of a Water Utility in a Medium Size City

Background

Water Supply and Sewerage Authorities (WASAs) in Bangladesh have low cost-recovery rates for multiple reasons including lack of metering, high non-revenue water (NRW), and inadequate billing mechanisms. Further revenue pressures are expected over the next 10-20 years if Development Partner funding shifts towards lower income countries as Bangladesh reaches (upper) middle income status. These challenges have created a need to improve the financial situation and sources of Bangladesh's WASAs for funding investments in water supply and sewerage systems.

Project Description

This project involved selecting a medium size city for a financial performance improvement project of the water utility, including full metering coverage and reduction of NRW. The project will be split in two parts: one will be designed to improve the financial performance and service levels of existing infrastructure, and one will involve investment in new infrastructure for service expansion.

The project has an estimated implementation period of 3 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 lead to full cost recovery and improved service levels across Water Supply and Sewerage Authorities, including the availability of drinking water 24-hours a day and increased piped water coverage.

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

Khulna WASA, Rajshahi WASA or Rangpur WASA

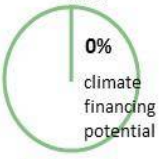
Delta Plan Goal(s)

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

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

Financing

	Mil BDT	Mil USD
Capex	383	5
Opex	9	0.11



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

Project Area

- A medium size city, in which a WASA is the operating entity, is to be selected.
- The shortlist includes Khulna, Rangpur, and Rajshahi.

Source: Map data ©2017 Google

Finance and Delivery Modality

There is currently a lack of private sector engagement because of low revenues from water supply delivery. Since there is no private or climate financing potential, this project will have to be delivered by the public sector.

UA 23.1 KHULNA WATER SUPPLY PROJECT PHASE II

BACKGROUND

Khulna is the third largest city in Bangladesh with a population of 1.5 million people. Rapid urbanisation, migration from surrounding districts and industrialisation have increased, and will continue to increase, demand for freshwater. A lack of parallel growth in water supply infrastructure and high rates of non-revenue water (NRW) have caused shortages of freshwater. Groundwater also suffers from arsenic contamination and high salinity.

PROJECT DESCRIPTION

Under this project a new surface water treatment plant will be constructed with an intake structure, transmission and distribution network system, impounding and distribution reservoir. This plant will serve about 800,000 inhabitants.

The project has an estimated implementation period of 6 years. The project is linked to the following Delta Plan strategies: (i) 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, (ii) Ensure Freshwater Supply to Support the Industrial Growth, (iii) 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 will improve the existing water supply system to ensure safe, potable and adequate water supply for the Khulna City area.

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 & Co-operatives

EXECUTING AGENCIES

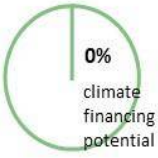
KWASA

DELTA PLAN GOAL(S)

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

FINANCING

	Mil BDT	Mil USD
Capex	26,662	336
Opex	12	0.15



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

PROJECT AREA

- Khulna City Corporation Area

Source: Map data ©2017 Google

FINANCE AND DELIVERY MODALITY

This project could potentially be designed, built, operated, maintained, and financed in part by a private firm. Revenues could come from water tariffs or from a contract for bulk water with the public water utility. PPPs are likely to be cheaper on a lifecycle cost basis since the projects are more likely to be maintained properly, leading to lower replacement costs.

UA 9.2 Improvement of Sanitation Systems in City Corporation Areas of Bangladesh

Background

Improving urban sanitation systems is a top priority for the Government of Bangladesh. Inadequate sanitation infrastructure helps spread water borne disease. It also pollutes the environment, including open drains, khals (waterways) and rivers. There is a need for additional public toilet and latrine facilities to ensure access to sanitary toilet facilities across the population. Moreover, several City Corporations do not have proper fecal sludge collection and treatment infrastructure. There is also insufficient technical capacity to ensure the sustainable operation and maintenance of sewage collection and treatment systems.

Project Description

This project involves the construction of new total sanitation systems in five different City Corporations, including four sewage treatment plants, 500 kilometers of sewer line, 250 community latrines and 50 public toilets. The project also involves a capacity building exercise to help ensure the sustainable operation and management of the new sanitation systems.

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 improve sanitation and, therefore, reduce the spread of waterborne disease. Living standards and community health are also expected to improve. In addition, expanded sanitation infrastructure should help improve the quality of the environment.

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, Sylhet City Corporation, Barishal City Corporation, Comilla City Corporation, Rangpur City Corporation, Gazipur City Corporation

Delta Plan Goal(s)

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

Financing

	Mil BDT	Mil USD
Capex	23,400	295
Opex	60	0.76

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

Project Area

- Sylhet City Corporation
- Barishal City Corporation
- Comilla City Corporation
- Rangpur City Corporation
- Gazipur City Corporation

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.

UA 1.1 Protection of Rivers System around Dhaka City with Their Ecological Restoration

Background

Dhaka City is bounded by four rivers: the Buriganga, the Turag, the Shitalakhya and the Balu. These rivers are considered the lifeline of Dhaka's environment and ecosystem. However, over recent decades, rapid population growth in Dhaka has led to unplanned urbanization, encroachment of floodplains, and the disposal and discharge of solid waste, and untreated industrial and domestic effluents into the rivers. This has led to environmental degradation and reduced river navigability. One way to help rehabilitate these rivers is by increasing their flow during the dry season.

Project Description

The projects seek to address the problems of river degradation in Dhaka through a combination of measures including dredging, improved waste management, and a series of infrastructure interventions (regulators, loop cuts, fish passages, and bridge adjustments) to increase river flows and restore ecology.

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 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, (ii) Dhaka-Narayanganj-Demara Area, (iii) Restoration of Major Rivers and Their Off-takes through Enhanced Regional Cooperation for Dry Season Flow Augmentation.

Expected Benefits

The main benefits of the project are expected to be ecological, including improved water quality, improved river flow and ecology, and higher amenity value. Economic benefits are also expected from improved navigation and from increased food and fisheries production.

The project has an estimated economic benefit-cost ratio of 2.15.

Responsible Ministry

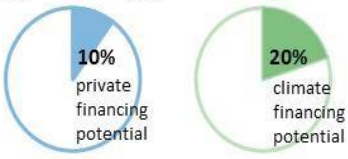
Ministry of Water Resources, Ministry of Environment and Forests

Executing Agencies

Department of Environment (lead), Bangladesh Inland Water Transport Authority, Bangladesh Water Development Board, Ministry of Industries, Dhaka South City Corporation, Dhaka North City Corporation

Financing

	Mil BDT	Mil USD
Capex	14,788	186
Opex	141	2



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

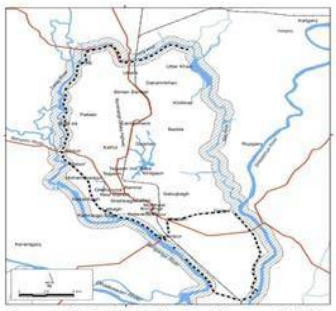
Delta Plan Goal(s)

#3: *Ensure integrated river systems and estuaries management*

#4: *Conserve and preserve wetlands and ecosystems and promote their wise use*

Project Area

- The project is located at four rivers around Dhaka City: the Buriganga, the Turag, the Balu and the Shitalakshya.
- The focus is mainly on Dhaka City. However, the administrative boundary covers the districts of Dhaka, Narayanganj, Munshiganj, Gazipur and Manikganj.



Source: GED, UA1.1 Project Concept Note

Finance and Delivery Modality

PPP arrangements could play a role in delivering the following elements of the project: dredging (which could be combined with land accretion), water navigation (as improved navigability may enable ferry services), solid waste management (to prevent further waste entering the rivers), sewage treatment (to prevent further pollution) and riverfront development (to take advantage of the amenity from the restored river systems).

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.

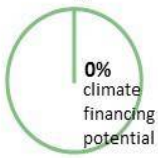
A feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits.

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.

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*

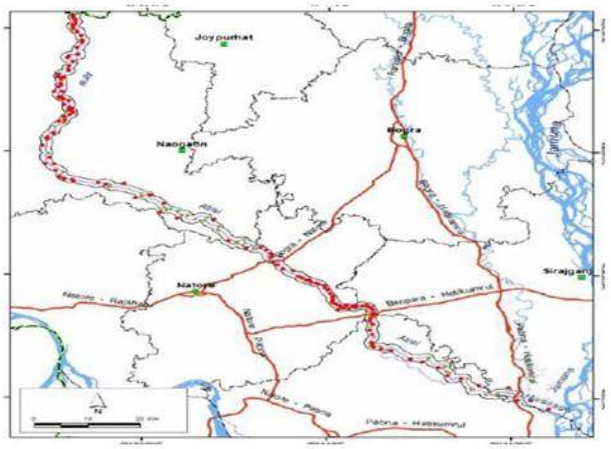
Financing

	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.

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.*

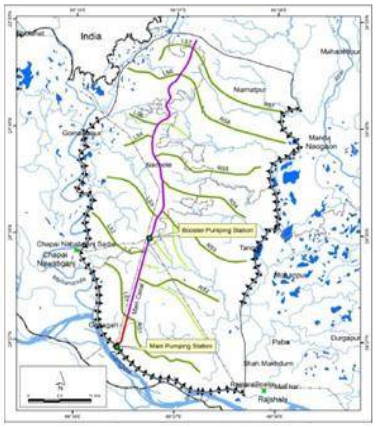
Financing

	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.

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)

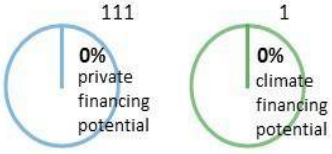
#1 *Ensure safety against water and climate change related disasters*

#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.

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*

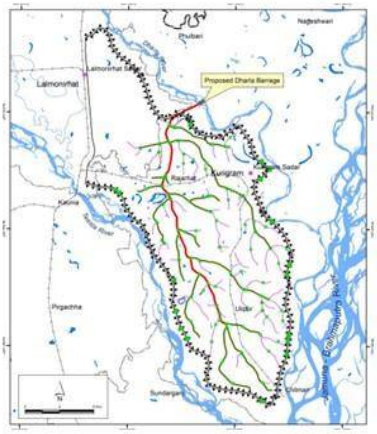
FINANCING

	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.

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

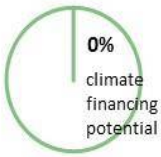
Bangladesh Water Development Board, North Rajshahi Irrigation Project

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.

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

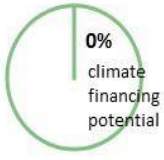
Bangladesh Water Development Board, Mahananda Irrigation Project and Barind Multipurpose Development Authority

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.

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

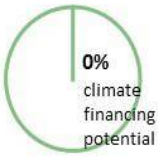
Bangladesh Water Development Board, Kurigram Irrigation Project I and II

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.

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

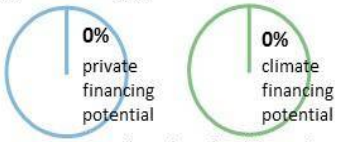
Ministry of Fisheries and Livestock (MoFL)

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.

CH 1.11 Implementation of Rationalized Water Related Interventions in Chittagong Coastal Plain Basin

Background

The project area is currently protected by flood control structures constructed in the past. However, due to lack of funds, they have not been maintained properly. As a result, the area is vulnerable to the impacts of climate change. People living in this area also face water shortage due to salinization, water logging due to drainage problems and siltation, and embankment erosion.

Project Description

The project seeks to improve and modernize existing water infrastructure by stabilizing river banks, dredging rivers/khals, and building sluices. The institutional component of the program includes participatory models for water management.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) 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, (ii) Increasing Resilience of Agricultural Production Systems, (iii) Major River Banks against Erosion.

Expected Benefits

The project will provide protection against flooding, improve resilience to climate change, and improve water and sanitation facilities for populations in the area. It is also likely to boost production in the agriculture, fisheries and livestock sectors.

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 Agency

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

Delta Plan Goal(s)

#1 *Ensure safety against water 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 in-country and transboundary water resources management*
#6 *Achieve optimal use of land and water*

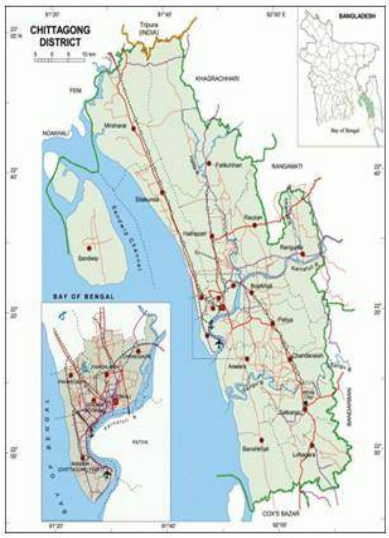
Financing

	Mil BDT	Mil USD
Capex	811	10
Opex	20	0.25

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

Project Area

- Chittagong, Cox's Bazar, Bandarban, Khagracharu and Rangamati Districts
- Total net cultivable area of 0.48 Mha



Source: GED, CH1.11 Project Concept Note

Finance and Delivery Modality

Since there is no private financing potential, this project will have to be delivered by the public sector. However, part of the project can be funded through climate financing.

CH 1.10 Rationalization of Polders in Chittagong Coastal Plain

Background

Existing polders (low-lying, reclaimed land) in the Chittagong Coastal Plain Basin are damaged due to environmental degradation. This has increased their vulnerability to natural disasters, erosion and salinity intrusion. Therefore, they need to be rebuilt. Moreover, internal drainage channels have become silted up causing drainage congestion. These need to be re-excavated.

Project Description

The project seeks to rationalize 28 of the 30 polders in the Chittagong Coastal Plain Basin (2 of them have not yet been built). The program components include a preparatory study, rehabilitating and redesigning existing infrastructure, building new structures for internal water management and capacity building initiatives.

The project has an estimated implementation period of 10 years. The project is linked to the Delta Plan strategy Intermediate Polders for Protection against Tidal Storm Surge and Coastal Inundation.

Expected Benefits

The project is likely to provide protection from cyclone and storm surges, salinity intrusion, and soil erosion. It is likely to boost production in agriculture, fisheries and livestock sectors, and improve water and sanitation systems.

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

Responsible Ministry

Ministry of Water Resources

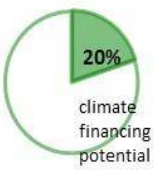
Executing Agency

Bangladesh Water Development Board, Water Resources Planning Organization, Department of Public Health Engineering, Department of Environment, Department of Disaster Management, Department of Fisheries, Forest Department, and Department of Livestock Services.

Financing

	Mil BDT	Mil USD
Capex	42,376	534
Opex	850	11

private financing potential



climate financing potential

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

Project Area

- Chittagong and Cox's Bazar Districts

Source: Map data ©2017 Google

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

Finance and Delivery Modality

Since there is no private financing potential, this project will have to be delivered by the public sector. However, part of the project can be funded through climate financing.

CH 26.2 Development of Catchment and Sub-Catchment Management Plans

Background

Rivers in Chittagong and Chittagong Hill Tracts originate in Bangladesh which means there is potential for both upstream and downstream water management. Problems experienced upstream like landslides, and those experienced downstream like sedimentation, can be addressed together.

Project Description

This project involves preparing integrated catchment and sub-catchment management plans that clearly express the inter-linkages of hills and plains. It includes developing a vision and a financially sustainable investment plan for the project area.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) 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, (ii) Conservation and Preservation of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs.

Expected Benefits

This project will support sustainable economic growth and development, protect water storage capacity, and protect existing ecological value in the project area.

Responsible Ministry

Ministry of Water Resources, Ministry of Chittagong Hill Tracts Affairs

Executing Agency

Chittagong Hill Tracts Regional Council, Local Government Engineering Department, and Department of Public Health Engineering

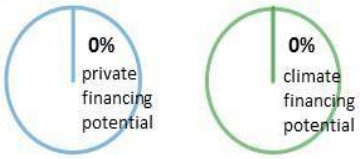
Delta Plan Goal(s)

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

#6 *Achieve optimal use of land and water*

Financing

	Mil BDT	Mil USD
Capex	16	0.21
Opex	0	0



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

Project Area

- Chittagong Hill Tracts and the Chittagong coastal plain

Source: Map data ©2017 Google

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.

CH 9.2 Water Supply and Environmental Sanitation in Pourashavas Under Chittagong Hill Tracts

Background

Compared to other Pourashavas of the country, the basic municipal services systems (water supply, drainage, sanitation and solid waste management) in Cittagong Hills Tracts' Pourashavas are inadequate to meet the public demand. In accordance with the standards of the Joint Monitoring Programme (JMP), water supply coverage is 59 percent, and sanitation coverage is 40 percent in these areas, against the national coverage of 85.5 percent for water supply, and 54 percent for sanitation. The hydro-geology is complex in the CHT and finding suitable water sources is often difficult. It is not always possible to find water-bearing aquifers for round-the-year use. Thus, one of the main problems in CHT area is inadequate water supply and sanitation services.

Project Description

This project consists mainly of structural interventions to increase water supply, and to improve water treatment and drainage in seven Pourashavas in the Chittagong Hill Tracts area. These interventions include constructing new pump houses, storage tanks, water mains, a reservoir, drains, toilet and latrine facilities, as well as refurbishing and upgrading a treatment plant.

The project has an estimated implementation period of 4 years and an operating period of 15 years. The project is linked to the following Delta Plan strategies: (i) 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, (ii) Improve Drainage and Prevent Water Logging in Chittagong and Barisal and Other Large Urban Cities with High Economic Density.

Expected Benefits

The project is expected to provide improved access to safe drinking water. The project is also expected to improve hygiene through new sanitation and drainage systems. As a result, overall public health, environmental conditions 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

-

Executing Agencies

Department of Public Health Engineering

Delta Plan Goal(s)

#2 *Ensure Water Security and Efficiency of Water Usages*

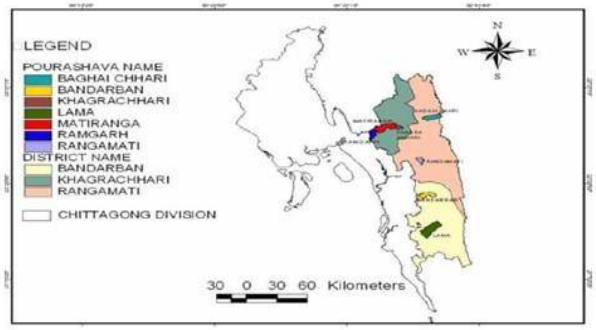
Financing

	Mil BDT	Mil USD
Capex	5,433	68
Opex	543	7

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

Project Area

- 7 Pourashavas: Rangamati, Baghaichari, Khagrachai, Malivaga, Ramgarh, Bandarban, Lama Paurashav



Source: GED, CH9.2 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.

CH 12.4 Enhancement of Livelihood in the Chittagong Hill Tracts Through Good Agricultural Practices

Background

Agriculture is the main source of livelihood for populations in the project area. Unsustainable farming practices coupled with environmental degradation has reduced agricultural productivity.

Project Description

The project seeks to assist small and marginal farmers in adopting Good Agricultural Practice; this includes using horticultural crops, maintaining soil health, improving farm water management and using improved agricultural inputs.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) Sustainably Intensifying Agricultural Production Systems, (ii) Diversification in Agricultural Output and Livelihoods.

Expected Benefits

The project will boost agricultural production, improve livelihoods of small-scale farmers and agri-business owners in the project area, and improve environmental conditions through the use of sustainable agricultural practices.

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

Responsible Ministry

Ministry of Agriculture

Executing Agency

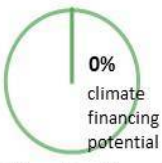
Department of Agriculture Extension

Delta Plan Goal(s)

#5 *Develop effective institutions and equitable governance for in-country and transboundary water resources management*
#6 *Achieve optimal use of land and water*

Financing

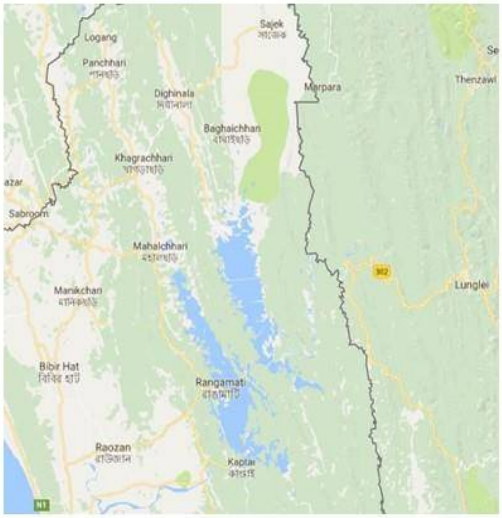
	Mil BDT	Mil USD
Capex	9,519	120
Opex	190	2



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

Project Area

- Three hill districts – Khagrachhari, Rangamati, Bandarban covering 25 Upazillas
- Total project area is 13,184 km²



Source: Map data ©2017 Google

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.

CH 26.1 KAPTAI LAKE REHABILITATION STUDY AND PILOT PROJECT

BACKGROUND

Kaptai lake was created when a dam was built over the Karnaphuli river as part of the Karnaphuli Hydro-electric power project. Agricultural land has become scarce since the dam submerged substantial tracts of land. Siltation due to land erosion in surrounding areas is also a problem.

PROJECT DESCRIPTION

The project seeks to develop a rehabilitation plan for Kaptai Lake. This includes pilots for managing lake compartments, lake levels and downstream water, agriculture on lake shores and hillsides, and knowledge-based solutions for optimized lake management.

The project has an estimated implementation period of 5 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) Green Belt around the Hills of the Kaptai Lake.

EXPECTED BENEFITS

The project promotes lake functionality, sustainable economic growth, and development in the Chittagong Hill Tracts area. It also seeks to improve livelihoods by boosting agriculture and aquaculture.

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

RESPONSIBLE MINISTRY

Ministry of Water Resources, Ministry of Chittagong Hill Tracts Affairs

EXECUTING AGENCY

Chittagong Hill Tracts Affairs, Local Govt. Engineering Department, and Department of Agriculture Extension

DELTA PLAN GOAL(S)

#2 *Ensure safety against water and climate change related disasters*
#4 *Conserve and Preserve Wetlands and Ecosystems and Promote their Wise Use*
#5 *Develop effective institutions and equitable governance for in-country and transboundary water resources management*

FINANCING

	Mil BDT	Mil USD
Capex	10	0.13
Opex	1	0.01

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

PROJECT AREA

- Kaptai lake catchment, Kaptai Upazilla, Rangamati District, Chittagong Division

Source: Map data ©2017 Google

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.

CH 1.1 Prospects for Promoting Soil Conservation and Watershed Protection in Chittagon Hill Tracts

Background

Chittagong Hill Tracts are hilly areas of Bangladesh where jhum cultivation is prevalent. Flash floods and heavy rainfall is common in these areas resulting in top soil erosion, deterioration of water quality in surrounding watersheds and siltation of river and lake beds.

Project Description

The project seeks to develop an integrated soil conservation and watershed management system in the Chittagong Hill Tracts, and ensure sustainable agricultural practices.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) 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, (ii) Improved Protection against Normal Flooding Protection and Improvement of Major River Banks against Erosion.

Expected Benefits

The project will boost agricultural production, protect soil from erosion, protect watersheds from degradation, and improve livelihoods of population living in the area.

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

Responsible Ministry

Ministry of Land, Ministry of Environment and Forest, and Ministry of Water Resources

Executing Agency

SRDI, Bangladesh Water Development Board, Forest Department, NARS Institute, Bangladesh Agricultural Research Council and CHT Council.

Delta Plan Goal(s)

#6 *Achieve optimal and integrated use of land and water resources*

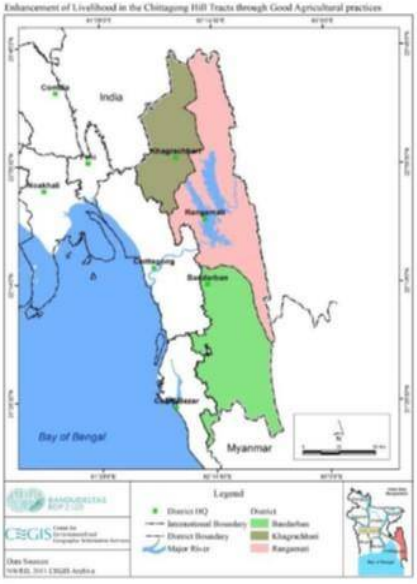
Financing

	Mil BDT	Mil USD
Capex	8	0.09
Opex	1	0.01

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

Project Area

- Three hill Districts – Khagrachhari, Rangamati, Bandarban
- Total project area is 13,184 km²



Source: GED, CH1.1 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.

CH 26.5 Flow Control and Water Storage Structures for Water Availability in the Dry Season

Background

Small dams, reservoirs, and water storage structures are possible solutions to the water-related problems of populations living in the Chittagong Hill Tracts and coastal plain. However, to be successful, these should be well designed and carefully implemented.

Project Description

The project involves designing and implementing multifunctional small-scale reservoirs. It also involves developing and implementing suitable arrangements for operation, maintenance and management for these reservoirs.

The project has an estimated implementation period of 5 years and an operating period of 50 years. The project is linked to the following Delta Plan strategies: (i) 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, (ii) Restoration of Major Rivers and Their Off-takes through Enhanced Regional Cooperation for Dry Season Flow Augmentation.

Expected Benefits

The project is expected to support equitable economic growth and sustainable development in the project area.

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

Responsible Ministry

Ministry of Water Resources, Ministry of Chittagong Hill Tracts Affairs

Executing Agency

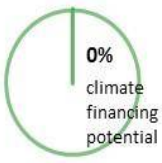
Ministry of Chittagong Hill Tracts Affairs and Chittagong Hill Tracts Regional Council

Delta Plan Goal(s)

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

Financing

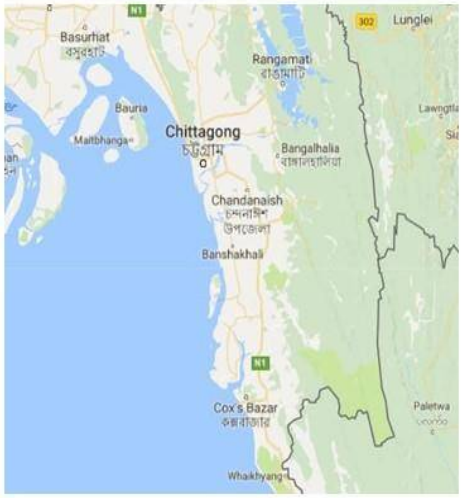
	Mil BDT	Mil USD
Capex	625	8
Opex	10	0.12



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

Project Area

- Chittagong Hill Tracts and the Chittagong coastal plain



Source: Map data ©2017 Google

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.

HR 2.1/ 2.2 Village Protection against Wave Action in Haor Area and Improved Water Management in Haor Basins

Background

The haor basin encompasses an area of about 8,000 square km and a population of approximately 20 million people. Annual rainfall averages between 2,200mm to 5,800mm, depending on the region of the basin.

The villages of the haor are built on platforms near rivers and are vulnerable to flooding and wave action. The villagers use a combination of organic materials—bamboo and *tarja* fencing, screens of *hijal*, *koraoch*, and other tress from the surrounding lowland forests—to protect against the flooding and the threat of wave action. These measure erode over time and often fail. The project is aimed at protecting the villages from wave action, which damages lives and livelihoods.

Project Description

The project will construct 202 revetment works over 74km, construct 180 stair and ramp works, construct a 37km green belt, and develop 17 nurseries. The project also rehabilitates 25 BWDB schemes to mitigate the effects of flash flooding. They include: construction of 6-vent regulators; construction of 2-vent regulators; repair/re-sectioning of 250 km of embankment; re-excavation of 50 km of river; re-excavation of 200 km of khal, canals, and drainage channels

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) Pre-monsoon Flood Protection from the Flashy Rivers in the Haor Region, (ii) Flood Protection in Haor Region during Monsoon.

Expected Benefits

The project will rehabilitate 25 existing haor schemes to protect agriculture and fisheries, improve pre and post monsoon drainage of Haor areas and improve conveyance capacity and navigability of the principal rivers of the region. These effects will protect the boro crops and improve yields. The project is expected to provide protection to a total of 202 homestead areas, saving lives and immobile property, facilitating sustainable livelihoods while developing surrounding greenbelts.

The project HR 2.2 has an estimated economic benefit-cost ratio of 4.37 and a feasibility study is needed to confirm the project design, environmental and social impact, and costs and benefits for project HR 2.1.

Responsible Ministry

Ministry of Water Resources

Executing Agencies

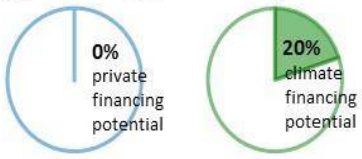
Department of Bangladesh Haor and Wetland Development (DBHWD), BWDB, LGED, DAE

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

Financing

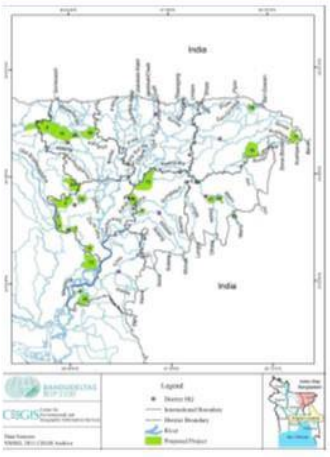
	Mil BDT	Mil USD
Capex	7,286	92
Opex	193	2



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

Project Area

- There are altogether 373 Haors in the north eastern region of Bangladesh distributed in the districts of Sylhet, Sunamganj, Moulvibazar, Habiganj, Netrakona and Kishoregonj. The region is situated just below the hilly areas of Assam, Meghalaya and Tripura of India
- The project covers districts of Sunamganj, Habiganj, Maulvibazar, Sylhet, Netrakona, Kishoreganj, Brahmanbaria



Source: GED, HR2.2 Project Concept Note

Finance and Delivery Modality

Climate financing is a likely source of funding for at least part of this project. It is likely that the remainder of the funding will need to come from government funds, grants, and NGOs.

HR 1.1 Program for Implementation of Rationalized Water Related Interventions in Upper Meghna Basin

Background

The Upper Meghna Basin contains numerous large, semi-natural wetlands such as haors, baors, and water falls. This basin is close to Cherapungi in India, which generates the highest rainfall in the world. The Basin serves as a catchment for this rainfall and is itself subject to considerable local precipitation. As a result, only one crop is cultivated—boro rice. The crop is susceptible to flooding, so the economy is therefore vulnerable. There is some cattle and industry as well, though these industrial plants do not have effective waste disposal mechanisms, and cause damage to surface water. From the early 1960s, 40 FCD/FCDI projects have been completed by BWDB to reduce flood damage and develop irrigation facilities. But insufficient funding and poor operation and maintenance have been persistent problems, leading to degrading facilities.

Project Description

The main objective of the program is to rationalize water resources management, improve infrastructure through modernization of existing water infrastructure, and institutionalize participatory schemes.

The project has an estimated implementation period of 10 years. The project is linked to the following Delta Plan strategies: (i) Pre-monsoon Flood Protection from the Flashy Rivers in the Haor Region, (ii) Flood Protection in Haor Region during Monsoon.

Expected Benefits

Reduce vulnerability and enhanced livelihood opportunities for the beneficiaries; increase the conveyance capacity to maintain green river; improve river navigation, reduce bank erosion; improve response to emergency situations; flood proofing houses in haors; maintain environmental water flow; conservation of fish habitat for sustainable reproduction.

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

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

Delta Plan Goal(s)

***#1** Ensure safety from floods and climate change related disasters*
***#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 in-country and trans-boundary water resources management*

Financing

	Mil BDT	Mil USD
Capex	5,780	73
Opex	100	1

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

Project Area

- North East Hydrological Region/ Upper Meghna Basin/ Sunamganj, Sylhet, Habiganj, Maulvibazar and Netrokona districts

Source: Map data ©2017 Google

Finance and Delivery Modality

A CBA is required to determine which sources of funding are most likely to be needed and/or possible. Some funding may be available through climate financing, with the remainder coming from government funds, grants and NGOs.

HR 2.4 Elevated Village Platforms for the Haor Areas

Background

There are altogether 373 Haors in the north eastern region of Bangladesh. The Haor basin encompasses an area of around 8,000 sq.km with a population of about 20 million. The annual rainfall ranges from 2,200 mm along the western boundary to 5,800 mm in its northeast corner. The region has about 20 transboundary rivers, which emanate from India.

The physical setting of Haor region is a unique wetland ecosystem in Bangladesh, which creates a variety of difficulties for the dwellers of the Haor area. The inhabitants of Haor are frequently affected by the flash floods. These flash floods spill onto low lying flood plains in the region, inundating and damaging crops. High waves and flooding also causes erosion and reduces the village area. These calamities often cause loss of lives and property.

Project Description

Development of Village Protections Plans which will develop eco-villages in elevated village platforms; construct wave protection walls; provide protection through revetment work; and develop green belts.

The project has an estimated implementation period of 3 years and an operating period of 30 years. The project is linked to the following Delta Plan strategies: (i) Pre-monsoon Flood Protection from the Flashy Rivers in the Haor Region, (ii) Flood Protection in Haor Region during Monsoon.

Expected Benefits

The project will protect the villages in haors from erosion due to wave action during wet season; protect facilities including schools, markets, etc. against wave action; protect the immovable property of the villagers and ensure sustainable livelihood of haor; and create a green belt using the wetland trees of the Haor area.

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 Agency

DBHWD and LGED

Delta Plan Goal(s)

#1 *Ensure safety against water and climate change related disasters*

Financing

	Mil BDT	Mil USD
Capex	3,942	50
Opex	394	5

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

Project Area

Haor districts located in the Haor region in the North-east part of Bangladesh

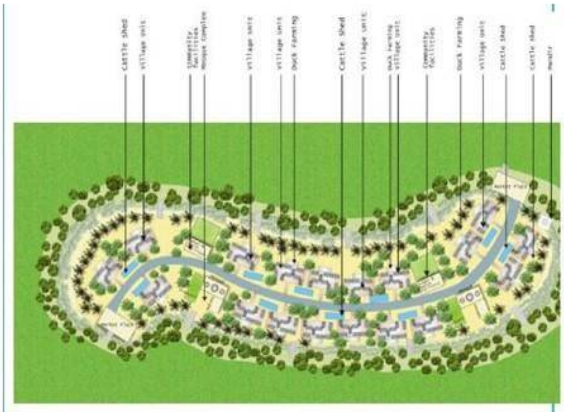


Figure 1: Proposed Eco village (in elevated platforms) at deeply flooded zone in Haor

Source: GED, HR2.4 Project Concept Note

Finance and Delivery Modality

A CBA is required to determine which sources of funding are most likely to be needed and/or possible. Some funding may be available through climate financing, with the remainder coming from government funds, grants and NGOs.

HR 14.1 Ecosystem Habitat Preservation Program for Plants, Wildlife, Fisheries, And Migratory Birds

Background

Haor wetlands inhabit a large stock of biodiversity. Illegal and over harvesting of wetland resources and natural calamities are damaging the habitats of plants and animals, especially of endangered species. The whole wetland ecosystem is under threat, and the quality of the wetland ecosystem may be altered irreversibly. Therefore, a habitat preservation proramme is required. The programme should establish new protected areas based on the size of the forest and species richness. Also regular monitoring of the habitat quality with indicators (e.g. soil, water quality or bio indicators) is needed to guide the management to evaluate the degradation or improvement of the ecosystem.

Project Description

This project aims to conduct a baseline study to assess the biodiversity of these haors. It also aims to preserve biodiversity by providing a suitable environment for plants, and animal species. This will be achieved by controlling and monitoring plants and the animal population within the protected areas.

The project has an estimated implementation period of 5 years. The project is linked to the Delta Plan strategy Conservation and Preservation of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs.

Expected Benefits

The project is expected to increase employment, create business opportunities, enhance eco-tourism. It will also protect the natural resources of the targeted areas.

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

Responsible Ministry

Ministry of Environment and Forest

Executing Agencies

Department of Forest, Department of Fisheries, Department of Environment, BWDB

Delta Plan Goal(s)

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

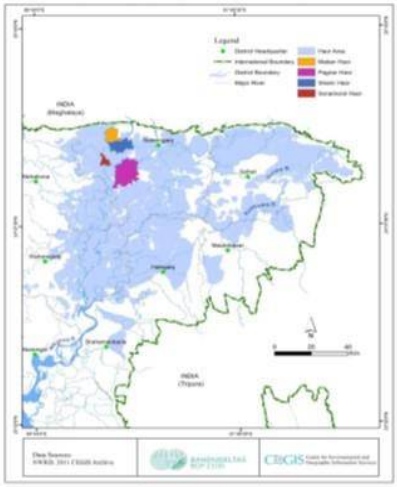
Financing

	Mil BDT	Mil USD
Capex	387	5
Opex	29	0.36

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

Project Area

- Matian Haor
- Shanir Haor
- Pagnar Haor
- Sonamorol Haor



Source: GED, HR14.1 Project Concept Note

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.

HR 15.4/5 Sustainable Haor Wetland/Rivers and Fish Habitat Management

Background

Haor is subject to the following major flood risks: (i) the degradation of the wetland habitat and because of the upstream water withdrawal, habitat alteration and fragmentation, and the over and indiscriminate fishing, (ii) the disturbance pre-monsoon spawning migration due to FCD/I projects, (iii) the over exploitation of the swamp forests, and (iv) the hampered environmental flow.

Project Description

This project will ensure perennial environmental flow for wetland and the rivers' ecosystem to maintain a sustainable fish habitat protected from human interventions. The project will also ensure that the quality of water respects national and international standards, restore and protect the fish habitat, and preserve the wetlands of global significance.

The project has an estimated implementation period of 5 years. The project is linked to the following Delta Plan strategies: (i) Pre-monsoon Flood Protection from the Flashy Rivers in the Haor Region, (ii) Conservation and Preservation of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs.

Expected Benefits

Maintaining environmental flows in the river systems would improve the water quality. Fish breeding and grazing grounds would improve water quality increasing environmental benefits, enhancing captured fish production, and improving the scenic beauty. This will in turn enhance tourism in Haor and the flash flood areas. The project will also manage wetland in a way that protect biodiversity.

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

Responsible Ministry

Ministry of Fisheries and Livestock

Executing Agencies

DoF, BwDB, BHWDB

Delta Plan Goal(s)

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

Financing

	Mil BDT	Mil USD
Capex	9,700	122
Opex	194	2

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

Project Area

- Kishoreganj, Netrokona, Sunamganj, Habiganj, Moulvibazar Sylhet

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.

HR 14.3 Management of Commercially Important Wetland Ecosystem

Background

Fisheries, timber, fuel wood, reeds and thatching material, and medicinal plants are major commercial products of wetlands. Commercial harvesting of plant and animal species creates pressure on overall ecosystem of Haor wetlands and some important species are being threatened. Promoting sustainable harvesting of the commercially important species is required to preserve the overall ecosystem.

Project Description

Conduct a baseline survey to create an inventory of the commercially important wetland and its ecosystem resources, and to identify appropriate sites for fish sanctuaries and pearl farming. Develop and implement a research, awareness and training programme for the local community to foster understanding of wetland resource management and conservation. Restore habitats destroyed by tree felling or excessive resource collection.

The project has an estimated implementation period of 5 years. The project is linked to the Delta Plan strategy Conservation and Preservation of Wetlands and Ecosystem through Institutional Capacity Building, Research and Awareness Raising Programs.

Expected Benefits

Direct Benefits: Employment generation, creation of business opportunities, eco- tourism, increased natural resources

Indirect Benefits: Recreation, bird watching, herbal medicine

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

Responsible Ministry

Ministry of Environment and Forest

Executing Agencies

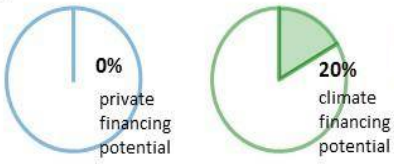
Department of Forest, Department of Fisheries, Department of Environment, Bangladesh Water Development Board

Delta Plan Goal(s)

#4 *Conserve and preserve wetlands and ecosystems and promote their wise use*

Financing

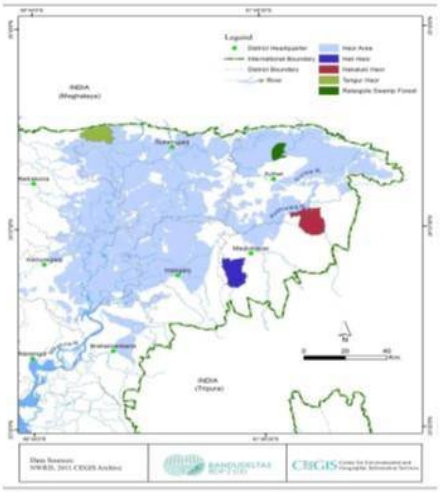
	Mil BDT	Mil USD
Capex	417	5
Opex	31	0.39



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

Project Area

- Hilsha breeding areas
- Tanguar Haor
- Hail Haor
- Hakaluki Haor
- Ratargul Swamp forest
- Ranchi Swamp forest



Source: GED, HR14.3 Project Concept Note

Finance and Delivery Modality

While this project may improve commercial returns in the long term, it is unlikely to attract private investment, since the benefits are largely non-rivalrous. However, climate finance, as well as government and NGO funding may be available due to the clear environmental benefits.

CC 18.5 Improvement of Urban Drainage in District and Upazila Level Municipalities of Bangladesh

Background

Bangladesh is experiencing a very high rate of urbanization. In 1974, people living in urban areas accounted for only 8.8% of the population. By 2001, urban population was 23.1% of total population. This trend is expected to continue. Urbanization brings many challenges, including increasingly burdened urban drainage systems. LGED has developed master plans including drainage master plans for more than 80% municipalities of the country. Parks and open spaces are also important to urban health and quality of life issues and are an adaptation option for broader environmental concerns.

Project Description

This projects aims to improve urban drainage and water harvesting systems as well as urban ecological zones. These will improve the environmental and health conditions in urban areas.

The project has an estimated implementation period of 9 years and an operating period of 40 years. The project is linked to the Delta Plan strategy of Extension of Improve Drainage and Prevent Water Logging in Chittagong and Barisal and Other Large Urban Cities with High Economic Density.

Expected Benefits

The project will improve the living conditions, social environment and hygiene in urban areas, reduce property damage and enrich environmental beauty and landscape of the municipal area.

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 & Co-operatives/Local Government Division

Executing Agencies

Local Government Engineering Department (LGED)

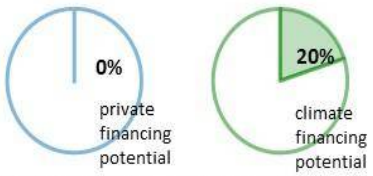
Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

#4 *Conserve and preserve wetlands and ecosystems and promote their wise use*

Financing

	Mil BDT	Mil USD
Capex	157,650	1,987
Opex	15,756	199



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

Project Area

- 19 districts municipalities and 178 Upazila level municipalities of Bangladesh

Source: Map data ©2017 Google

Finance and Delivery Modality

This project may attract climate finance, dues to its climate mitigating effects. It is unlikely to attract private financing. It will also require government, development partner, or NGO funding.

CC 12.37 Integrated Agricultural Development in Moderately Cyclone Affected Area

Background

Bangladesh has a long and dynamic coastline. The coastal zone extends over a 47,150 sq km area and has a population of 38.52 million. The coastal zone is highly vulnerable to disasters and to the impact of climate change. In 2007, the catagory-4 super Cyclone "SIDR" hit South West Bangladesh. It affected almost 9 million people in 30 southern districts. The total damage and loss caused by the cyclone was Taka(BDT) 115.6 Billion (US$ 1.7 billion). The cyclone affected food supply, income and employment, agricultural inputs, and prices of food and agricultural inputs. The rice crop was the hardest hit among the many affected crops. As such, an integrated, multi-pronged approach for the economic recovery of the affected areas and for the reconstruction irrigation structure is required.

Project Description

This project involves technical and rehabilitation support for the supply of irrigation equipment, and improved agricultural technologies and practices, particularly in yield enhancement and salinity resistance.

The project has an estimated implementation period of 5 years. The project is linked to the Delta Plan strategy of Extension of Sustainably Intensifying Agricultural Production Systems .

Expected Benefits

The project is expected to increase crop production by 10-20%; increase soil productivity by 10-15%; increase irrigated area; increase farmers income by 10%; improve employment opportunity due to crop cultivation, homestead gardening, cattle rearing and fish culture.

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

Responsible Ministry

Ministry of Agriculture

Executing Agencies

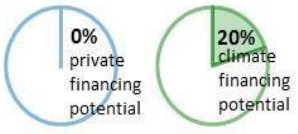
Department of Agriculture Extension (DAE); Department of Irrigation & Water Management

Delta Plan Goal(s)

#1 *Ensure water security and efficiency of water usage*
#2 *Ensure safety against water and climate change related disasters*
#6 *Achieve optimal use of land and water*

Financing

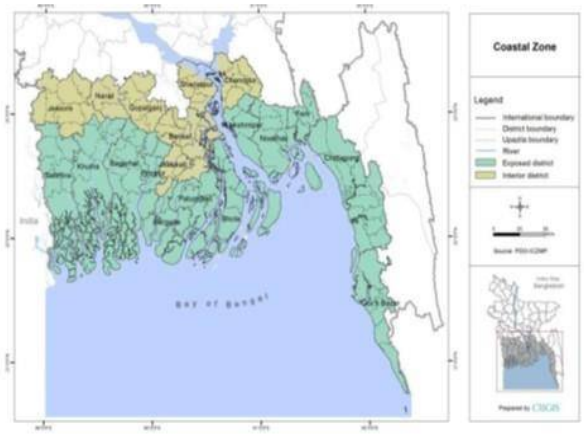
	Mil BDT	Mil USD
Capex	16,398	207
Opex	328	4



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

Project Area

- 57 upazilas under 8 coastal districts (Khulna, Satkhira, Barisal, Bhola, Jhalokhathi, Gopalgonj, Madaripur & Sariatpur)



Source: GED, CC12.37 Project Concept Note

Finance and Delivery Modality

This project may attract climate finance and will also require government, development partner, and/or NGO funding. It is unlikely to attract private financing.

CC 1.4 Development/Improvement of Multi-purpose Disaster Shelters and Its Management Information System

Background

Bangladesh is a flat and low lying deltaic country, faced with frequent floods and cyclones. Settlements, roads and other infrastructures are often damaged and the people's day to day life is disrupted. People living in the rural areas have to move temporarily to shelters during severe floods and cyclones. These shelters act as a safeguard against disasters. Through the funding of development partners, several projects were taken to construct multi-purpose disaster shelters by LGED such as the Multipurpose Cyclone Shelter (MCS), Multipurpose Disaster Shelter Project (MDSP) and Emergency Cyclone Recovery and Restoration Project (ECRRP). More shelters need to be developed to provide protection. Additionally, to monitor the progress and current condition of the facilities, a management information system (MIS) is required.

Project Description

This project will facilitate the development/improvement of Multipurpose Disaster Shelters and the development of a Multipurpose Shelter Management Information System.

The project has an estimated implementation period of 12 years and an operating period of 30 years. The project is linked to the Delta Plan strategy of Improved Protection against Normal Flooding.

Expected Benefits

The shelters will act as a safe haven against disasters, protecting lives and property. The shelters may also serve dual purposes—for example, they could function as schools, when not in primary use. The MIS aspect of the project will ensure the sustainable management of the shelters.

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

Responsible Ministry

MoLGRD

Executing Agency

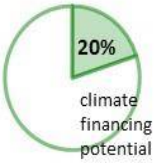
LGED

Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

Financing

	Mil BDT	Mil USD
Capex	307,624	3,876
Opex	30,762	388



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

Project Area

- Flood prone areas near the major rivers and flood plains and the cyclone prone areas in the Coastal Zone

Source: Map data ©2017 Google

Finance and Delivery Modality

This project is not suitable for private finance and will need to be financed by the Government, perhaps with NGO and/or development partner assistance. Climate financing may also be available.

CC 1.3 Dynamic Climate Smart Knowledge Portal and Hydro-geological Database for MoWR and BWDB

Background

As one of the core implementing agency under the Ministry of Water Resources (MOWR), BWDB has been responsible for planning and implementing projects for the development of water sector since 1972. BWDB also maintains stations for monitoring of surface and ground water level.

Climate change affects Bangladesh's water resource availability, functioning, quality, and trans-boundary flow. Water related projects need to be adaptive to climate change, and a sound knowledge of water resources, based on hydrological and geological characteristics is required.

Project Description

This project consists of two separate components: i) Development of Hydro-geological Database, ii) Development of Climate Smart Knowledge Portal.

The project has an estimated implementation period of 12 years. The project is linked to the Delta Plan strategy of Improved Protection against Normal Flooding.

Expected Benefits

The knowledge portal will enable the Ministry to coordinate and plan development and research activities conducted by the different agencies. The portal will be the hub of knowledge that can support project planning and implementation.

In the long run, proper planning and timely implementation of these projects can bring socio economic benefits by providing flood-free land for agriculture, enhanced degree of safety to human lives, livestock, settlement, industry and infrastructure from hazards like floods and surges. Also, integrated management of water resources can ensure higher crop yields, intensive crop production, culture fisheries, and protection.

Responsible Ministry

Ministry of Water Resources

Executing Agency

Bangladesh Water Development Board

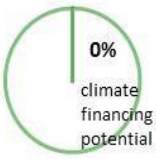
Delta Plan Goal(s)

#1 *Ensure safety from floods and climate change related disasters*

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

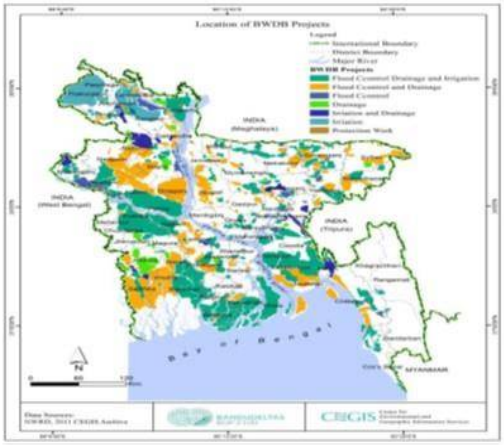
Financing

	Mil BDT	Mil USD
Capex	191	2
Opex	0	0



Project Area

- All water resource projects across Bangladesh



Source: GED, CC1.3 Project Concept Note

Finance and Delivery Modality

This project is not suitable for private finance or climate finance and will need to be financed by Government, perhaps with NGO and/or development partner assistance.

CC 1.41 Program for Implementation of Rationalized Water Related Interventions in Dhaleswari Basin

Background

To reduce groundwater over-abstraction, reduce flood damages, and avoid effluent and water pollution discharges in the region's rivers, the BWDB implemented 23 FCD/FCDI projects since the early 60s. However, the operation and maintenance of these projects is a problem due to insufficient budget. The O&M divisions are also not getting the approved O&M budget in-time. For this reasons the structures are steadily becoming more vulnerable. To rationalize existing water resources, new development projects with sustainable and efficient water resources management practices are needed. These projects will reduce flood and drought damages, and improve irrigation facilities, food production as well as enhance economic growth.

Project Description

This project aims to manage the water resources in an integrated, holistic way. The project will (i) rationalize water resources by modernizing existing water infrastructures with institutionalized participatory schemes cycle management process and ADM principles, (ii) reduce vulnerability and enhance livelihood opportunities for the beneficiaries, (iii) increase the conveyance capacity to maintain green rivers, (iv) improve navigation facilities, (v) reduce bank erosions, (vi) improve the drainage system, (vii) maintain environmental water flow (viii) conserve fish habitat for sustainable reproduction.

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

Expected Benefits

The project will reduce flood risk, increase agricultural, fisheries, and livestock production, and increase fresh water supply and sanitation facilities

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 in-country and transboundary water resources management
#6 *Achieve optimal and integrated use of land and water resources*

Financing

	Mil BDT	Mil USD
Capex	1,838	23
Opex	35	0.44

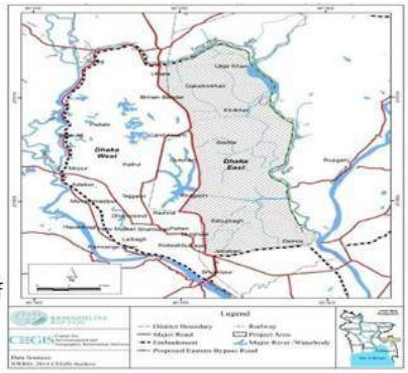
**Costs are estimated—to be refined through feasibility study.*

Executing Agencies

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

Project Area

- Dhaleswari (NC hydrological region) Basin (Dhaka, Gazipur, Narayanganj, Norsingdi, Munshiganj, Tangail, Manikganj; and some portion of Mymensingh, Jamalpur.



Source: GED, CC1.41 Project Concept Note

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.

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.

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

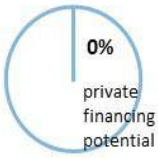
Delta Plan Goal(s)

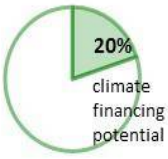
#1 *Ensure safety from floods and climate change related disasters*

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

Financing

	Mil BDT	Mil USD
Capex	23,485	296
Opex	660	8

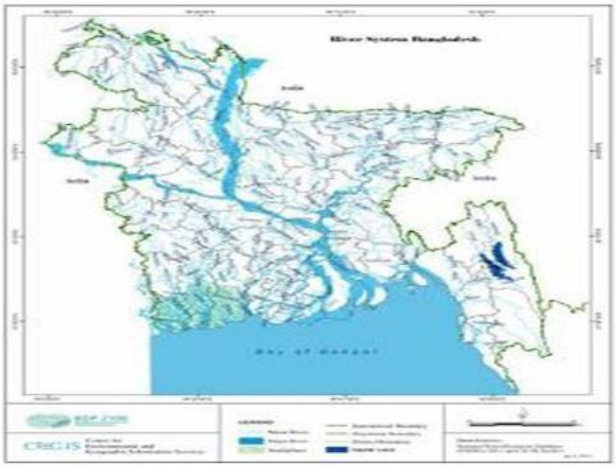




**Costs are estimated—to be refined through feasibility study.*

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.

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

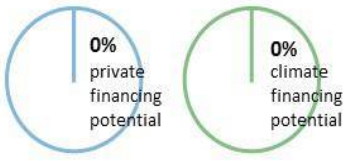
Department of Public Health Engineering, Selected Pourashavas

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.

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.

CC 9.17 Project for Improvement of Water Supply and Sanitation Facilities in Char Area

Background

Char areas in Bangladesh experience frequent flooding during the monsoon which often damages existing water and sanitation infrastructure. Further, aquifers in these areas are prone to salinity intrusion. Char areas are inhabited by poor and marginalized populations who do not have access to adequate water and sanitation facilities.

Project Description

The project seeks to install safe water and sanitation sources in the project areas.

The project has an estimated implementation period of 4 years. The project is linked to the Delta Plan strategy of Char Development and Protection against Natural Calamities.

Expected Benefits

The project will reduce environmental degradation and improve access to water and sanitation. This will improve health, hygiene and living standards of the populations living in Char areas.

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

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	9,720	122
Opex	9,72	12

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

Project Area

- 160 Chars in 50 Upazillas covering 10 districts – Bogra, Gaibandha, Jamalpur, Kurigram, Lalmonirhat, Nawabganj, Nilhamari, Pabna, Rajshahi and Sirajganj

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.

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.

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.

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.

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

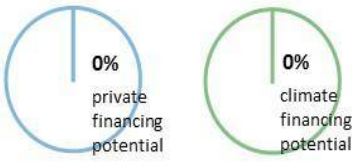
Department of Public Health Engineering, Selected Pourashavas

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.

CC 16.19 Climate Resilient Livestock Production

Background

Bangladesh's livestock consists of approximately 26 million large ruminants, 18 million small ruminants, and 137 million poultry with about 70% to 82% of them being raised by landless and small farmers. The Ministry of Fisheries and Livestock and its stakeholders support the production of milk, meat, and eggs using different Farm Animal Genetic Resources in the country. The Bangladesh Livestock Research Institute (BLRI) is the only National Institute that performs research on livestock production. The scientific manpower strength is limited and not fully equipped to research certain environment and development areas. Therefore, developing and training human resources is a priority to cater to future needs of scientific development and to cope with the future challenges of climate change. A new research center to deal with environmental issues pertaining to livestock production including SLCPs will be established. There is a strong need to identify and integrate indigenous technical knowledge for the benefit of farmers, considering their socio-economic conditions.

Project Description

The project addresses climate resilient livestock production, market oriented management of livestock manure, and producing clean air. The project activities will be integrated with the relevant development programmes of the Department of Livestock Services (DLS) and Bangladesh Livestock Research Institute (BLRI). Its objectives are to contribute to climate smart animal resilient livestock production, to reduce emissions, to strengthen institutions, build capacity, and develop partnerships. The project will also coordinate draft national integrated livestock manure management (ILMM) policy implementation.

The project has an estimated implementation period of 6 years and years and an operating period of 30 years. The project is linked to the Delta Plan strategy Controlled Flooding and Living with Annual Flood.

Expected Benefits

The project will protect livestock. In addition, it will support milk, meat, and egg production. It will also support rural socio-economic development.

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

Responsible Ministry

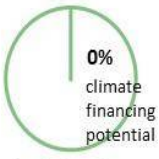
Ministry of Fisheries and Livestock

Executing Agencies

Bangladesh Livestock Research Institute and Department of Livestock Services

Financing

	Mil BDT	Mil USD
Capex	1,190	15
Opex	24	0.30



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

Project Area

- Throughout the country

Source: Map data ©2017 Google

Delta Plan Goal(s)

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

#5 *Develop Effective Institutions and Equitable Governance for in-country and trans-boundary water resources management.*

Finance and Delivery Modality

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

Appendix B: Investment Planning with Adaptive Delta Management

In Bangladesh, more than 156 million people depend on the Bangladesh Delta for their lives and livelihoods. Therefore, it is crucial to plan thoroughly and implement interventions in the water system that will facilitate social, ecologic, and economic development. This process leads to sound decision-making on interventions taking into consideration the objectives and uncertainties related to exogenous future developments.

As one of the largest most densely populated deltas in the world, the Bangladesh Delta has already experienced numerous interventions of water management including upstream water withdrawal, reduction of floodplain and pollution. All these interventions, coupled with natural changes, have restricted the capacity to provide needed services to the Bangladesh Delta.

Adaptive Delta Management (ADM) is the core approach of the BDP2100 and the Investment Plan (IP). ADM principles are specifically applicable in situations with impactful, long-term spatial planning under uncertain future conditions, which is the case with BDP2100 and its IP.

In the development process of Bangladesh, it will be important to look for opportunities to combine different investment agendas. The ADM concept advances the combination of these agendas as it searches for flexibility in the strategies to achieve the country's objectives. It considers potential developments in agriculture and aquaculture, fisheries, forestry, transportation, water and sanitation, energy, industry and ecosystems. These sectors depend on an effective and efficient water management (sufficient quantity and quality), but also affect the water system.

For this IP of the Bangladesh Delta Plan, the process of screening, ranking and sequencing of projects has been done following the principles of ADM. In this Appendix, first the concept of ADM and its value for integrated planning will be explained. Next, based on the ADM concept, adaptive pathways (ADP) have been developed for identifying relevant (archetypical) interventions for each of the six regional hot spots and three cross-cutting themes. In total eighteen pathways are constructed. These pathways form the basis for the programmatic approach for each of the regional hot spots in the IP.

Based on the concepts of ADM and ADP, projects as proposed in the BDP-process have been screened, ranked and sequenced. The methodology and results of this procedure are presented in the following sections.

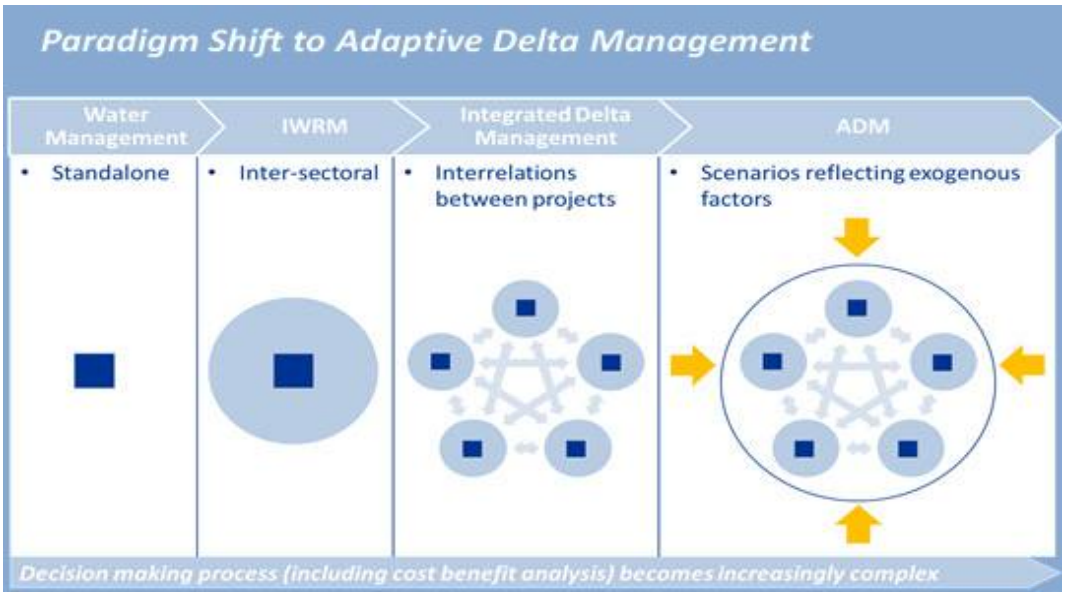
B.1 Introduction to Adaptive Delta Management

ADM embodies a structured, iterative process of decision-making in the face of uncertainty with an aim to reduce uncertainty over time via systematic monitoring. ADM minimizes the likelihood of over- or under-investment in water-related challenges, by holistically considering the effects of interrelationships between needs and demands in space and time, and the uncertainties of exogenous factors, such as climate change, demography, and economic and technological development.

ADM has roots in the theory of complex dynamic systems. A dynamic system has an equilibrium state to which it returns after a "hit" or shock. When a so-called 'tipping point' has been reached, the system goes to a new equilibrium state. Recognizing when a dynamic system is going to a new equilibrium state is the essence of preparing for an unpredictable future. ADM means understanding the dynamic equilibrium of the ecological, social, hydro-dynamical, and other relevant dynamic subsystems; understanding tipping points and how these can be triggered; and making decisions based on adaptation pathways. ADM is a continuous decision-making process that requires input and involvement of all stakeholders to reduce the risk of over and under investment. It works best if it is organized in an inclusive manner.

ADM is part of a paradigm shift in planning and managing projects. The first step in this evolution were stand-alone projects, which later changed into integrated water resources management approaches. The next step is referred to as integrated delta management, which has now been followed up by ADM. These subsequent development steps are schematically shown in Figure B.1 and explained to illustrate the complexity of the chosen planning approach.

Figure B.1: Paradigm Shift to Adaptive Delta Management



A first step forward in planning processes is moving from a stand-alone projects execution approach towards a fully Integrated Water Resources Management (IWRM) approach. IWRM is a process which promotes the coordinated development and management of water, land and related resources to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

The IWRM approach has globally promoted the transition from standalone, sector-by-sector, top-down projects towards combined and inclusive initiatives that better reflect the fundamentally interconnected nature of hydrological resources. For example, high irrigation demands may mean less fresh water for drinking or industrial use.

In the Bangladesh Delta, these interdependencies are particularly strong. For example, the construction of a dam to retain water or to produce electricity, will influence the river discharge distribution downstream, which will have consequences for sediment transportation, erosion, and salt intrusion. Integrated Delta Management, as a next step to IWRM, considers the effects of interventions on a larger spatial scale and looks at the interrelations between different (IWRM or standalone) projects.

ADM goes one step further than Integrated Delta Management by considering uncertainties in drivers that influence water availability and demand. These drivers include demography, economic development, and climate change. Water-related projects cannot influence these exogenous drivers, but these exogenous drivers can strongly influence water supply and demand. Examples being: population growth increases water demand; climate change alters precipitation patterns and river discharges; and economic development influence water quality.

Implementing the ADM Approach: Key concepts

The predictability of demographic and economic development and local impact of global climate change, is generally low for the long-term (decades). This implies that predictions on the main drivers of change in the Bangladesh Delta, can only be given with a certain range of outputs. A programme with structural and non-structural measures (projects) aims to support the development of a region. While developing such a programme, ample consideration must be given to these ranges of possible future developments (adaptation strategies).

Tipping points are moments in time, or sudden events, when adaptation strategies are no longer adequate to contribute to reach the long-term development goals. A tipping point is generally an undesirable situation, such as a specific level of salt intrusion beyond which agricultural production is no longer feasible. Additional strategies with different sets of measures will then be required to further safeguard the long-term development of that particular area. Adaptive Delta Management essentially, is a tool to intervene before tipping points occur.

Large investments that account for future scenarios can lead to over- or under-investment. If developments occur faster than expected, investments may prove insufficient. If developments slow down, large investments may prove having been unnecessary, for instance when smaller investments could have been sufficient instead.

Investment planning also needs to consider technological developments. Future generations will have new technologies and more insights in dominating processes, which can be used to cope with their own delta challenges. For example, more efficient ways to use water decreases the future water demand and, consequently lowers the necessity for future new investments in technical interventions aiming to increase the water supply.

B.2 Constructing and Using Adaptation Pathways

The number of possible combinations of projects, hotspots, themes, local conditions and circumstances, scenario's, and possible local preferences, makes it impossible/unworkable to generate pathways for each combination. Instead a methodology has been applied that provides sufficient detail to discuss why and when under certain conditions, per theme and per hotspot a certain type of measure would make sense.

The level of detail is deliberately not such that decisions can be made to implement one specific project from the BDP2100 list of projects in a specific year in the future. In fact, such detailed planning based on adaptation pathways would be in contradiction with the principle philosophy of ADM that the future is fundamentally unpredictable.

B.2.1 Working with archetypical measures

First, a list of potentially possible measures has been developed, both structural and non-structural. These measures are not taken from the list of identified BDP2100 projects, but reflect archetypical measures, such as "creating reservoirs" (infrastructural measure), or "increasing local flood safety awareness" (non-infrastructural measure). Some of these archetypical measures can be considered for each of the six hotspots and per hotspot for each of the three cross-cutting themes. This gives a total of 18 lists of archetypical measures which are presented on each factsheet of the adaptation pathways. Most of the archetypical measures are linked with concrete examples of projects. In some cases, there were no projects available in the list of identified BDP2100 projects, which provides for an opportunity to develop additional projects filling in the gaps when updating the pathways and the IP.

Adaptation pathways have been developed for each of the six BDP regional hotspots: The Coastal Zone, Barind and Drought Prone Area, Haor Region, Chattogram Hill Tracts and Coast, Rivers and Estuaries, and Urban Areas. Three crosscutting themes are assessed per hotspot:

- Preventing too much water, relating to flood risk and waterlogging;
- Supplying sufficient quantity of water, relating to drought, food security, and navigability;
- Supplying sufficient quality of water, relating to health and environmental standards.

For each 'hotspot-theme' combination, an adaptive pathway has been constructed, using the set of project archetypes further explained in the following paragraph.

Lumped sets of archetypical measures

The lists of archetypical measures are long, which is due to the spatial scale and local specificities per hotspot as well as the complexity of the three themes (which are spatially different). To be able to develop useful adaptation pathways, project archetypes per hotspot-theme combination have been structured and clustered in three groups:

- Cluster 0+: Improvement of current system: Projects or measures that are not drastically different than the ones already implemented. Usually this involves projects that aim at improving current water management systems, or measures to improve flood resiliency. Implementation of these archetypes of measures is probably not too difficult because implementation capacity is often already in place. Investment requirements are generally low or manageable. The water system as such is not changed, even though current approaches can be improved or slightly altered. These archetypical measures are relatively adaptive to changing circumstances, and relatively easy scalable. Examples are: protection and reinforcement of embankments, sustainable operation and maintenance approaches, and living with water awareness programs;

- Cluster 1: Change in current approach: Projects or measures that follow a distinct different course in dealing with the respective themes compared to the current approaches. These archetypical measures change the current approach but do not include major system changes, indicating that these measures are relatively flexible compared to Cluster 2 but less flexible relative to Cluster 0+. Implementation of these measures need a change in approach and often need more funds for implementation and monitoring. Examples are: building with nature techniques, tidal river management, flood proofing, and land reclamation using cross-dams;

- Cluster 2: Change in the water system's behavior: Projects or measures that fundamentally change the water system or how the themes are being governed. In some cases, and under certain conditions it may be important to consider a drastic change in approach. Often this requires major investments and multi stakeholder implementation capacity. Moreover, they have likely major consequences for the socioeconomic and environmental system. Examples are: abandonment of highly vulnerable areas (retreat), and build storm surge barriers (move forward).

Improvements of the current approach (Cluster 0+) generally entails a low risk of overinvestment, but possibly a higher risk of underinvestment because of this strategy's relatively lower intended impact. Significant improvements of the current water system (Cluster 1) implies larger changes to the current system with relatively higher investment costs and a higher impact. Project archetypes within this strategy are still relatively more adaptive to changes in environmental and socio-economic developments compared to Cluster 2 measures. Major changes in the water system behavior (Cluster 2) could only be adopted with a low risk of overinvestment when the current system and accompanied adaptation strategies are not robust enough to cope with unwanted situations.

The adaptation pathways presented in the 18 factsheets below suggest which cluster of measures can reasonably be followed for a future time interval. Tipping points indicate when it is likely that a change is needed from Cluster 0+ to Cluster 1 or from Cluster 1 to Cluster 2 (generally in that order). This 'prioritization' of types of measures in time, assumes that the current situation is not 'entirely unworkable'. Because if that would be the case, which is generally not, then a Cluster 2 type of measure would be needed instantly and it would not make sense from an investment point of view to first consider Cluster 0+ or Cluster 1 type of measures. For specific situations, for example on a spatial scale of one polder, it may be possible that such 'game changer' (Cluster 2) is needed, but finding these exceptions is not the intention the adaptation pathways. The intention is to provide information geared at avoiding over-or under investments "at large", and to guide discussions between all involved stakeholders.

Four scenarios

When drawing long-term adaptation pathways (up till 2100), it is necessary to make assumptions about climatologic and socio-economic changes. The Bangladesh Delta Plan 2100 Formulation Project (BDP2100) has developed four different scenarios, each one characterized by specific

changes in land use, climate, and upstream development. These changes result in different challenges related to water supply, flood management and environmental protection. To properly carry out strategy assessment, the scenarios were not designed as projections. Instead, they depict the 'extreme edges' of possible outcomes to identify those strategies that are well equipped and effective in all scenarios. The following scenarios are used:

- A: Extreme climate change and high economic growth: This scenario coincides with a dynamic delta; extreme weather events, high GDP growth, fast urbanization, rapid population growth, and increased vulnerability to climate change effects. High GDP growth increases the possibilities of the Bangladesh Delta to implement large (adaptive) interventions and investments to decrease vulnerability to extreme climate events.
- B: Extreme climate change and low economic growth: In this scenario, most important is basic needs first. A very low GDP growth and extreme climate change results in little possibilities to decrease vulnerability and increase adaptive capacity of the Bangladesh Delta.
- C: Moderate climate change and high economic growth: This scenario reflects a market driven delta in which the economy is leading and implementation of adaptive measures to climate change can gradually be implemented.
- D: Moderate climate change and low economic growth: Low economic growth and a relatively low vulnerability towards climate change reflects a delta under pressure, because there is little opportunity to implement large investments to secure a safe and climate resilient delta.

Adaptation pathways within the IP

The available project archetypes for each hotspot-theme combination have been assessed on potential impact and flexibility to adapt to different adaptation outcomes. From this assessment, conclusions have been drawn regarding the risk of over- and underinvestment of project archetypes. The pathways can be used to illustrate which archetype of projects make sense from an ADM point of view. For example: building a mega dike may not be attractive from an ADM point of view if (for example) a certain sea level rise has not yet occurred or if the asset value of what needs to be protected is not high enough.

The constructed pathways are not the result of any 'mathematics'; they are principally a starting point for discussion. Undoubtedly, there will be situations on a local scale and for specific issues, where projects may be prioritized differently compared to the suggested prioritization in the pathways. For instance, if no related Cluster 0+ project precedes a proposed Cluster 1 or Cluster 2 project, these projects may be started in an earlier phase then what is shown in the 'default' pathways. As the future unfolds, it becomes clearer in which direction the economy and climate in Bangladesh are developing, and the adaptive pathways can be adjusted accordingly. Additionally, the range of possibilities of adaptation pathways is not limited to what is presented in the 18 factsheets.

B.2.2 Adaptation pathways per hot spot and cross cutting theme

Adaptation pathways have been developed for each of the six BDP regional hotspots: The Coastal Zone, Barind and Drought Prone Area, Haor Region, Chattogram Hill Tracts and Coast, Rivers and Estuaries, and Urban Areas. Three crosscutting themes are assessed per hotspot:

- Preventing too much water, relating to flood risk and waterlogging;
- Supplying sufficient quantity of water, relating to drought, food security, and navigability;
- Supplying sufficient quality of water, relating to health and environmental standards.

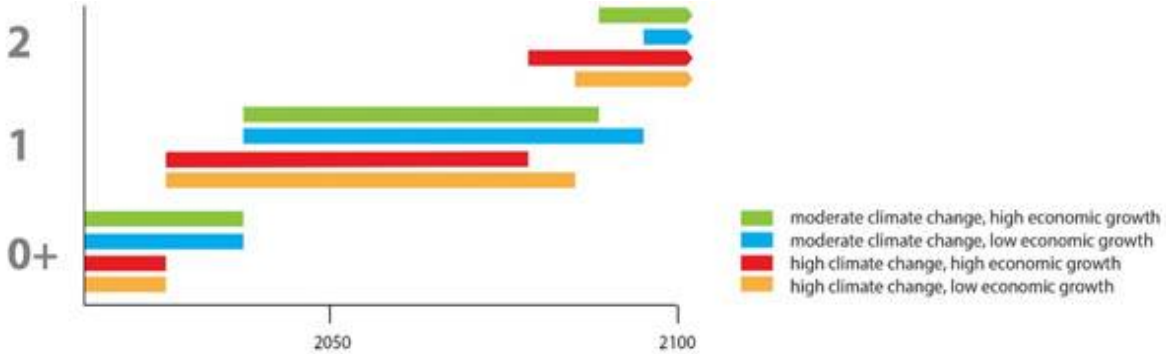
For each 'hotspot-theme' combination, an adaptive pathway has been constructed, using the set of project archetypes.

Table B.1: Coastal Zone Archetypical Projects for Too Much Water

Hotspot: Coastal zone		Theme: too much water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Strengthening of embankments (erosion and wave protection)	CZ1.8/1.21, CZ1.26, CZ1.9, CZ1.30, CZ1.40, CZ1.41, CZ1.44, CZ1.45, CZ1.47, CZ1.48
	• Polder management and drainage regulation (e.g. pumping, retention zones)	CZ1.8/1.21, CZ1.11/1.38, CZ1.26, CZ1.9, CZ1.41, CZ1.44, CZ1.45
	• Excavation of khals and dredging of peripheral rivers to increase conveyance or storage capacity	CZ1.12, CZ1.30, CZ1.40, CZ1.44, CZ1.45, CZ1.47, CZ1.48
	• Char development (poldering of new chars and exposed area)	CZ1.3
	• Sustainable operation and maintenance	CZ1.40, CZ1.44, CZ1.47
	• Disaster preparedness (e.g. improving early warning systems and cyclone shelters, community-based disaster preparedness plans)	CZ1.40, CZ1.41, CZ1.44, CZ1.47, CZ1.48
	• Flood recovery	CZ1.41
	• Knowledge/institutional (innovative water solutions, participatory water management)	CZ1.39, CZ4.1, CZ12.6, CZ14.7, CZ17.1, CZ1.40, CZ1.44, CZ1.45, CZ1.47
1	• River management; River training, Room for rivers	CZ1.41
	• Flood and cyclone proofing (e.g. flood hazard zoning, infrastructure (roads) modification)	CZ1.41, CZ1.45, CZ1.47, CZ1.48
	• Flood control structures (e.g. multi-purpose embankments) and controlled flooding by gated embankments	CZ1.30, CZ1.40, CZ1.44, CZ1.45, CZ1.47, CZ1.48
	• Building with nature techniques, including tidal river management (TRM) (e.g. integral polder heightening using natural sediment) restoration of natural wetland areas (e.g. mangrove reforestation)	CZ14.7, CZ1.41, CZ1.45, CZ1.48
	• Land reclamation (e.g. by using cross dams) on request	CZ 1.6, CZ 1.7, CZ 1.12
	• Spatial planning (e.g. priority investments on higher grounds and support interventions that decrease population vulnerability)	

2	• Coastal embankments and storm surge barriers (coast line length reduction)	-
	• Spatial planning: Abandonment of vulnerable zones	-

Adaptation pathway



Narrative

Flood risk management in the coastal zone generally requires relatively large investments. The influence of climate change through rising sea levels is apparent, requiring additional investments to maintain a certain safety level for the coastal zone. The current system of uniform safety levels for all coastal polders will require considerable investment under changing climate conditions, and brings risks of over- and underinvestment.

The risk of overinvestment in archetypical measures of Cluster 0+ is low. Polder management, drainage regulation, and strengthening of embankments will have enough impact up to a certain point when changes in the current approach are needed (high risk of underinvestment).

In a low economic growth scenario, the need to change the current approach of uniform flood management into the differentiation between safety levels through flood risk management and the accompanying imposing of flood zones in the coastal zone will become more pressing. Different adaptation strategies can then be developed for low value (rural) and high value (economic) areas and infrastructure, reducing the risk of under- and overinvestment. Changing the current approach (Cluster 1), includes archetypical measures such as creating room for the river, reclaiming land, or prioritizing investments on higher grounds that increase the resiliency of the area. These archetypical measures are usually efficient for the mid-term.

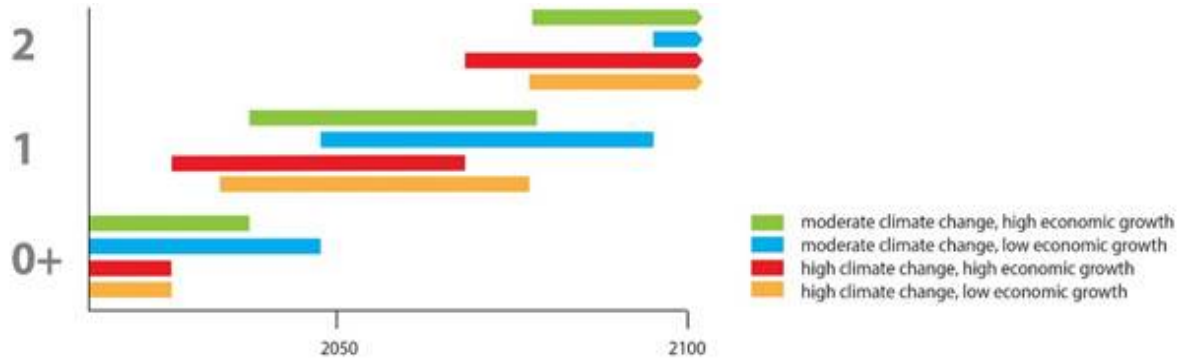
Under pressure of high climate change, a new tipping point can come in the mid-term in the case of low economic growth. In this situation, the risk of overinvestment is relatively high, as additional investment in low-value coastal areas yield limited effect. A system change can then be more opportune, in the form of the abandonment of highly vulnerable zones.

In a high economic growth scenario, adaptation options for flood risk management can long sustain an adequate safety level. In a high climate change scenario, a system intervention in the form of coast line shortening can be required to protect the developed coastal zone. Earlier investments in local adaptation projects can then partially become redundant (over investment). These major system interventions have consequences for the entire system and require high investment.

Table B.2: Coastal Zone Archetypical Projects for Sufficient Quantity of Water

Hotspot: Coastal zone		Theme: Supplying sufficient quantity
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Development of ground water sources (tube wells)	CZ 1.8/1.21, CZ1.48
	• Hotpot dredging (navigability of waterways)	CZ 1.40, CZ1.41, CZ1.44, CZ1.45, CZ1.47, CZ1.48
	• Rainwater harvesting (for potable water)	CZ 1.3
	• Crop diversification and aquaculture	CZ 1.8/1.21, CZ 17.1
	• Sustainable operation and maintenance	CZ 1.26, CZ1.44, CZ1.45, CZ1.47
	• Improved FCDI	CZ 1.30, CZ 1.40, CZ 1.41, CZ1.44, CZ1.45, CZ1.47
	• Water reservoirs (restoration of beels)	CZ 1.8/1.21
	• Knowledge/institutional (innovative water solutions)	CZ 1.39, CZ 4.1, CZ 12.6, CZ 14.7, CZ 17.1, CZ 1.40, CZ1.41, CZ1.44, CZ1.45
	• Drought and salinity monitoring	-
	• Arsenic groundwater pollution	-
	• Improved operation and maintenance of current water supply facilities	-
1	• Development of surface water sources for potable drinking water	-
	• River rejuvenation	-
	• Water demand management and regulation	-
	• Desalination	-
2	• River barrage (e.g. Ganges barrage)	CZ 1.1
	• River diversion/interlinking	-
	• Spatial planning: abandonment of contested areas	-

Adaptation pathway



Narrative

Salinity increase, caused by sea level rise (and increased floods), and arsenic pollution put pressure on the availability of fresh water in the coastal zone. Water is currently abstracted from local groundwater.

Fresh water is required for agriculture and drinking water. To lower the pressure on the availability of fresh water, project archetypes within Cluster 0+ should be implemented on the short-term, independent of the economic growth or climate change scenario. The risk for overinvestment in the project archetypes under Cluster 0+ is low. However, the impact of these projects alone will generally not suffice to cope with changing climate change conditions in the future. This translates into a high risk of underinvestment.

On the short-term, an increase in the use of tube wells is required to meet the fresh water requirements for agricultural and drinking water purposes (Cluster 0+). A shift to saline resistant crops (crop diversification) or aquaculture will be needed on the short-term as well to maintain agricultural productivity. With high economic growth and high climate change scenarios this shift in agriculture will be required sooner.

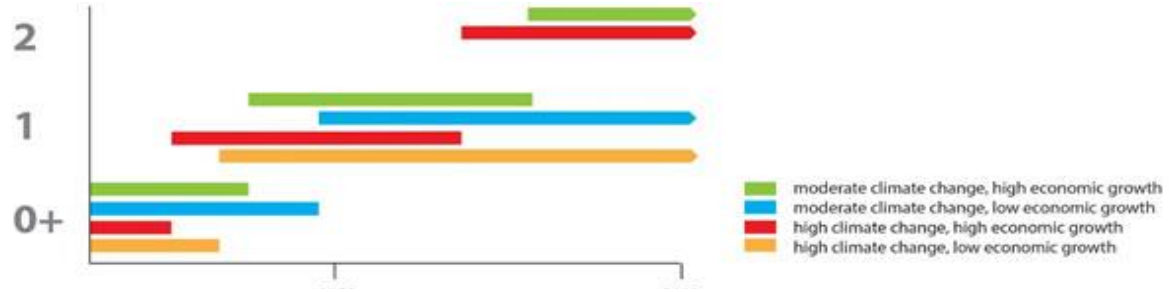
In the medium-term, a shift to surface water use is required instead of groundwater use because of increased salinity and arsenic pollution in groundwater. This shift will be required sooner in high climate change (because of increased floods and sea level rise) or economic growth scenarios (because of increased fresh water demand).

In the long-term, surface water use and land use adjustment (Cluster 1), and ultimately major interventions (for example construction of a river barrage, Cluster 2) can be required for the supply of fresh water where groundwater and surface water is heavily salinized and polluted with arsenic. Again, in a high climate change scenario this requirement will manifest itself sooner. In a scenario of low economic growth, the abandonment of highly vulnerable areas is more likely compared to the construction of a barrage. This poses a risk of redundancy and thus overinvestment in project types in Cluster 1.

Table B.3: Coastal Zone Archetypical Projects for Quality of Water

Hotspot: Coastal zone		Theme: sufficient quality of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Land use control (economic zones); reallocation of polluting industries to dedicated economic zones	-
	• Enforce restrictions on illegal wastewater disposal	CZ1.48
	• Knowledge/institutional	CZ1.45
	• On-site sanitation solutions (improved sanitation coverage)	CZ1.45, CZ1.48
1	• Construction of (industrial) effluent treatment plants	CZ1.45
	• Centralized sanitation solutions (e.g. sewerage systems)	CZ1.48
2	• Large scale reallocation of industries or ports	-

Adaptation pathway



Narrative

In addition to salinity increase in coastal wetlands and chars, water quality issues add to environmental degradation of, for example the Sundarbans. Land use control (for example reallocating to economic zones, Cluster 0+) can be used to protect vulnerable ecosystems from polluting industries. Additionally, restriction on illegal wastewater disposal will decrease environmental pollution. In high economic growth scenarios, more industries (for example ports) will expand and be constructed. This results in earlier needs for the construction of industrial effluent treatment plants (Cluster 1). The risk of overinvestment for archetypes under Cluster 0+ is low.

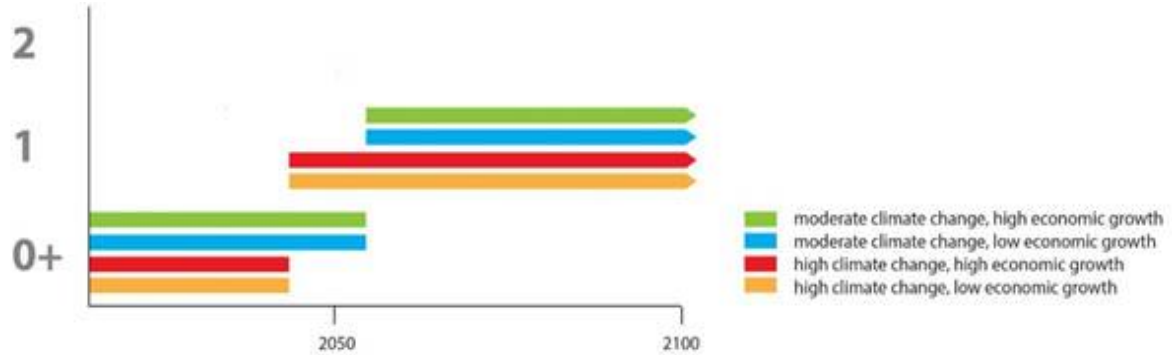
In high economic growth scenarios, the risk of underinvestment of these archetypes is relatively large. In this case, implementation of projects under archetype Cluster 1+ is required earlier. This includes sanitation solutions to prevent the increase in health risks. Additionally, effluent treatment plants could be required.

On the long-term, in high economic growth scenarios it could be necessary to reallocate ports and other industries to less vulnerable areas to guarantee environmental protection. This poses a risk of redundancy and thus overinvestment in project types in Cluster 1.
In the case of well-developed treatment plants, efficient regulation and high economic growth, further development and expansion of treatment plants could be sufficient. In this case, the risk of overinvestment in project types in Cluster 1 is low.

Table B.4: Barind and Drought prone Areas Archetypical Projects for Too Much Water

Hotspot: Barind and Drought Prone Area		Theme: too much water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Modernization of FCDI projects, including the minimization of crop losses.	DP 1.21
	• Dredging and re-excavation of rivers, khals and/or beels to increase conveyance or storage capacity	DP 1.2, DP 1.21
	• Sustainable operation and maintenance (SOM)	-
	• apacity building	-
1	• Strengthening of institutions and governance framework	-
	• Integral Flood risk management approach (protection of lives and assets through a combination measures combining flood hazard and vulnerability mitigation) and its implementation.	-
	• Protection of cities and towns	
	• Flood proofing of settlements and infrastructure	-DP 1.21
	• Disaster preparedness	DP 1.21
2	-	-

Adaptation pathway



Narrative

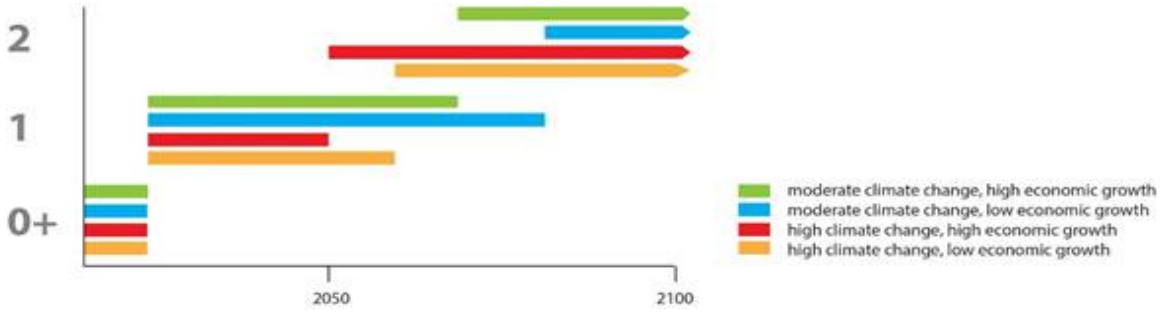
Waterlogging and drainage congestion are frequent in the Barind and Barind and Drought prone Areas and have long lasting effects on large areas, specifically in the Atrai-basin and the southern Ganges floodplain. As part of this issue is caused by man-made interventions in the natural system, the modernization of FCD projects and infrastructure combined with dredging and re-excavation of rivers, beels and khals (Cluster 0+) is expected to sufficiently address the waterlogging issues up to the medium-term. The risk of overinvestment in Cluster 0+ projects is considered as low, as the projects can sort significant effect and the effects of climate change will ask for additional adaptation measures.

Eventually, when climate conditions or economic conditions require, a more advanced approach to flooding in the form of flood risk management could be implemented (tipping point to Cluster 1 projects). System interventions (Cluster 2) are not expected to play a role in this hotspot for managing too much water. The project archetypes in Cluster 0+ and Cluster 1 are expected to suffice to cope with local conditions as set in the scenarios, also in the long-term.

Table B.5: Barind and Drought prone Areas Archetypical Projects for Sufficient Quantity of Water

Hotspot: Barind and Drought Prone Area		Theme: sufficient quantity of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Modernization of FCDI projects	DP 1.1, DP 1.4+1.5, DP 25.3
	• Sustainable operation and maintenance (SOM)	-
	• Capacity building	-
	• Improved operation and maintenance of current water supply facilities	-
1	• Strengthening of institutions and governance framework	-
	• Demand management (which can include water tariffs)	-
	• Rainwater harvesting for human consumption	-
	• Integrated water resource management	DP 1.1, DP 1.4+1.5, DP 25.3
	• Irrigation improvement (including new irrigation schemes, conversion from surface to localized irrigation, control structures)	DP 1.2, DP 1.3
	• Water buffering in beels or reservoirs	DP 1.1
	• Water saving techniques including crop diversification (less water demanding crops)	-
	• Demand management and regulation	-
	• Control structures for water conservation and sustainment of environmental river flow	-
	• Groundwater and surface water protection zones	-
	• Waste water reuse for non-potable use purpose (industry, agriculture)	-
2	• River diversion/interlinking/barrages and reservoirs	-
	• Abandonment of critical zones	-

Adaptation pathway



Narrative

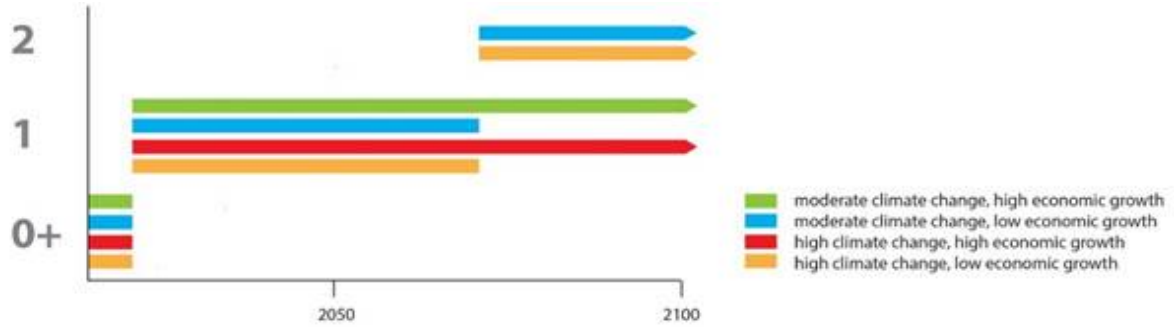
The modernization of FCDI projects (Cluster 0+) is required but will not be sufficient to address the presently experienced drought problems in the Barind hotspot. An integrated water resource management approach, which is currently being initiated, is required to secure fresh water availability for all sectors. The tipping point from Cluster 0+ to Cluster 1 project archetypes is foreseen in the near future as the current system is far from being able to deliver.

The tipping point from Cluster 1 archetypes to system interventions (Cluster 2) such as the Brahmaputra and/or Ganges Barrage is estimated to come into the picture around the mid-term at earliest in a high climate change-high economic growth scenario. In an alternative high climate change-low economic growth scenario the abandonment of critical zones could become a relevant consideration. In moderate climate change scenarios, these tipping point are deferred to the medium- to long-term.

Table B.6: Barind and Drought prone Areas Archetypical Projects for Quality of Water

Hotspot: Barind and Drought Prone Area		Theme: sufficient quality of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Modernization of FCDI projects, including the reconnection of wetlands to floodplains	DP 1.1, DP 1.4+1.5, DP 25.3
	• Wetland protection	DP 1.2, DP 1.21
	• Improved sanitation coverage in settlements (on-site solutions)	-
	• Sustainable operation and maintenance (SOM)	-
	• Capacity building	-
1	• Strengthening of institutions and governance framework (including cost-recovery, private sector participation)	-
	• Water quality monitoring	-
	• Fecal sludge management	-
	• Effluent treatment plants (ETP's) for industries	-
	• Sewerage and waste water treatment plants for cities and towns	-
2	• Discontinuation and reallocation of polluting land uses	-

Adaptation pathway



Narrative

To improve water quality in this hotspot, it is required to improve sanitation coverage, address industrial pollution and protect wetlands in the short-term.

The wetlands in the Barind and Barind and Drought prone Areas hotspot serve various ecosystem services on which many economic activities are dependent. Wetland degradation caused by decreased floodplain connectivity is the result of past development of roads and other line-infrastructure. Investment in the modernization of FCDI projects and demand management in pre-monsoon season could sort significant impact on improving wetlands conditions. The current practice of wetland protection (Cluster 0+) can be strengthened and advanced into a strategy for ecosystem preservation, integrated into water resources management. The risk of overinvestment in project archetypes in Cluster 0+ and Cluster 1 is considered as low, regarding the certain impact these projects can achieve and its flexibility to changes in climate and economic growth.

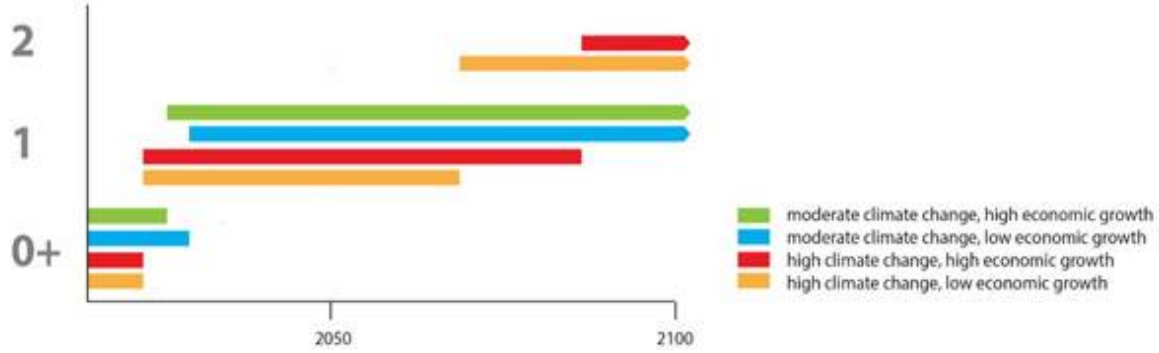
The improvement of sanitation coverage and services in settlements, towns and cities requires considerable investment. The tipping point for modern sanitation solutions has long passed and should be initiated or extended in the short-term. In low economic growth scenarios, an alternative to the Cluster 1 archetypes could be the discontinuation of low-value yet highly polluting land uses (for example industries).

Table B.7: Haor and Wetlands Archetypical Projects for Too Much Water

Hotspot: Haor and Flash Flood Areas		Theme: too much water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• **Modernization of FCDI projects, including the strengthening/ stabilization of embankments, submersible embankments, and replacement/repair of water control structures**	**HR 1.1**
	• **Dredging and re-excavation of rivers, khals and/or beels to increase the conveyance or storage capacity**	**HR 1.1**
	• Erosion control near population centers, including wave breakers	HR 2.2/3.1
	• Improved disaster preparedness (early warning systems)	HR 1.1
	• Sustainable operation and maintenance (SOM)	-
	• Capacity building	-

1	• Strengthening of institutions and governance framework	-
	• Monitoring of river morphology and hydrology	-
	• Integral flood risk management approach (protection of lives and assets through a combination measures combining flood hazard and vulnerability mitigation) and its implementation.	HR 1.1
	• Retention basins for flash flood attenuation	-
	• River management (river training and room for the river)	-
	• Flood proofing through flood hazard zoning, adaptation of roads, raising of village platforms, construction of livestock shelters, crop storage platforms	HR 2.4, HR 1.1
	• Sediment management to counter effects of subsidence	-
2	• Flash flood control through compartmentalization, river flow diversion and barrages	-
	• Abandonment of highly vulnerable areas	-

Adaptation pathway



Narrative

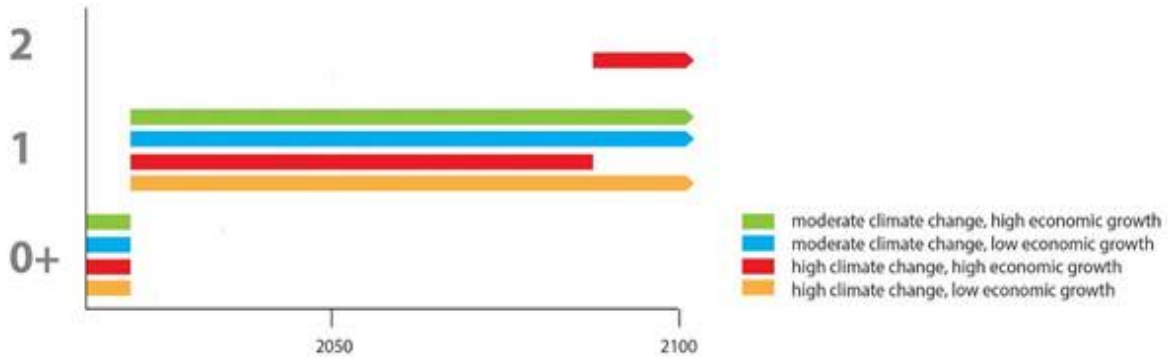
The archetypical projects under Cluster 0+ can serve as a base for future measures but will generally not suffice in managing flood risk in the Haor. An integral flood risk management approach including the flood proofing of infrastructure and other measures aimed to lower flash flood vulnerability and flood hazard will be highly effective regardless of which specific climate change scenario unfolds. Therefore, the tipping point from Cluster 0+ to Cluster 1 measures is expected in the short-term, and thus the risk for underinvestment when pursuing Cluster 0+ measures is considered as high.

The Haor is one of Bangladesh's most productive regions for agriculture, aquaculture and fishery. In a high economic growth scenario, the region could capitalize on its potential and develop high-value food production. In a high climate change scenario, this would require considerable investment in flood control structures and other flood attenuation measures (all listed under Cluster 1 and Cluster 2). In a low economic growth-high climate change scenario, it could be required to abandon highly vulnerable yet low-value zones.

Table B.8: Haor and Wetlands Archetypical Projects for Sufficient Quantity of Water

Hotspot: Haor and Flash Flood Areas		Theme: sufficient quantity of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• FCDI projects, including the strengthening/stabilization of embankments, submersible embankments, and replacement/ repair of water control structures	HR 1.1
	• Hotspot dredging and re-excavation of rivers, khals and/or beels to increase conveyance or storage capacity	HR 1.1
	• Sustainable operation and maintenance (SOM)	-
	• Rainwater harvesting for human consumption	-
	• Local arsenic solutions (filters and sand filters)	-
	• Groundwater irrigation and water supply	HR 1.1
	• Floodproof wells	-
	• Capacity building	-
	• Improved operation and maintenance of current water supply facilities	-
1	• Strengthening of institutions and governance framework for integrated water resource management	HR 1.1
	• Piped water supply and water treatment plants in cities and towns	HR 1.1
	• Centralized arsenic treatment	-
	• Integrated water resource management, entailing the following project archetypes:	HR 1.1
	• Control structures for water conservation and sustainment of environmental river flow (e.g. rubber dams)	HR 1.1
	• Water buffering in beels or reservoirs	HR 1.1
	• Surface water irrigation	HR 1.1
2	• River diversion/interlinking/barrages and reservoirs	-

Adaptation pathway (water quantity management for food production)



Narrative

In this narrative, water quantity management for three sectors are discussed; food production, water supply for human consumption, and navigability of rivers. Water supply and navigability can require project archetypes that are listed in Cluster 0+ and Cluster 1. In a high economic growth scenario, it can be expected that the tipping point to project archetypes in Cluster 1 (piped water supply, dredging for navigability) is reached sooner under the influence of increased urbanization and upscaling of production and transportation facilities.

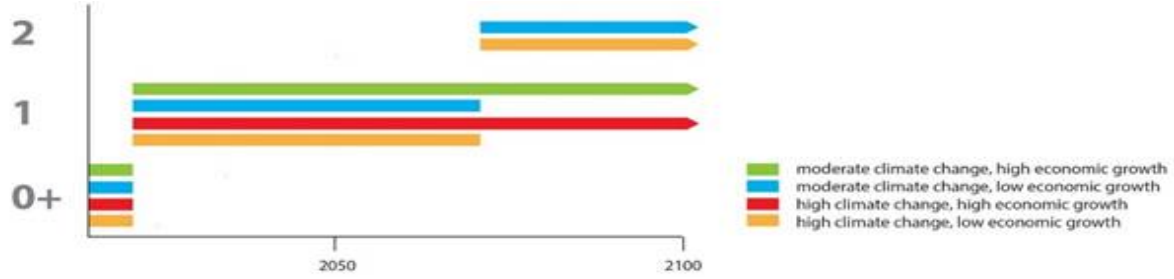
Food production activities in the Haor are relatively varied and include agriculture, aquaculture and fisheries. Regardless of the economic growth scenario and climate change scenario the change from individual-local efforts (Cluster 0+) to an integrated water resource management approach (Cluster 1) is likely to bear fruit in the short-term. In both climate change scenarios, significant investment will be required, aligned with a strategy for integral flood risk management.

In a high climate change-high economic growth scenario, system interventions (Cluster 2) can be required in the long-term, to secure the fresh water provision to valuable food production areas in the Haor.

Table B.9: Haor and Wetlands Archetypical Projects for Quality of Water

Hotspot: Haor and Flash Flood Areas		Theme: sufficient quality of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Wetland protection	**HR 14.1**
	• Improved sanitation coverage in settlements (on-site solutions)	**HR 1.1**
	• Capacity building	-
	• Sustainable operation and maintenance (SOM)	-
1	• Strengthening of institutions and governance framework (including cost-recovery, private sector participation)	**HR 1.1**
	• Water quality monitoring	**HR 1.1**
	• Fecal sludge management	**HR 1.1**
	• Effluent treatment plants (ETP's) for industries	**HR 14.1, HR 14.3**
2	• Sewerage and waste water treatment plants for cities and towns	**HR 1.1**
	• Ecosystem preservation and enhancement	**HR 1.1**
	• Reallocation of polluting land uses	-

Adaptation pathway



Narrative

To improve water quality in the Haor region, it is required to improve (flood-proof) sanitation coverage and address industrial pollution in the short-term. An alternative for industrial ETP's in a low economic growth scenario can be relocation to regions other than the environmentally critical Haor (Cluster 2)

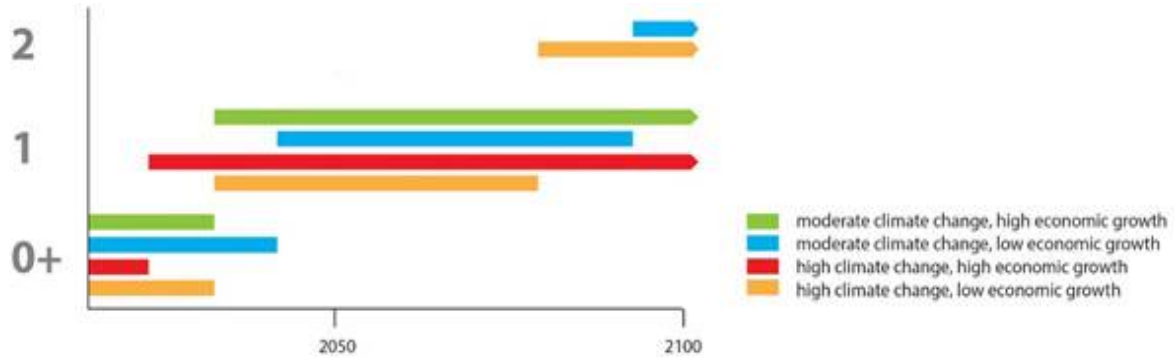
The wetlands in the Haor region serve various ecosystem services on which many economic activities are dependent. The current practice of wetland protection (Cluster 0+) can be strengthened and advanced into a strategy for ecosystem preservation and enhancement, integrated with water resources management. The risk of overinvestment in project archetypes in Cluster 0+ and Cluster 1 is considered as low, regarding the certain impact these projects can achieve and its flexibility to changes in climate and economic growth.

The improvement of sanitation coverage and services in settlements, towns and cities requires considerable investment. The tipping point for modern sanitation solutions has long passed and should be initiated or extended in the short-term.

Table B.10: CHT Archetypical Projects for Too Much Water

Hotspot: Chattogram Hill Tracts		Theme: too much water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Land use control (economic zones)	-
	• Disaster preparedness (e.g. improving early warning systems, cyclone shelters, and community-based disaster preparedness plans)	CH1.11, CH1.10
	• Strengthening of embankments	CH1.11, CH1.10
	• Drainage regulation	CH9.2, CH1.11, CH1.10
	• Excavation of khals and rivers	CH1.10
	• Sustainable operation and maintenance	-
	• Knowledge/institutional	CH26.1, CH26.2, CH1.10
	• FCDI	CH9.2, CH1.11, CH1.10
	• Improved operation and maintenance of current water supply facilities	-
1	• River management; river training, Room for rivers	-
	• Flood control structures (e.g. multi-purpose embankments) and controlled flooding by gated embankments	CH1.11
	• Flood and cyclone proofing	CH1.11
	• Spatial planning (e.g. priority investments on higher grounds)	-
	• Building with nature techniques, including tidal river management (TRM)	-
	• Conserve and preserve wetlands and ecosystems	CH1.1, CH1.11
2	• Spatial planning: abandonment of vulnerable zones	-
	• Coastal embankments and storm surge barriers (coast line length reduction)	-

Adaptation pathway



Narrative

The archetypical projects under Cluster 0+ can will generally not be sufficient to manage flood risk in the Chattogram Hill Tracts and Coastal Plain. Flash floods, water logging and storm surges increase the vulnerability of the region. An integral flood risk management approach including Room for the Rivers, flood and cyclone proofing, and other measures aimed to lower flash flood vulnerability (for example prevent landslides) and flood hazard will be highly effective regardless of which specific climate change scenario unfolds. Therefore, the tipping point from Cluster 0+ to Cluster 1 measures is expected in the short-term, and thus the risk for underinvestment when pursuing Cluster 0+ measures is considered as high.

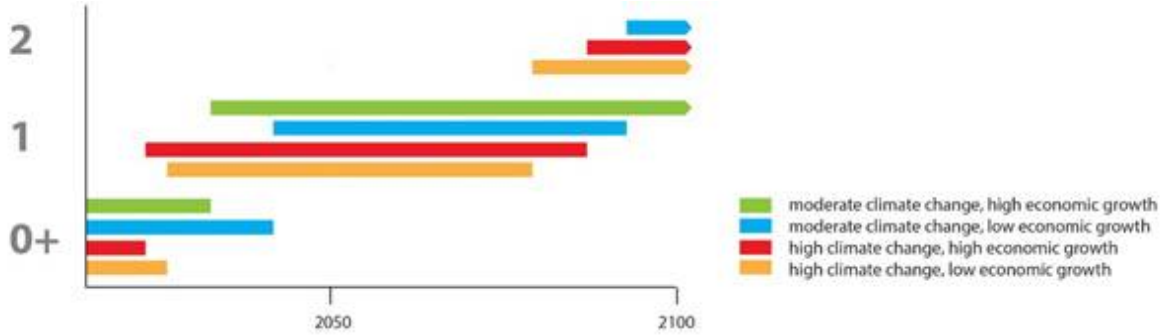
In a high economic growth scenario, the Chattogram coastal plain could develop high value industrialized and agricultural areas. In a high climate change scenario, this would require considerable investment in flood and cyclone proofing and coastal embankments (all listed under Cluster 1 and Cluster 2). In a low economic growth-high climate change scenario, it could be required to abandon highly vulnerable yet low-value zones.

Table B.11: CHT Archetypical Projects for Sufficient Quantity of Water

Hotspot: Chattogram Hill Tracts		Theme: sufficient quantity of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Knowledge/institutional	CH9.2, CH26.1, CH26.2, CH1.10, CH12.4, CH26.4, CH26.5
	• Rainwater harvesting	-
	• Spring restoration and protection	-
	• Improved FCDI	CH9.2, CH1.11, CH12.4
	• Hotspot dredging and re-excavation of rivers, khals and/ or beels to increase conveyance or storage capacity	CH1.10
	• Arsenic groundwater pollution	-
	• Ground water use	CH9.2

Hotspot: Chattogram Hill Tracts		Theme: sufficient quantity of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
1	• Large-scale strategic dredging	-
	• Water demand management and regulation	-
	• Surface water use (piped water system)	CH9.2
	• Conserve and preserve wetlands and ecosystems	CH1.1, CH1.11
	• Reservoirs	CH26.1, CH26.5
	• Crop diversification	CH12.4
2	• River diversion, barrages and reservoirs	-

Adaptation pathway



Narrative

Fresh water supply and navigability can require project archetypes that are listed in Cluster 0+ and Cluster 1. In a high economic growth scenario, it can be expected that the tipping point to project archetypes in Cluster 1 (piped water supply, dredging for navigability) is reached sooner under the influence of increased erosion, urbanization and upscaling of production and transportation facilities. In a high climate change scenario, the tipping point to Cluster 1 projects is reached sooner because of decreased navigability and increased salinity in the coastal plains.

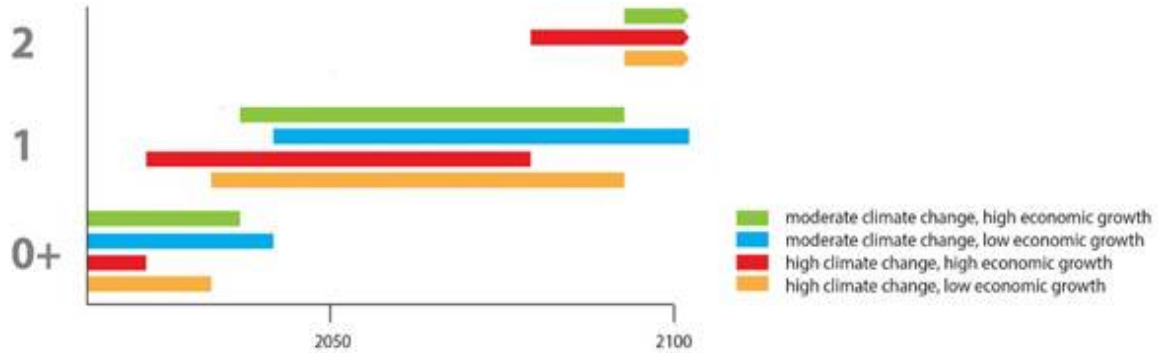
In a high climate change and high economic growth scenario, system interventions (Cluster 2) such as fresh water reservoir barrages can be required in the long-term, to secure fresh water in the Chattogram Hill Tracts and Coastal Plains.

Table B.12: CHT Archetypical Projects for Quality of Water

Hotspot: Chattogram Hill Tracts		Theme: Sufficient quality of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Land use control (economic zones)	-
	• On-site sanitation solutions	CH9.2
	• Restricted cultivation on steep slopes (erosion management)	CH1.11
	• Knowledge/institutional	CH9.2, CH1.1, CH26.2, CH26.3, CH26.4

Hotspot: Chattogram Hill Tracts		Theme: Sufficient quality of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
1	• Centralized sanitation solution (e.g. sewerage systems)	CH9.2
	• Construction of (industrial) effluent treatment plants	-
	• Solid waste management systems	CH9.2
	• Soil conservation	CH1.1, CH1.11
2	• Shut-down and large-scale reallocation of industries	-

Adaptation pathway



Narrative

Improving water quality in the Chattogram Hill Tracts and Coastal Plain requires immediate restriction on cultivation on steep slopes (to prevent erosion). Land use control (for example redirecting industries to economic zones equipped with ETP's) has high impacts on water quality the short-term. The improvement of sanitation coverage and services in settlements, towns and cities requires considerable investment. The tipping point to Cluster 1 should be initiated or extended in the short-term.

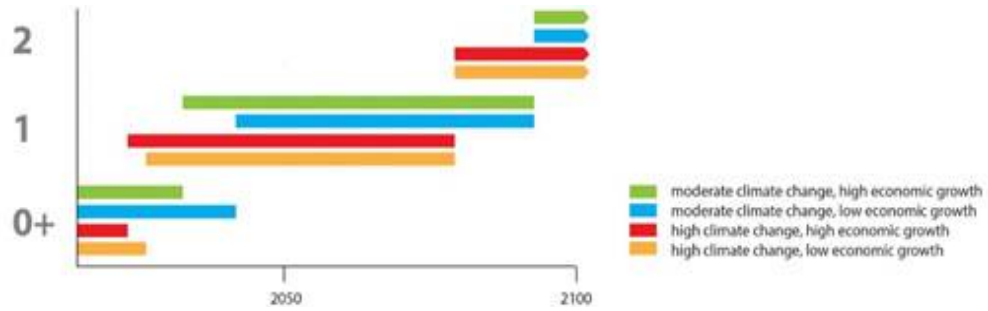
In a high climate change scenario and/or high economic growth scenario, the tipping points to Cluster 1 archetypical projects is earlier, indicating a higher risk of underinvestment in these scenarios on the short-term for Cluster 0+.

On the long-term, in high economic growth scenarios it could be necessary to reallocate ports and other industries to less vulnerable areas to guarantee environmental protection. This poses a risk of redundancy and thus overinvestment in project types in Cluster 1.

Table B.13: River System and Estuaries Archetypical Projects for Too Much Water

Hotspot: River System and Estuaries		Theme: Too Much Water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Strengthening and stabilization of embankments	MR1.1
	• Replacement and repair of water control structures	MR1.1, MR3.1, MR1.6,
	• Dredging and re-excavation of tributaries, distributaries and branches to increase conveyance or storage capacity	MR1.1, MR1.2
	• Sustainable operation and maintenance (SOM)	MR1.1
	• Stabilization of (newly formed) Char lands	-
	• Knowledge development and capacity building	-
	• Transboundary efforts to reduce peak discharges and uncontrolled construction of upstream embankments	-
1	• Extension of embankments and raising of safety standards	MR3.1,
	• River stabilization and channelization through river training works	-
	• Flood risk management: differentiation of safety levels	MR1.1
	• Flood proofing of properties and infrastructure including flood zoning and flood shelters and other forms of spatial adaptation to flood risk	MR1.1
	• Localized removal of encroachments in floodplains and allowing 'room for the river' (in areas without tidal influence) to secure river discharge capacity	-
	• Building with nature concepts	-
	• Land reclamation along river banks on request	-
2	• Abandonment of highly vulnerable areas	-

Adaptation pathway



Narrative

The influence of flood risk of the region around rivers is apparent. Vulnerability is especially high because of relatively high population density living on river banks. Increased river discharge on the short-term, caused by upstream (monsoon) precipitation increase and increased melt water from the Himalayas, requires immediate implementation of archetypical projects under Cluster 0+. Modernization of FCDI projects is needed on the short-term, regardless of which climate change scenario unfolds.

Advanced river management interventions (for example enlarging local river discharge capacity and river training) and large-scale extension of embankments are highly effective. The tipping point from Cluster 0+ to Cluster 1 is expected in the short-term, indicating a high risk of underinvestment when implementing Cluster 0+ measures.

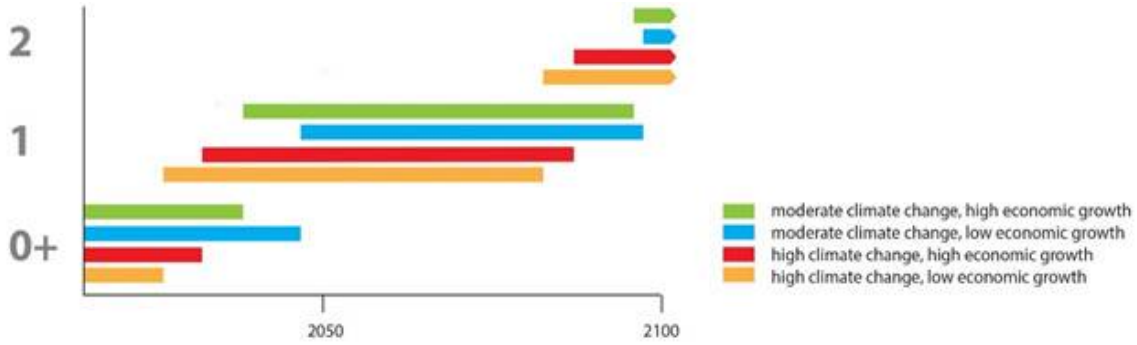
In a high economic growth scenario, the highly-industrialized river areas and agricultural land on river banks have higher values and thus more resources at risk. This requires large-scale investments in flood protection (for example large-scale embankments). In a low economic growth scenario, a system with flood zones and diversified levels of flood risk is better suited to protect specific high value areas. In a scenario of high climate change and low economic growth, it can be required to abandon low value areas in the long-term.

Table B.14: River System and Estuaries Archetypical Projects for Sufficient Quantity of Water

Hotspot: River System and Estuaries		**Theme: Sufficient water quantity**
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Groundwater use for drinking water (tube wells)	MR1.1, MR1.6, MR15.1
	• Drainage regulation	MR1.1
	• Embankments strengthening (prevent erosion)	MR1.1, MR1.5, MR1.2, MR15.1
	• Institutional capacity and knowledge	MR3.1, MR1.6
	• Hotspot dredging (navigability of waterways)	MR15.1
	• Crop diversification	-
	• Stabilization of newly formed char lands	-
1	• Large-scale strategic dredging	MR3.1
	• Water demand management	-
	• Reservoirs	MR1.6
	• Development of piped water systems (surface water use)	-
	• Building with nature concepts	-
	• River training	-
	• Rainwater harvesting	-
	• Redistribution of water	-

Hotspot: River System and Estuaries		Theme: Sufficient water quantity
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
	• Sustainable restoration of connectivity of major navigation routes	MR3.1
	• River stabilization and channelization	-
2	• River barrage (e.g. Ganges barrage)	-
	• Spatial planning: abandonment of highly vulnerable areas	-

Adaptation pathway



Narrative

Water quantity in the River System and estuaries hotspot is relevant for navigability, agriculture, and industries. Irrespectively of the climate change and economic growth scenarios, Cluster 0+ archetypical projects have a low risk of overinvestment. However, the risk of underinvestment increases with time because of expected climate change and economic growth. This indicates that, regardless of the scenarios, a shift to Cluster 1 archetypical projects is required.

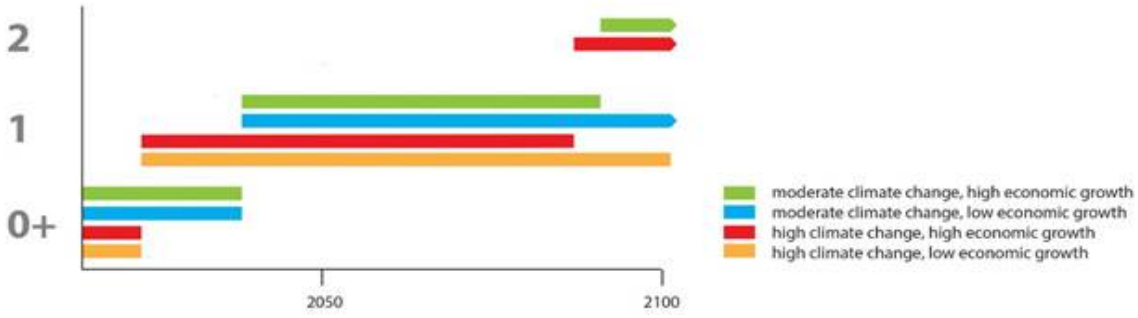
In a high economic growth scenario, it can be expected that the tipping point to Cluster 1 archetypical projects (piped water supply, dredging for navigability) is reached sooner under the influence of increased transportation facilities, and urbanization. This could be sufficient when a moderate climate change scenario unfolds.

In the situation of high economic growth and extreme climate change, it is necessary to develop river barrages to secure fresh water availability for agricultural, human consumption, and industrial purposes in the long-term.

Table B.15: River System and Estuaries Archetypical Projects for Quality of Water

Hotspot: River System and Estuaries		Theme: Water quality
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Natural water cleaning	-
	• Enforce restrictions on illegal wastewater disposal	-
	• Enforce fertilizers regulation	-
	• Relocation of polluting industries to dedicated economic zones	-
	• On-site sanitation solutions (improved sanitation coverage)	-
	• Knowledge development	MR1.5, MR1.2
1	• Construction of industrial effluent treatment plants (ETP's)	-
	• Centralized sanitation solutions (sewerage systems)	-
	• Innovative on-site waste water treatment	-
	• Measures to reduce arsenic pollution	-
	• Preservation of ecosystems	-
2	• Large scale reallocation of industrial zones	

Adaptation pathway



Narrative

To improve water quality in the River System and estuaries region, it is required to enforce restrictions on illegal wastewater disposal by industries, and enforce regulation on fertilizers on the short-term (Cluster 0+). The current practice of environmental protection (Cluster 0+) can be strengthened and advanced into a strategy for ecosystem preservation and enhancement, integrated with water resources management.

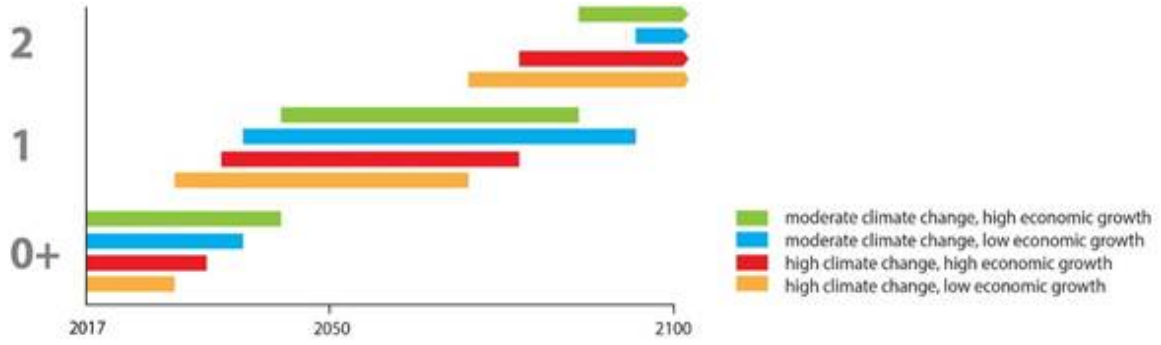
In the short-term, regardless of the scenario, industrial ETP's and on-site waste water treatment is needed to improve water quality of the rivers. In a low economic growth scenario, it could be more beneficial to reallocate industries to dedicated industrial zones. The risk of overinvestment in project archetypes in Cluster 0+ and Cluster 1 is considered as low, regarding the certain impact these projects can achieve and its flexibility to changes in climate and economic growth.

The improvement of sanitation coverage requires considerable investment. In high economic growth scenarios, the risk of overinvestment of centralized sanitation solutions is lower, indicating an earlier tipping point to Cluster 1 measures.

Table B.16: Urban Areas Archetypical Projects for Too Much Water

Hotspot: Urban Area		Theme: Too Much Water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Restoration of existing drainage system's retention and discharge capacity	UA 10.1, UA 1.3
	• Sustainable operation and maintenance (SOM)	-
	• Traditional extension of drainage system's retention and discharge capacity	UA 10.1, UA 1.3
	• Embankment protection and reinforcement	UA 1.1, UA 1.3
	• Local flood proofing of vital and critical infrastructure and highly valuable areas	-
	• Protection and preservation of wetlands, khals, and retention area's	UA 1.1
	• Capacity building	-
1	• Strengthening of institutions and governance framework	UA 27.2
	• Integral urban development and storm water retention solutions, green-blue spaces.	UA 27.3, UA 27.5
	• Spatial adaptation to flood risk	-
	• Large scale extension of city embankments and raising of safety standards	UA 1.2
	• River management; enlarged local river discharge capacity, river training	UA 1.1
2	• River surge barriers (diversion of river peak flows)	-
	• Abandonment of highly vulnerable areas (spatial planning)	-

Adaptation pathway



Narrative

This narrative firstly handles the project types that are aimed to handle waterlogging. Secondly, riverine flood risk management projects are discussed.

Bangladesh's urban areas currently experience heavy waterlogging incidences on regular basis. Therefore, investments in the physical improvement and extension of current drainage systems and sustainable operation and maintenance will have a certain impact in reducing local waterlogging hazards. Thus, the risk for overinvestment in the project archetypes under Cluster 0+ is low. However, the impact of these projects alone will generally not suffice to cope with changing climate change conditions in the future. This translates into a high risk of underinvestment.

In the context of a scenario of moderate climate change and low economic growth, the approach of improving the current systems (Cluster 0+) can be sustained up to the mid-term as these can offer the relatively limited required impact most effectively (low cost). For other scenario's, the tipping point requiring a change in the current approach (Cluster 1) is already reached in the short-term. This is the result of high climate change, which will require local adaptation to increasing waterlogging risk, including integral strategies for urban (re)development and storm water retention solutions.

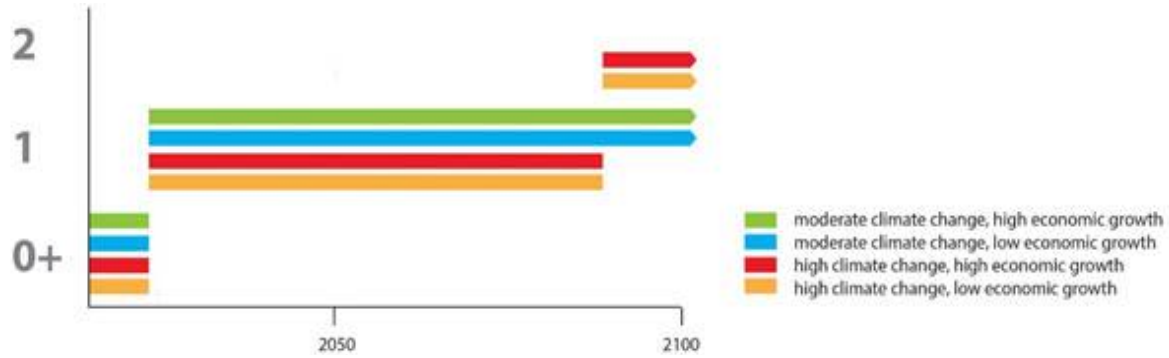
The ability for the local urban system to discharge storm water to nearby rivers is dependent on regional river management, therefore changes in the physical system can be required to facilitate this (tipping point to Cluster 2). This tipping point comes earlier in extreme climate change scenarios. In a scenario of low economic growth, the abandonment of highly vulnerable areas is more likely on the long-term.

Riverine flood risk is currently managed by raising local town embankments (Cluster 0+). Additional investment in projects that follow flood risk management can be aimed at vulnerability reduction of high-value areas and critical infrastructure without a high risk of overinvestment. Further adaptation to changing climate change conditions requires a change in approach (Cluster 1), aiming at (a combination of) prevention measures (hazard reduction), spatial adaptation (vulnerability reduction), or evacuation (disaster management). In a scenario of high climate change, the tipping point for system interventions (Cluster 2) is reached in the midterm and can require abandonment of areas (low growth scenario) or river barriers (high growth scenario).

Table B.17: Urban Areas Archetypical Projects for Sufficient Quantity of Water

Hotspot: Urban Area		Theme: sufficient quantity of water
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Improved effectivity of water service providers (limit leakage, reduce non-revenue water share)	UA 9.1, UA 23.2
	• Ground water use for drinking water (hand pumps, deep tube wells)	UA 1.1, UA 11.1
	• Hotspot dredging and excavation of rivers, khals, and/or beels (navigability of waterways)	UA 1.1
	• Sustainable operation and maintenance	-
	• Capacity building	UA 23.2
1	• Strengthening of institutions and governance framework	UA 23.2
	• Aquifer monitoring and management	UA 1.1
	• Water demand management and regulation	UA 9.1, UA 23.1, UA 23.2
	• Development of piped water systems	UA 9.1, UA 23.1
	• Surface water based systems for major cities	UA 9.1, UA 23.1
	• Water treatment plants, including centralized arsenic removal	UA 1.1
	• Ground water recharge	UA 1.1
	• Desalination	-
	• Waste water reuse for non-potable use purpose (industry, agriculture)	-
2	• River diversion/interlinking	-
	• Spatial planning: abandonment of critical zones	-

Adaptation pathway



Narrative

In urban areas, the water quantity theme translates to the adequate supply of drinking water and water for industrial uses. Water is currently abstracted from local ground water aquifers by hand pumps or (deep) tube wells (Cluster 0). As there is insufficient natural recharge in and around the major urban areas (mainly Dhaka, Chattogram, small cities in Barind region) local ground water tables are dropping. In a scenario of high economic growth, it is likely that this process will accelerate and spread to other locations as small urban centers attract more dwellers and industries, thus requiring additional fresh water supply. Therefore, a shift to surface water sources

and accompanying systems can be required (Cluster 1) in the short-term, to alleviate the pressure on ground water sources in major cities. Additionally, it can be required to regulate water demand for all sectors.

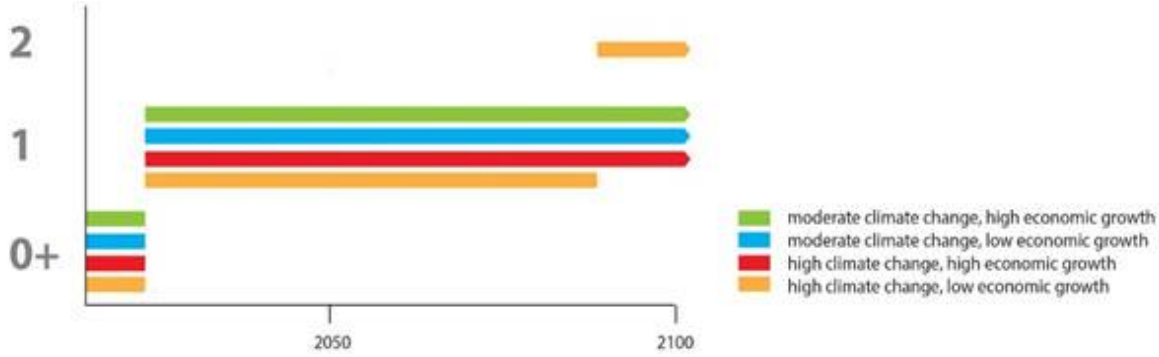
In the medium- to long-term, a high climate change scenario will negatively affect the recharge rates of ground water sources, further increasing the need for surface water sources. Ground water will remain the primary source for drinking water in Bangladesh. However, the development of surface water sources for drinking water will be required in major urban centers (Cluster 1).

In the long-term, desalination, waste water re-use (Cluster 1), and ultimately major interventions (Cluster 2) can be required for the supply of fresh water where the use of ground water and surface water is heavily contested. If so, this will mainly occur in the Barind and drought prone areas and Coastal Zone. Again, in a high climate change scenario this requirement will manifest itself sooner.

Table B.18: Urban Areas Archetypical Projects for Quality of Water

Hotspot: Urban Area		**Theme: sufficient quality of water**
Cluster	**Archetypical projects**	**Example projects (BDP batch 1-4)**
0+	• Land use control (zoning) and spatial planning; Relocation of polluting industries to dedicated economic zones	UA 1.1
	• Dredging and re-excavation local rivers to increase conveyance	UA 1.1
	• On-site sanitation solutions (improved sanitation coverage)	UA 11.1
	• Improvements and extension of traditional sewerage systems, including the construction of waste water treatment plants (improved sanitation coverage)	UA 9.1, UA 10.1, UA 1.3, UA 9.2
	• Enforce restrictions on illegal wastewater disposal	UA 1.1, UA 1.3
	• Sustainable operation and maintenance (SOM)	-
	• Capacity building	UA 9.2
	• Solid waste management	UA 1.1, UA 3.1, UA 9.3
1	• Strengthening of institutions and governance framework (including cost-recovery, private sector participation)	-
	• Construction of industrial effluent treatment plants (ETP's)	UA 1.1, UA 3.1
	• Strengthening of governance framework (PPP's, Polluter-pay principles)	UA 1.3, UA 10.1, UA 3.1
	• Cost recovery in the sanitation sector (premiums, municipal taxes)	UA 10.1, UA 9.2
	• Fecal sludge management (collection, disposal, treatment)	-
	• Innovative on-site/decentralized urban waste water treatment solutions (e.g. small bore)	-
2	• Large scale reallocation of industrial zones and/or ports	-

Adaptation pathway



Narrative

Water quality management in urban areas has two main aspects; sanitation and industrial pollution control. Both aspects require immediate investments in basic infrastructure (Cluster 0+) to prevent additional environmental degradation and health risks.

Sewerage and centralized waste water treatment are currently the best available sanitation concepts. It is expected that technological advancements in the short-term will bring alternative concepts in the form of decentralized waste water treatment (Cluster 1). These include the wider application of fecal sludge management and small-bore sewerage concepts, which also allow for the separate conveyance of waste water streams and storm water.

Therefore, in a high climate change scenario with increased precipitation the tipping point for traditional sewerage conveyance to decentralized concepts with separated water streams will be reached sooner. Archetype projects in Cluster 1 aimed at the strengthening of governance, (private) construction of ETP's and cost recovery can be adopted more rapidly in a high economic growth scenario.

It is expected that water quality will suffer most in a scenario of high climate change and low economic growth. When periods of drought are longer and more frequent, problematic situations will arise as water flows are low in rivers around urban centers and ETP's are not in place to process industrial waste water. Polluting industries will then have to be put down and reallocated to elsewhere to improve local water quality.

B.3 Assessing the Identified BDP2100 projects

Taking ADM and the adaptation pathways as the core approach, all identified BDP2100 IP projects (Batches 1-4) have been screened and prioritized in such a manner that investments are made according to the principles "not too much, too early" but instead "enough and in time". To this end, all projects have been assessed on the following criteria:

- Robust/flexible in relation to adaptation of the intervention: can the project be adapted/scaled up when circumstances require so?

- Robust/flexible in relation to transition within or between adaptation pathways: can the project be combined with additional measures to increase effectiveness?

- Robust/flexible in relation to technological development: does the project allow for adopting technological innovations after implementation?

- Robust/flexible in relation to synchronization with developments in other sectors does the project take onboard easily.

ADM being a major driver for the IP, this means that:

- Projects not aligned to ADM principles, have not been selected;

- Projects are prioritized based on their contribution to the BDP-goals;

- Sequencing of the selected and prioritized projects in the hot spot portfolios is aligned with the position in the respective adaptation pathway.

B.4 Participatory Multicriteria Analysis

The 96 projects in BDP Batch 4 generally are projects in an early concept stage of development. For these projects an additional assessment, prioritization and sequencing procedure was necessary. This has been done by means of a participatory Multicriteria Analysis (MCA).

Each project has been assessed on multiple criteria, ultimately leading to a description of the performance of Batch 4-projects. The criteria used and description of each of the scales, are presented in Table B.19.

In the MCA, various criteria are used to describe the performance of Batch 4-projects. The scores of the projects on these criteria are obtained by means of desk research. The available project concept notes (PCN's) and additional information was studied to establish the scores. Furthermore, expert judgement has been used as complimentary sources. Two reviewers in the project team verified the scores. Table B.19 gives an overview of the criteria, corresponding indicators and measurement scales used. Additional parameters are included in the database of projects such as name, type of projects, feasibility study available, etc. These were used to specify advice for further steps.

Table B.19: Criteria and Scales Used in the MCA

	Criteria	Indicator	Scale
C1	Adaptive delta management (ADM)	Upscaling potential, combination with other measures, relation with technological development	• -(1): The project includes infrastructure that is hard to adapt to changing physical conditions foreseen in the short-to medium-term, and does not offer any potential to be combined with other relevant measures. Or, the project does not offer a contribution to technological or knowledge development relevant to the reaching the goals of the Bangladesh Delta. • - (2): The project includes infrastructure that has limited adaptive capacities and offers limited options for combining the project with other relevant measures. Or, the project offers a relevant but limited contribution to technological or knowledge development required to reach the goals of the Bangladesh Delta. • -0 (3): The potential for the application of ADM is unknown, or the project holds a wide, but balanced range of relatively flexible and inflexible infrastructure. • + (4): The infrastructure in this project can be adapted to changing physical conditions foreseen in the short- to medium-term, and is easily combined with other relevant measures. Or, the project offers an essential contribution to technological or knowledge development required to reach the goals of the Bangladesh Delta. • ++ (5): The infrastructure in this project can be adapted to changing physical conditions foreseen in the short-, medium- and long-term, and is easily combined with other relevant measures. Or, the project offers an essential contribution to technological or knowledge development required to reach the goals of the Bangladesh Delta.
C2	Institutional strengthening & capacity	Increasing implementation capacity of involved stakeholders & knowledge development	• -- (1): The project negatively influences the development of additional institutional implementation capacity. • - (2): The project negatively influences the development of additional institutional implementation capacity. • 0 (3): The project does not strengthen the implementation capacity of the institutions involved, nor does it strengthen the development or adoption of knowledge in the institutions. Or, the effect is unknown. • + (4): The project offers a large contribution to improving the implementation capacity or knowledge position of the involved institutions. • ++ (5): The project offers a significant and essential contribution to the implementation capacity or knowledge position of the involved institutions, required to reach the goals of the Bangladesh Delta.
C3	Sensitive ecosystems	Decreased vulnerability and increased number of protected ecosystems	• -- (1): The project has significant adverse effects on local environmental quality. • - (2): Overall, the project has adverse effects on local environmental quality. • 0 (3): The project has a limited or no effect on environmental quality. • + (4): Overall, the project enhances local environmental quality. • ++ (5): The project greatly enhances local environmental quality, or brings a relatively large area with valuable ecosystems under protection.

	Criteria	Indicator	Scale
C4	Flood and disaster risk reduction	Decrease of vulnerable areas and/or increase in protected areas	• -- (1): The project significantly increases flood hazard or flood vulnerability of lives, assets or critical infrastructure. • - (2): The project increases flood hazard or flood vulnerability of lives, assets or critical infrastructure. • 0 (3): Uncertain or no effect on flood hazard or flood vulnerability of lives, assets or critical infrastructure. • + (4): The project reduces flood hazard or flood vulnerability of lives, assets or critical infrastructure. • ++ (5): The project significantly reduces flood hazard or flood vulnerability of lives, assets or critical infrastructure.
C5	Disaster preparedness	Increase preparedness by early warning systems, flood zones, awareness	• -- (1): Significant adverse effects in flood response or recovery. • - (2): Adverse effects in flood response or recovery. • 0 (3): Uncertain or no effect in flood response or recovery. • + (4): Moderate improvement in flood response or recovery. • ++ (5): Significant improvement in flood response or recovery.
C6	Water security	Improved water security by increased fresh water availability	• -- (1): Significant adverse effects on water security (quantity or distribution) for food production, human consumption or industries. • - (2): Adverse effects on water security (quantity or distribution) for food production, human consumption or industries. • 0 (3): Uncertain or no effect on water security (increased quantity or improved distribution) for food production, human consumption or industries. • + (4): Moderate improvement in water security (increased quantity or improved distribution) for food production, human consumption or industries. • ++ (5): Significant improvement in water security (increased quantity or improved distribution) for food production, human consumption or industries
C7	Water pollution control	Decreased water pollution, improved sanitation and/or increased water quality standards	• -- (1): Significant increase of direct or indirect discharge of pollutants into waterbodies. • - (2): Moderate increase of direct or indirect discharge of pollutants into waterbodies. • 0 (3): Uncertain or no reduction of direct or indirect discharge of pollutants into waterbodies. • + (4): Moderate reduction of direct or indirect discharge of pollutants into waterbodies. • ++ (5): Significant reduction of direct or indirect discharge of pollutants into waterbodies.
C8	Integral spatial planning	Finding optimal (integral) solutions with limited negative external effects and maximize positive external effects	• -- (1): Project offers a sectoral solution whilst there is clear potential for the maximization of positive external effects. • - (2): The project has integral elements, but misses some opportunity for enlarging positive effects. • 0 (3): It is unknown or uncertain if the solution offered by the project is integrally developed, or there are no known external effects, or there is only limited potential to maximize positive external effects. • + (4): Project offers an integral solution with limited negative external effects and some positive external effects. • ++ (5): Project offers an optimally integrated solution with limited negative external effects and large positive external effects.

	Criteria	Indicator	Scale
C9	Sediment management	Increased navigability of waterways and/or land reclamation and/or decreased erosion	• -- (1): Contributes greatly to the siltation of waterways, or negatively influences erosion control near large hydraulic structures. • - (2): Contributes to the siltation of waterways, or negatively influences erosion control near hydraulic structures. • 0 (3): Uncertain or no effect on the siltation of waterways, erosion control or land reclamation. • + (4): Improved navigability of waterways, reduction of erosion near hydraulic structures, or small land reclamation project. • ++ (5): Significant improvement to the navigability of waterways, significant reduction of erosion near hydraulic structures, or the reclamation of a relatively large area.
C10	Investment costs	Total estimated project costs in M. BDT	• -- (1): More than 25,000 M BDT • 0 (3): Uncertain or 1,000 – 25,000 M BDT • ++ (5): Less than 1,000 M BDT
C11	Economic efficiency	Social benefits > Social costs	• -- (1): Social costs expected to be twice as high than social benefits • - (2): Social costs higher than social benefits • 0 (3): Uncertain or social benefits are expected to be equal to social costs • + (4): Social benefits are higher than social costs • ++ (5): Social benefits are expected to be at least twice as high than social costs
C12	Stakeholder support	Stakeholder support on national-strategic level	• -- (1): Significant adverse effects on sediment management • - (2): Adverse effects on sediment management • 0 (3): Uncertain or no effect on sediment management • + (4): Moderate improvement of sediment management • ++ (5): Significant improvement of sediment management
C13	OPEX/CAPEX	Ratio of OPEX/CAPEX indicates the required resources (knowledge, funds, workforce) to maintain and operate the project	• -- (1): Significant adverse effects on sediment management • - (2): Adverse effects on sediment management • 0 (3): Uncertain or no effect on sediment management • + (4): Moderate improvement of sediment management • ++ (5): Significant improvement of sediment management
C14	Capacity	Institutional capacity available	• -- (1): No capacity in Bangladesh or elsewhere and no potential to increase capacity to a sufficient level • - (2): The institutional requirements of this project are beyond what currently exists in Bangladesh. Major efforts would be needed to build the required capacity, and there is a material risk that these efforts would fail resulting in failure of the project. • 0 (3): Uncertain or implementation and/or operation of this project would require material upgrades to existing capacity or changes to institutional arrangements • + (4): It is likely that institutions in Bangladesh can implement and operate this project, though limited increments in capacity or changes to institutional arrangements would be required • ++ (5): Proven capacity to implement and operate projects like this exists in the relevant agencies

	Criteria	Indicator	Scale
C15	Risk in relation to physical context	Technical complexity of the project	• -- (1): High technical complexity • - (2): Medium-high technical complexity • 0 (3): Average technical complexity • + (4): Medium-low technical complexity • ++ (5): Low technical complexity
C16	Ability to attract private finance	Extent to which likely to be able to attract Private Finance	• -- (1): not suitable for PPP or private finance • - (2): unlikely to be suitable for PPP or private finance at all • 0 (3): Uncertain or possibly could be done as a PPP, but not clear, or financing expected would be low relative to total project costs • + (4): likely that could be privately financed, but over 50% of cost recover would be from government sources • ++ (5): likely that could be 50% or more privately financed, with costs recovered from user-charges or other non-governmental sources (given appropriate policy and regulatory settings)
C17	Climate finance	Extent to which likely to be able to attract Climate finance	• -- (1): Will not attract climate finance • - (2): Unlikely to attract climate finance • 0 (3): Uncertain or may attract some climate finance, but not clear, or contribution relative to be low relative to total project costs • + (4): likely that could be climate financed, but likelihood is relatively low, or expected climate finance contribution is less than 50% • ++ (5): likely that could be 50% or more financed from climate finance sources, given appropriate policy and regulatory settings
C18	Expected Impact	Expected number of people affected by the project	• -- (1): Less than 10,000 people affected • - (2): 10,000–1,000,000 people affected • 0 (3): 1,000,000–5,000,000 people affected • + (4): 5,000,000–10,000,000 people affected • ++ (5): More than 10 million people affected

The MCA consists of three stages.

Stage 1: Selection

In Stage 1 of the MCA-procedure the Flag Model was used to select all projects that contribute to the BDP-goals, are efficient and comply to the principles of ADM. Projects pass the selection stage when they fulfil the following constraints:

1. A project 'passes' or obtains a Green Flag on the BDP-criteria in case they have a neutral or positive score (>3) on all the BDP-criteria
2. A project 'passes' or obtains a Green Flag in case it has a positive score (≥4) on the Efficiency-criterion
3. Projects 'passes' or obtains a Green Flag in case it has a positive score (≥4) on the ADM-criterion.

Stage 2: Categorization

Batch 4 consists of various types of projects; infrastructure projects (hard measures), knowledge development, institutional reform, and planning measures.
Projects are categorized into four categories:

1. Infrastructure projects
2. Knowledge, institutional reform, and planning projects
3. Medium-to-high risk, infrastructural projects
4. Projects with an uncertain score on Efficiency and no feasibility study available

For each category, a different CTV (critical threshold value) for the criteria Impact and Efficiency is used. Again, the Flag Model is used as MCA-method to construct a portfolio of projects per hotspot. Below the various steps in the analyzes and the CTV's used are described.

Box B.1: Assessing Risk

For each project, we determined its risk profile and used the following criteria:

- Required capacity of the managing agent which is reflected by the OPEX/CAPEX ratio. The reasoning is as follows. A project with a high OPEX/CAPEX ratio requires more capacity of the managing agent (budget and qualified personal) to operate and maintain than the project after implementation. The CTV is set at 5%, indicating that projects with a OPEX/CAPEX ratio higher than 5% is marked as high risk because of high required capacity.
- Technical risk: the risk related to a physical change of the situation caused by implementation of the project. For example, strengthening river embankments involves more physical system changes than, for example, small-scale dredging, and thus has a higher technical risk.

The score on these two criteria determine the risk profile of a project. We assumed that both criteria are equally important.

Infrastructure projects

Projects are included in the category Infrastructure (hard measures) when they fulfil the following constraints:

- A project 'passes' or obtains a Green Flag in case it has a score of 3 or higher (CTV) on the criterion Impact. This implies that at least 1,000,000 people are positively affected
- A project 'passes or obtains a Green Flag in case it has a score of 4 or higher (CTV) on the criterion Efficiency. This implies that expected benefits exceed expected costs
- A project 'passes' or obtains a Green Flag in case it has a low or low-to-medium risk profile.

These CTVs mean that only medium to high impact projects (over 1 million people affected) that are economically efficient and have a low to medium risk profile are included in this category. The criteria Impact (C18) and Efficiency (C11) are explained in Table B.19. Box B.1 explains how the risk profile of each project was determined.

Knowledge, institutional reform, and planning projects

Projects included in this category pass the categorization stage when they fulfil the following constraints:

- A project 'passes' or obtains a Green Flag in case it has a score of 3 or higher (CTV) on the criterion Efficiency
- A project 'passes' or obtains a Green Flag in case it has a low or low-to-medium risk profile.

Using these CTVs implies that all efficient and non-high-risk projects are selected in the category Knowledge, institutional reform, and planning. Thus, projects that are knowledge, institutional reform, and/or planning projects are included in this category when they have a low or low-to-medium risk profile, and when they are economically efficient. The criterion Efficiency (C11) is explained in Table B.19. Box B.1 explains how the risk profile of each project was determined. Scores of projects on the criterion Impact are not taken into consideration.

Medium- to high-risk, infrastructural projects

Projects included in this category pass the categorization stage when they fulfil the following constraints:

- Only projects in the category Infrastructure are selected
- A project 'passes' or obtains a Green Flag in case it has a score of 4 or higher (CTV) on the criterion Efficiency. This implies that expected benefits exceed expected costs
- A project 'passes' or obtains a Green Flag in case it has a medium or medium-to-high risk profile.

The CTV presented above and Green Flag indicate that this category hard measure (infrastructure) projects. These projects must also be economically efficient. The criterion Efficiency (C11) is explained in Table B.19. Projects within this category have a medium-to-high risk profile. Box B.1 explains how the risk profile of each project was determined.

Projects with an uncertain score on Efficiency and no feasibility study available

Projects included in this category pass the categorization stage when they fulfil the following constraints:

- A project 'passes' or obtains a Green Flag in case it has a score of 3 on the criterion Efficiency. This implies that Efficiency is uncertain
- A project 'passes' or obtains a Green Flag in case it has no feasibility study available.

The Green Flags explained above indicate that this category includes projects for which economic efficiency is uncertain. These projects also do not have a feasibility study yet.

Stage 3: Prioritization

To produce the rank order of projects in a portfolio the method of Weighted Summation has been used. The method is suitable to address choice problems that involve a finite and discrete set of projects or policies that should be evaluated in the light of conflicting objectives. For any given objective, one or more different criteria are used to measure the performance of the proposed project in relation to that objective. The criteria scores are usually measured on different measurement scales and therefore cannot be compared with each other directly. Weighted summation is a compensatory method, which means that 'bad' criterion scores can be compensated by 'good' ones and is linear additive model.

Weighted summation makes scores on 'incomparable' criteria comparable, prioritizes them by assigning weights and finally reduces the amount of information by aggregating the weighted standardized scores. This process provides not only a ranking of the alternatives, but also comprehensibility and the strengths and weaknesses of the policy alternatives.

Important steps in the application of Weighted Summation are:

- Assign values to each criterion for all projects
- Standardization of the scores to make the criteria comparable
- Weighting of criteria, to assign priorities to them.

A total score for each project is calculated by multiplying the standardized scores with its weight valued. In the next step, the weighted scores are summed and the projects are ranked based on the outcome. To make scores on the criteria comparable they are standardized or normalized. Various methods to standardize scores are available. According their relative position on the interval between the lowest and highest score scores are standardized in the interval [0, 1].

MCA Questionnaire methodology

The rankings of projects are produced by means of weight vectors(s) which reflect the preferences of stakeholders. Weights have been obtained by consulting various stakeholders. Their preferences regarding the BDP-goals are elicited by means of a questionnaire which is based on the AHP-method (Saaty). To construct the weight vectors(s) questionnaires, interviews and a workshop have been held.

The aim of the questionnaire was to gain insight in the value different stakeholders attach to several criteria included in the MCA. The result of these questionnaire is two-fold:

- An additional check on our selection procedure of projects to be included in the IP;
- To gain additional insights into the relative importance of each goal of the Bangladesh Delta for different hotspots.

Table B.20 presents an overview of the stakeholders that were invited to participate, after having consulted GED.

Table B.20: Stakeholders Invited to Participate in the MCA

Organization	Position (Title)	Name
Government		
Bangladesh Agricultural Development Corporation	Member Director (Irrigation)	
Bangladesh Bureau of Statistics	Director General	
Bangladesh Inland Water Transport Authority	Director General	
Bangladesh Water Development Board	Additional Director General (Planning)	
Bangladesh Water Development Board	Former Director General	Mr. Mukhles uz Zaman
Bangladesh Water Development Board	Former Director General	S. M. Mozadded Faruque
Bangladesh Water Development Board	Director General	
Bangladesh Water Development Board	Director (Planning 1)	
Bangladesh Water Development Board	Director (Planning 1)	
BEZA	Executive Chairman	
BIWTA	Chairman	
BIWTC	Joint Secretary	
Department of Agriculture Extension	Director General	
Department of Environment	Director (NRM)	Mr. Sultan Ahmed
Department of Environment	Director General	
Department of Environment	Director (Planning)	
Department of Fisheries	Director General	
Department of Fisheries	Director (Marine)	
Department of Haor and Wetland	Director General	
Dhaka WASA	Managing Director	Eng. Taqsen A Khan
Economic Relations Division	Additional Secretary, Europe Wing	
GED	Senior Assistant Chief	Dr. Taibur Rahman
Joint River Commission	Member	Md. Mofazzal Hossain
Joint River Commission	Former Member	Mir Sajjad Hossain
Local Government Engineering Department	Chief Engineer	
Ministry of Environment & Forest	Additional Secretary	Mr. Abdullah Al Mohsin Chowdhury
Ministry of Fisheries & Livestock	Joint Chief	
Ministry of Fisheries & Livestock	Secretary	
Ministry of LGRD & Cooperatives	Director General, MEE Wing, Local Government Division	
Ministry of Shipping	Joint Chief	
Ministry of Water Resources	Joint Chief	
Ministry of Water Resources	Additional Secretary	

Organization	Position (Title)	Name
Planning Commission	Chief, Agriculture, Water Resources & Rural Institution Division	
Planning Commission	Member, Agriculture, Water Resources & Rural Institution Division	
Planning Commission	Member, Physical Infrastructure Division	
Roads Transport Division	Joint Chief	
WARPO	Director General	
Academic		
Bangladesh Institute of Planners	President	
BUET	Institute of Water and Flood Management	Dr. Masfiqus Salehin
BUET	Department of Water Resources Engineering	Dr. Umme Kulsum Navera
CEGIS		Mr. Waziullah
CEGIS	Deputy Executive Director	Malik Fida A. Khan
Center for Urban Studies	Chairman	Professor Nazrul Islam
Environment & Infrastructure Management Solution (EIMS)	Chairman	Dr. Ahmadul Hassan
Institute of Water Modelling	Executive Director	Dr. M. Monowar Hossain
IWM	Director (Coast Port and Estuary Division)	Zahir-ul-Haque Khan
Policy Research Institute of Bangladesh	Vice Chairman	Dr. Sadiq Ahmed
Policy Research Institute of Bangladesh	Operations Director	Dr. Khurshid Alom
Policy Research Institute of Bangladesh	Executive Director	Dr. Ahsan H. Mansur
BanDuDeltAS		Dr. Giasuddin Ahmed
Private Sector		
Bangladesh Infrastructure Finance Fund Ltd. (BIFFL)	Executive Director & CEO	
Islamic Bank Bangladesh Ltd	Chairman	Araastoo Khan

In addition, participants at the draft Investment Plan workshop held in April 2017 were also invited to participate in the MCA. These participants are listed in Box B.2.

Box B.2: Draft Investment Plan Workshop Participants

Participants are not listed in order of seniority.

1. Sk Anower Sadat, Unit Head, Large Infrastructure, BIFFL
2. Md. Muzanur Rahman, Unit Head, CRM, BIFFL
3. AKM Tahmidul Islam, Director, Planning 2, BWDB Dhaka
4. Mohd. Enamul Haque, Deputy Chief (CC), GED, Planning Commission
5. Murtuza Zulkar Nain Noman, Senior Assistant Chief, GED, Planning Commission
6. Mohammad Asaduzzaman Sarker, Senior Assistant Chief, GED, Planning Commission
7. Fatema, Assistant Chief, ERD
8. Arastoo Khan, Chairman, Islami Bank BD Ltd.
9. Chowdhury Sachi Ahmed, Economist, CEGIS
10. Engr. Motaleb Hossain Sarker, Director Ecology, CEGIS
11. Aminul Islam, Deputy Director, Department of Fisheries
12. Dr. Umme Kulsum Navera, Professor, Dept of Water Resources Engs., BUET
13. Dr. Sultan Ahmed, MD (NRM), BARC, Dhaka
14. Peter de Vries, Embassy of the Kingdom of the Netherlands
15. G. M. Khurshid Alam, Policy Research Institute
16. Md. Mohsin, Joint Secretary, Ministry of Disaster Management and Relief
17. A.N.M. Azizul Haque, Deputy Chief, Ministry of Disaster Management and Relief
18. Azizun Nahar, Deputy Chief, Agriculture Division, Water Resources and Rural Institutions, Planning Commission
19. Md. Liaket Ali, joint Chief, Local Government Division
20. Md. Mafidul Islam, Joint Chief, GED
21. Md. Monsurul Alam, Deputy Chief, Road Transport and Highways Division
22. Dr. Md Abdullah Al Mamuh, Director (SE RHD), Bangladesh Road Research Laboratory, RHD
23. Sjeda Sitwat Shahed, Consultant, IFC
24. Abul monzur Md. Sadeque, Executive Engineer (Planning), LGED
25. Md. Mizanur Rahman, Executive Engineer, WRM Unit, LGED
26. Mirz Ashfaqur Rahman, Deputy Chief, GED, Planning Commission
27. Dr. Ahmadil Hassan, Chairman, EIRNS
28. Naquim Bim Mahbub, Chief, GED
29. Dr. AKM Abul Kalam, President, Bangladesh Institute of Planners
30. Ziauddin Ahmed, Joint Director, Bangladesh Bureau of Statistics, Ministry of Planning
31. Imran Ahmed, Assistant Chief Conservator of Forests, Forest Department
32. Nazmul Haque, Director (Investment), IDCOL
33. Monfu Kumar Bisuas, Joint Chief, Ministry of Water Resources
34. Dr. Md. Ruhul Amin, Director, Department of BD, Haor and Wetland Development
35. Md. Zahangir Alam, Director (PMEF), PPP Authority
36. Dr. Syed Ali Ahasan, ULO, Department of Livestock Services
37. Saleh Ahmed, Manager (Deputy Secretary), BEZA, PMO
38. Giasuddin Chowdry, Deputy Team Leader, BDP2100
39. Yeusuf Ahmed, Research Associate, BDP2100 Formulation Program
40. Md. Dilwar Bakth, Chairman, SPARRSO
41. A.T.M. Khaleduzzaman, Senior Advisor, Integrated Water Resources Management, Embassy of the King dom of the Netherlands
42. Md. Mahmud Hossain, Member Director (Seed & Horticulture), BADC
43. Muhammad Monzur Hossain, Deputy Director, Bangladesh Bank
44. Dr. Manoranjan Mondal, Water Scientist, International Rice Research Institute
45. Mahmud Hasan Salim, Director (Planning), BIWTA, Ministry of Shipping
46. Md. Basir Uddin, Director, Planning, Project Implemenetation, and ICT Wing, Department of Agricultural Extension
47. Md. Lutfor Rahman, Deputy Chief Engineer, BADC
48. Md. Anwar Hossain, Joint Chief, Ministry of Agriculture
49. Mir Sajjad Hossain, Advisor, CEGIS
50. Md. Monirul Islam, FCA, Director, BRACE PL Investments Ltd.
51. Md. Sarafat Hossain Khan, Director General, WARPO
52. Mukhlesazzaman, Director General (Retired), BWDB
53. Dr. Monsrar Hossain, BD, IWM
54. Dr. Md. Mostak Ali, Associate Professor, DWRE, BUET
55. Shakhaowat Hossain, Assistant Chief, GED, Planning Commission

Each participant was asked to fill in the questionnaire as a representative of their agency/institution. The questionnaire consisted of two questions:

1. Please answer the following question: "Which criterion of each pair is more important: A or B? And how much more on a scale of 1-9 (see Table B.21)?".

   The following criteria are compared: Impact (Expected amount of people affected by the project), Efficiency (Social benefits are higher than the social costs), and Risk (Technical complexity of the project).

2. Please answer the following question: "Which BDP goal of each pair is more important: A or B? And how much more on a scale of 1-9?"

   The following BDP goals are compared: disaster preparedness, flood and disaster risk reduction, water security, water pollution control, sediment management, sensitive ecosystems, institutional strengthening & capacity, and integral spatial planning.

Question 1 was asked to be filled in from a country-perspective and Question 2 from the perspective of one of the six hotspots in Bangladesh (Coastal Zone, Urban Areas, Chattogram Hill Tracts and Coastal Plains, Barind and Drought Prone Areas, Haor Region or Rivers and Estuaries).

Table B.21: Explanation of the MCA Scale

Intensity of importance	Definition	Explanation
1	Equal importance	The two criteria are equally important
3	Moderate importance	The selected criterium is moderately more important
5	Strong Importance	The selected criterium is strongly more important
7	Very strong importance	The selected criterium is very strongly more important
9	Extreme importance	The selected criterium is extremely more important

2,4,6,8 can be used to express intermediate values

Three rounds of questionnaires

The questionnaires were distributed in three participative rounds:

- A round of questionnaires sent by email
- A round of questionnaires completed through in-person interviews
- A round of questionnaires distributed at the draft Investment Plan workshop in Dhaka on 10 April 2017.

Table B.22 provides an overview of the number of participants per hotspot, categorized into the different types of organizations: government stakeholders; civil society institutions, research institutes, and private sector participants.

Table B.22: Summary of MCA Participants

Hotspot	Type of Organization				Total Participants
	Govt.	Civil Society	Research Institute	Private Sector	
Barind and Drought Prone Areas	1	-	3	1	5
Chattogram Hill Tracts	2	-	2	-	4
Coastal Zone	15	1	8	1	25
Cross Cutting Areas	-	-	2	-	2
Haor and Flash Flood Areas	2	-	2	-	4
River System and Estuaries	1	-	2	2	5
Urban Areas	4	2	4	1	11
Total	**25**	**3**	**23**	**5**	**56**

Results of the Questionnaire

The results of the questionnaire confirm that Impact is more important than Risk (see Table B.23). The respondents are indifferent between efficiency and the risk profile of projects. This implies the Investment Plan should include very efficient, average/high impact infrastructure projects with a medium- to high- or high-risk profile.

Table B.23: Results of the Questionnaire Question 1

Variable	Min. Weight Value	Avg. Weight Value	Max. Weight Value
Impact	0.046	0.399	0.808
Efficiency	0.050	0.292	0.787
Risk	0.042	0.309	0.808

Table B.24 presents the assigned weights to each criterion related to the BDP goals. These weights are based on first results of the Questionnaire. The results show that participants assign relatively equal weights to all the criteria related to the Delta Goals. This suggest that each of the Delta Goals are perceived as equally important for each hotspot. Overall, the results of the questionnaire confirmed the used methodology of the MCA. However, some remarks can be made:

- The average weight value of the criterion Institutional strengthening & capacity building is relatively high compared to the other criteria. This holds for every hotspot, and indicates that institutional strengthening and capacity building is seen by the participants as an important goal throughout Bangladesh.
- The criterion Flood and disaster risk reduction and Water security have a relatively high weight value compared to the other criteria of the Delta Goals. This holds for the following hotspots: Barind and Drought Prone Areas, Chattogram Hill Tracts and Coastal Plains, Coastal Zone, Haor Region, Rivers, and Urban Areas. This result suggests that flood risk reduction and water security are perceived by the participants as the most important Delta goals in these hotspots.
- The criterion Disaster preparedness has a relatively low weight value. This suggest that the other criteria are perceived as more important by the participants.

Table B.24: Assigned Weights Based on Questionnaire Results

Delta Goal	#	Criteria	Barind and Drought Prone Areas		Chattogram Hill Tracts and Coastal Plains		Coastal Zone		Cross Cutting Areas		Haor Region		Rivers and Estuaries		Urban Areas	
			Av.	Dev.	Av.	Dev.	Av.	Dev.	Av.	Dev.	Av.	Dev.	Av.	Dev.	Av.	Dev.
DG 5	C2	Institutional strengthening & capacity	0.14	0.015	0.14	0.015	0.13	0.005	0.14	0.015	0.14	0.015	0.14	0.015	0.14	0.015
DG 4	C3	Sensitive ecosystems	0.11	-0.015	0.10	-0.025	0.11	-0.015	0.11	-0.015	0.11	-0.015	0.11	-0.015	0.11	-0.015
DG 1	C4	Flood and disaster risk reduction	0.16	0.035	0.16	0.035	0.16	0.035	0.15	0.025	0.15	0.025	0.15	0.025	0.15	0.025
DG 1	C5	Disaster preparedness	0.07	-0.055	0.07	-0.055	0.07	-0.055	0.07	-0.055	0.07	-0.055	0.07	-0.055	0.07	-0.055
DG 2	C6	Water security	0.17	0.045	0.16	0.035	0.18	0.055	0.16	0.035	0.17	0.045	0.17	0.045	0.17	0.045
DG 2	C7	Water pollution control	0.13	0.005	0.13	0.005	0.13	0.005	0.14	0.015	0.13	0.005	0.13	0.005	0.13	0.005
DG 6	C8	Integral spatial planning	0.13	0.005	0.13	0.005	0.12	-0.005	0.13	0.005	0.13	0.005	0.13	0.005	0.13	0.005
DG 3	C9	Sediment management	0.11	-0.015	0.10	-0.025	0.11	-0.015	0.1	-0.025	0.11	-0.015	0.10	-0.025	0.10	-0.025

Av. = average weight value; Dev. = deviation from equal weights in absolute values

Results of the MCA Analysis

Table B.25 shows the MCA scores for each project and the results of the MCA analysis.

Table B.25: MCA Analysis Scores and Results

#	Project Code	Project Name	MCA Scores for Each Criterion																		Overall MCA Score	Screened In	Objectives	Project Type	Category	In IP
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18						
1	CZ1.12	Construction of 11 Cross Dams in the Meghna - Tetulia Estuary	3	3	3	4	3	3	3	4	4	3	4	5	Low	High	3	4	3	2	0.23	No	Multiple	Infrastructure	Not feasible	No
2	CZ1.30	Rehabilitation of Water Management Infrastructure in Bhola District	4	3	3	4	3	4	3	4	4	3	4	4	High	High	3	4	4	3	0.33	Yes	Multiple	Infrastructure	High-risk project	Yes
3	CZ1.39	Morphological Dynamics of Meghna Estuary for Sustainable Char Development	4	5	3	3	3	3	3	3	3	5	4	3	Low	High	5	1	3	1	0.10	Yes	Single	Knowledge	Low-risk project	Yes
4	CZ1.40	Ensure safety from floods and climate change related disasters	4	4	3	5	4	4	3	4	3	1	4	5	Low	High	3	2	3	3	0.43	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
5	CZ1.41	Program for Implementation of Rationalized Water Related Interventions in Gorai-Passur Basin	4	4	4	5	4	4	4	3	4	3	4	5	Low	High	3	3	4	3	0.52	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
6	CZ1.44	Rationalization of Polders in Baleswar - Tentulia Basin	4	4	4	5	4	3	4	4	3	1	4	5	Low	High	3	3	4	3	0.42	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
7	CZ1.45	Program for Implementation of Rationalized Water Related Interventions in Baleswar-Tentulia Basin	4	4	3	5	4	4	4	3	3	3	4	4	Low	High	3	3	4	3	0.39	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
8	CZ1.47	Rationalization of Polders in Gumti - Muhuri Basin	4	4	3	5	4	3	3	3	4	1	4	4	Low	High	3	3	4	3	0.34	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
9	CZ1.48	Program for Implementation of Rationalized Water Related Interventions in Gumti - Muhuri Basin	4	4	4	5	4	4	4	4	4	3	4	4	Low	High	3	3	4	3	0.59	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
10	CZ1.52	Land beyond Land, Efforts to Reclaim lands at near Coast; Preparatory Surveys and Studies	4	5	3	3	3	3	3	3	3	5	4	5	Low	High	5	1	2	1	0.10	Yes	Single	Knowledge	Low-risk project	Yes
11	CZ1.53	Structural interventions for managing sea level rise: preparatory surveys & studies	4	5	3	3	3	3	3	3	3	3	4	5	Low	High	5	1	3	1	0.10	Yes	Single	Knowledge	Low-risk project	Yes
12	CZ4.1	Development of Climate Smart Integrated Coastal Resources Database (CSICRD)	4	5	3	3	3	3	3	3	3	5	4	3	Low	High	5	1	3	1	0.10	Yes	Single	Knowledge	Low-risk project	Yes
13	CZ12.6	Integrated Coastal Zone Land Use Planning in Bangladesh using GIS and RS Technology	4	5	3	3	3	3	3	4	3	5	4	4	Low	High	3	1	3	2	0.16	Yes	Multiple	Planning	Low to medium-risk project	Yes
14	CZ12.8	Southern Agricultural Improvement Project (SAIP)	4	4	3	3	3	4	3	4	3	1	4	5	Low	High	3	3	2	1	0.21	Yes	Multiple	Knowledge	Low to medium-risk project	Yes
15	CZ14.7	Restoration of Ecologically important Coastal Islands	4	5	4	3	3	3	3	3	3	5	4	4	High	High	3	2	3	1	0.16	Yes	Multiple	Knowledge	Medium to high-risk project	No
16	CZ17.1	Exploration of the Production potential of Coastal Saline Soils of Bangladesh	4	5	3	3	3	3	3	4	3	5	4	5	Low	High	5	1	3	1	0.16	Yes	Multiple	Knowledge	Low-risk project	Yes
17	MR1.46	Integrated Jamuna-Padma Rivers Stabilization and Land Reclamation Project	4	3	4	5	3	4	3	4	5	5	4	4	Low	High	3	4	4	5	0.36	Yes	Multiple	Infrastructure	Low to medium-risk	Yes
18	MR12.1	Enhancement of Agricultural Productivity towards Food Security in Char Lands	4	4	3	3	3	4	3	4	3	3	4	4	Low	High	3	2	4	4	0.19	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
19	MR15.2	Eco-management Zoning of Charland Ecosystem for Biodiversity Protection	4	5	5	3	3	3	3	3	3	5	4	4	High	High	3	1	3	1	0.24	Yes	Multiple	Knowledge	Medium to high-risk project	No

#	Project Code	Project Name	MCA Scores for Each Criterion																		Overall MCA Score	Screened In	Objectives	Project Type	Category	In IP
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18						
20	UA1.1	Restoration of River System and it's ecology around Dhaka Ci	4	4	5	4	3	4	5	4	5	1	4	5	High	High	1	4	4	5	0.61	Yes	Multiple	Infrastructure	High-risk project	Yes
21	UA3.1	Improvement of drainage network, flood control and solid waste management for Khulna City	4	4	4	5	3	3	5	3	3	1	4	5	High	High	5	4	4	3	0.49	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
22	UA9.1	Water Supply project for the city corporation areas in Bangladesh (Phase I & II)	4	4	3	3	3	5	3	3	3	1	3	5	High	High	3	5	3	3	0.22	Yes	Multiple	Infrastructure	High-risk project	Yes
23	UA9.2	Improvement of sanitation system in city corporation areas of Bangladesh	4	4	5	3	3	3	5	3	3	3	3	5	High	High	3	4	3	3	0.34	Yes	Multiple	Infrastructure	High-risk project	Yes
24	UA9.3	Project for improvement of storm water drainage facilities in the city corporation area	4	4	3	5	3	3	3	3	3	3	4	5	High	High	5	3	4	3	0.30	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
25	UA11.1	Improvement of Drainage Congestion, Canal Dredging and Flood Control for Barisal CC area	5	4	4	5	5	4	4	4	5	3	5	5	High	High	3	2	4	2	0.64	Yes	Multiple	Infrastructure	High-risk project	Yes
26	UA23.1	Khulna Water Supply Project Phase II	4	4	4	3	3	5	4	3	3	1	3	5	High	High	3	5	3	3	0.34	Yes	Multiple	Infrastructure	High-risk project	Yes
27	UA23.2	Financial performance improvement of a Water Utility in a medium size city	4	5	4	3	3	5	3	3	3	5	5	5	High	High	3	2	3	2	0.38	Yes	Multiple	Infrastructure	High-risk project	Yes
28	UA27.1	Creating integrated base maps	4	5	3	3	3	3	3	3	3	5	4	5	High	High	5	1	2	1	0.20	Yes	Single	Planning	Medium to high-risk project	No
29	UA27.2	Capacity development for integral urban design and spatial planning	4	5	3	3	3	3	3	3	3	5	4	5	High	High	5	1	2	1	0.20	Yes	Single	Institutional	Medium to high-risk project	No
30	UA27.3	Integrated strategy for urban drainage, including increasing the urban water storage capacity	4	4	3	3	3	3	3	4	3	5	4	5	High	High	5	1	3	1	0.18	Yes	Multiple	Knowledge	Medium to high-risk project	No
31	UA27.4	Integrated Waterfront development	4	4	3	3	3	3	3	3	3	5	4	5	High	High	5	3	3	1	0.10	Yes	Single	Knowledge	Medium to high-risk project	No
32	UA27.5	Integrated sustainable wetland development	4	4	3	3	3	3	3	4	3	5	4	5	High	High	5	3	3	1	0.18	Yes	Multiple	Knowledge	Medium to high-risk project	No
33	UA27.6	National and regional spatial strategies	3	5	3	3	3	3	3	4	3	5	4	5	High	High	5	1	3	1	0.28	No	Multiple	Planning	Not feasible	No
34	UA27.7	National Comprehensive Development Planning Interfaced Land Use Plan for the Whole Country	5	5	3	3	3	3	3	4	3	3	3	5	High	High	5	1	3	1	0.28	No	Multiple	Planning	Not feasible	No
35	UA27.8	Prioritizing economic zones	4	5	3	3	3	3	3	4	3	5	4	5	High	High	5	1	2	1	0.28	Yes	Multiple	Planning	Medium to high-risk project	No
36	UA27.9	Vision development for sustainable urban areas	4	4	3	3	3	3	3	4	3	5	4	4	High	High	5	1	3	1	0.18	Yes	Multiple	Knowledge	Medium to high-risk project	No
37	DP1.21	Program for Implementation of Rationalized Water Related Interventions in Hurasagar basin	4	4	4	4	4	4	4	4	4	3	4	4	Low	High	3	3	3	3	0.50	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
38	DP3.2	Establishment of Inland Container Terminals at Nagarbari / Baghabari and Balashi / Chilmari in the northern region of Bangladesh	3	4	3	3	3	3	3	3	3	3	4	4	Low	High	3	5	1	3	0.03	No	Single	Infrastructure	Not feasible	No
39	DP15.3	Barind Area Fisheries Development Project	4	4	4	3	3	3	3	3	3	3	4	4	Low	High	3	1	3	3	0.09	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
40	DP25.1	Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M under the North Rajshahi Irrigation with Ganges Barrage	4	5	3	3	3	3	3	3	3	5	4	4	Low	High	3	1	3	1	0.07	Yes	Single	Institutional	Low-risk project	Yes
41	DP25.2	Development of Scheme WMOs and Agreement with Individual LLP Owners/Operators for Cost Recovery for O&M for the Mahananda Irrigation Scheme	4	5	3	3	3	3	3	3	3	5	4	4	Average	High	3	1	3	2	0.07	Yes	Single	Institutional	Low to medium-risk project	Yes
42	DP25.3	Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M for the Kurigram Irrigation Schemes (I & II)	4	5	3	3	3	3	3	3	3	5	4	4	Average	High	3	1	3	2	0.07	Yes	Single	Institutional	Low to medium-risk project	Yes

#	Project Code	Project Name	MCA Scores for Each Criterion																			Overall MCA Score	Screened In	Objectives	Project Type	Category	In IP
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18							
43	CH1.1	Prospects for Promoting Soil Conservation and Watershed Protection in CHT	4	4	4	3	3	3	3	4	3	5	4	4	Low	High	3	1	3	3	0.07	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
44	CH1.10	Rationalization of Polders in Chittagong Coastal Plain	4	4	3	4	4	3	3	3	4	1	4	4	High	High	3	3	4	4	0.29	Yes	Multiple	Infrastructure	High-risk project	Yes
45	CH1.11	Program for Implementation of Rationalized Water Related Interventions in Chittagong Coastal Plain Basin	4	4	4	4	4	4	4	3	4	5	4	4	Low	High	3	3	4	4	0.47	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
46	CH12.4	Enhancement of Livelihood in the Chittagong Hill Tracts Through Good Agricultural Practice	4	4	3	3	3	5	3	3	3	3	4	4	Low	High	3	2	3	3	0.25	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
47	CH26.1	Kaptai Lake rehabilitation Study and Pilot Project	4	4	3	3	3	3	4	4	3	5	3	4	Low	High	3	3	3	1	0.10	Yes	Multiple	Infrastructure	Low-risk project	Yes
48	CH26.2	Development Catchment and Sub-catchment Management Plans	4	5	3	3	3	3	3	3	3	5	4	4	Low	High	3	1	3	2	0.04	Yes	Single	Planning	Low-risk project	Yes
49	CH26.3	Sustainable tourism CHT feasibility study	3	5	3	3	3	3	3	3	3	5	4	4	N/A	High	5	1	2	1	0.04	No	Single	Knowledge	Not feasible	No
50	CH26.4	Promoting Sustainable cultivation practices, including agro-forestry	4	5	3	3	3	3	3	3	3	5	4	4	High	High	3	2	3	1	0.04	No	Single	Knowledge	Not feasible	No
51	CH26.5	Flow control and water storage structures for water availability in the dry season	4	4	3	3	3	5	3	4	3	5	4	4	Low	High	3	3	3	3	0.28	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
52	HR1.1	Program for Implementation of Rationalized Water Related Interventions in Upper Meghna Basin	5	4	5	5	4	3	3	4	5	3	3	4	Low	High	1	3	4	5	0.58	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
53	HR2.4	Elevated Village Platforms for the Haor Areas	4	3	5	5	3	3	3	4	4	3	4	5	Low	High	3	3	4	3	0.48	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
54	HR14.1	Ecosystem habitat preservation program for plants, wildlife, fisheries and migratory birds	4	4	5	3	3	3	3	3	3	5	3	4	High	High	3	2	4	2	0.12	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
55	HR14.3	Management of Commercially Important Wetland Ecosystem	4	4	5	3	3	3	3	3	3	5	3	4	High	High	3	2	4	3	0.12	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
56	HR15.5	Sustainable Haor Wetland/Rivers and Fish Habitat Manager	4	4	4	3	3	3	3	3	4	3	4	4	Low	High	3	2	3	3	0.14	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
57	CC1.3	Dynamic Climate Smart Knowledge Portal and Hydro-geological Database for MoWR and BWDB	4	5	3	3	3	3	3	3	3	5	4	4	N/A	High	5	1	3	1	0.05	Yes	Single	Knowledge	Low-risk project	Yes
58	CC1.4	Development/Improvement of Multi-purpose Disaster Shelters and its Management Information System (MDS&MIS)	4	4	3	3	5	3	3	3	3	5	4	4	Low	High	3	2	4	3	0.10	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
59	CC1.41	Program for Implementation of Rationalized Water Related Interventions in Dhaleswari Basin	5	4	4	5	4	3	3	4	4	3	4	4	Low	High	2	3	4	5	0.44	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
60	CC1.43	Revitalization of Khals all over the country	4	3	4	5	3	4	3	3	5	3	4	4	High	High	2	2	4	5	0.38	Yes	Multiple	Infrastructure	High-risk project	Yes
61	CC1.44	Institutional Capacity Building for Groundwater Management and Preparation of Water Budget and Water Allocation Plans at Upazila Level of Bangladesh	4	4	3	3	3	5	3	4	3	5	3	4	High	High	3	1	3	1	0.23	No	Multiple	Institutional	Not feasible	No
62	CC1.45	Expansion and Modernization of Monitoring Network and Tools for Sustainable Development, Management and Governance of Groundwater in Bangladesh	4	4	3	3	3	4	3	4	3	3	4	4	Low	High	3	1	3	1	0.19	Yes	Multiple	Institutional	Low to medium-risk project	Yes
63	CC1.46	Managed Aquifer Recharge for Artificial Storage (MARAS) of Water to Improve Groundwater Table and Quality Conditions in Vulnerable Areas of Bangladesh	4	4	3	3	3	5	4	3	3	3	4	4	High	High	3	2	3	2	0.29	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
64	CC1.47	Institutional and Policy Reform Initiatives for Coordinated Ground Water Management	4	5	3	3	3	4	3	3	3	5	4	4	High	High	3	1	1	1	0.14	Yes	Multiple	Institutional	Medium to high-risk project	No

#	Project Code	Project Name	MCA Scores for Each Criterion																		Overall MCA Score	Screened In	Objectives	Project Type	Category	In IP
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18						
65	CC3.6	Modernizing Existing DGPS System and Replacement of Electronic Positioning System of BIWTA	3	4	3	3	3	3	3	3	3	5	4	4	High	High	3	1	1	1	0.02	No	Single	Infrastructure	Not feasible	No
66	CC3.7	Digitization of Gauge Stations and Collection of Data from Gauge Stations through Global System for Mobile (GSM)	3	4	3	3	3	3	3	3	3	5	4	4	Low	High	3	1	1	1	0.02	No	Single	Institutional	Not feasible	No
67	CC3.8	Maintenance Navigability of 88 River Routes of IWT Network	4	4	3	3	3	3	3	5	1	3	4	High	High	1	5	2	1	0.05	No	Multiple	Infrastructure	Not feasible	No
68	CC3.9	Development and Rehabilitation of Existing Ferry Points at Road-Heads	3	3	3	3	3	3	3	3	4	3	4	4	High	High	3	5	1	3	0.01	No	Single	Infrastructure	Not feasible	No
69	CC3.10	Charting of Inland Waterways through Comprehensive Hydrographic Survey	3	4	3	3	3	3	3	3	4	3	4	4	Low	High	3	1	1	1	0.04	No	Multiple	Knowledge	Not feasible	No
70	CC3.11	Institutional Readiness for Implementation of the Delta Plan 2100: Proposal for Restructuring BIWTA for Present and Future Needs	4	5	3	3	3	3	3	3	3	5	3	4	High	High	3	1	2	1	0.05	No	Single	Institutional	Not feasible	No
71	CC3.12	Development & Improvement of 1200 way side landing stations in the rural areas of Bangladesh	3	3	3	3	3	3	3	3	5	3	4	4	High	High	3	5	1	4	0.02	No	Single	Institutional	Not feasible	No
72	CC3.13	Development and Modernization of 24 Inland River Ports in Bangladesh	3	3	3	3	3	3	3	5	1	4	4	High	High	1	5	1	4	0.02	No	Single	Infrastructure	Not feasible	No
73	CC3.14	Origin-Destination (O-D) survey of IWT Traffic in Bangladesh waterways.	4	4	3	3	3	3	3	4	5	5	4	4	High	High	1	1	1	1	0.07	Yes	Multiple	Knowledge	Medium to high-risk project	No
74	CC9.10	Piped Water Supply project in 100 Pourashavas	4	4	3	3	3	5	4	3	3	1	4	4	Low	High	3	4	3	5	0.29	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
75	CC9.11	Water Supply project in the Urban areas of Bangladesh (secondary towns)	4	4	3	3	3	5	4	3	3	1	4	4	Low	High	3	5	3	5	0.29	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
76	CC9.12	Improvement of sanitation system in urban area of Bangladesh	4	4	3	3	3	3	5	3	3	3	4	4	Low	High	3	4	3	4	0.18	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
77	CC9.13	Village Piped water supply system project (Phase I & II)	4	4	3	3	3	4	4	3	3	1	4	4	Low	High	3	4	3	5	0.19	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
78	CC9.15	WASH education and facilities in secondary schools	4	4	3	3	3	3	5	3	3	1	3	4	High	High	3	2	3	2	0.18	No	Multiple	Institutional	Not feasible	No
79	CC9.16	WASH education and facilities in Primary Schools & Madrashas	4	4	3	3	3	3	5	3	3	1	3	4	Low	High	3	2	3	2	0.18	No	Multiple	Institutional	Not feasible	No
80	CC9.17	Project for improvement of water supply and sanitation facilities in char area	4	4	3	3	3	4	5	3	3	1	4	4	High	High	3	2	4	3	0.27	Yes	Multiple	Infrastructure	High-risk project	Yes
81	CC9.18	Project for improvement of storm water drainage facilities in pourashava (Phase I)	4	4	3	5	3	3	3	3	3	3	4	4	Low	High	3	2	4	4	0.40	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
82	CC12.37	Integrated Agricultural Development in moderately Cyclone affected area	4	4	3	3	3	4	3	4	3	3	4	4	Low	High	3	2	4	3	0.14	Yes	Multiple	Infrastructure	Low to medium-risk project	Yes
83	CC16.19	Climate Resilient Livestock Production	3	4	3	3	3	3	3	3	3	3	4	4	Low		4	1	3	4	0.06	No	Single	Knowledge	Low risk project	Yes
84	CC18.5	Improvement of Urban Drainage in District and Upazila level municipalities of Bangladesh	4	4	4	4	3	3	3	3	4	1	4	4	Low	High	3	3	4	5	0.27	Yes	Multiple	Infrastructure	Medium to high-risk project	Yes
85	CC18.9	Capacity Building of Upazila Parishads for Adaptive Delta Management	4	5	3	3	3	3	3	3	3	1	4	4	High	High	3	1	3	2	0.05	Yes	Single	Institutional	Medium to high-risk project	No

#	Project Code	Project Name	MCA Scores for Each Criterion																		Overall MCA Score	Screened In	Objectives	Project Type	Category	In IP
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18						
86	CC25.1	Delta Projects Enabling Public Private Partnership(PPP) Facility	4	5	3	3	3	3	3	3	3	5	4	4	High	High	5	1	3	2	0.05	Yes	Single	Institutional	Medium to high-risk project	No
87	CC25.2	Feasibility Study for Innovation & Demonstration Fund for Water Projects Bangladesh	4	5	3	3	3	3	3	3	3	5	4	4	High	High	5	1	3	1	0.05	Yes	Single	Institutional	Medium to high-risk project	No
88	CC25.3	Developing Green Climate Fund Strategy & Facility	4	5	3	3	3	3	3	3	3	5	4	4	High	High	5	1	1	1	0.05	Yes	Single	Institutional	Medium to high-risk project	No
89	CC25.4	Integrated Modelling to Support Adaptive Delta Management (ADM) for Water Sector	4	5	3	3	3	3	3	3	3	5	4	4	High	High	5	1	3	1	0.05	Yes	Single	Institutional	Medium to high-risk project	No
90	CC25.4	Support to the Establishment of the Delta Commission to Implement the BDP 2100	4	5	3	3	3	3	3	3	3	5	4	4	High	High	3	1	3	1	0.05	Yes	Single	Institutional	Medium to high-risk project	No
91	CC25.5	Development and Setting up of Geo-Management Information System (GMIS) and Digital Office of the Bangladesh Delta Commission	4	5	3	3	3	3	3	3	3	5	3	4	High	High	3	1	1	1	0.05	No	Single	Institutional	Not feasible	No
92	CC25.6	Capacity Building for Delta Commission Personnel and related Committee	4	5	3	3	3	3	3	3	3	5	3	4	High	High	3	1	2	1	0.05	No	Single	Institutional	Not feasible	No
93	CC25.7	Macro Planning in the Water Sector: Supporting Dialogue to Re-establish Place and Position of WARPO	4	5	3	3	3	3	3	3	3	5	3	4	High	High	3	1	1	1	0.05	No	Single	Institutional	Not feasible	No
94	CC25.8	Evolving Governance Framework for Decentralised and Devolved Water Resources Management	4	5	3	3	3	3	3	3	3	5	3	4	High	High	3	1	3	1	0.05	No	Single	Institutional	Not feasible	No
95	CC25.9	Establishment of Governance Framework for Enhancement of 'Blue Economy'	4	5	3	3	3	3	3	3	3	5	3	4	High	High	3	1	1	1	0.05	No	Single	Institutional	Not feasible	No
96	CC25.10	Providing Delta related Information at Community Doorsteps through Union Digital Centers (UDCs) Supporting E-governance and Decentralisation	4	5	3	3	3	3	3	3	3	5	3	4	High	High	3	1	3	2	0.05	No	Single	Institutional	Not feasible	No
97	CC25.11	Revitalised and New Look BWDB – Strengthening of Functionalization	4	4	3	3	3	3	3	3	3	5	3	4	High	High	3	1	2	1	0.02	No	Single	Institutional	Not feasible	No
98	CC25.12	Establishment of Issue Based Problem Solving Coordination Mechanism at Field Level	4	5	3	3	3	3	3	3	3	5	3	4	High	High	3	1	3	1	0.05	No	Single	Institutional	Not feasible	No
99	CC25.13	Digitisation of Land Records of Newly Accreted Riverine and Coastal Areas, Erosion prone Areas and Coastal & Riverine Chars and Islands under the BDP 2100 Programme Supporting on-going National Efforts	4	4	3	3	3	3	3	3	3	5	3	4	High	High	3	1	3	1	0.02	No	Single	Institutional	Not feasible	No
100	CC25.14	Strengthening of Coast Guard for Improvement of Safety and Security Supporting the Newly Emerging 'Blue Economy'	3	5	4	3	4	3	3	3	3	5	3	4	High	High	3	1	1	1	0.13	No	Multiple	Institutional	Not feasible	No
101	CC25.18	Develop Institutional Arrangement and Coordination Mechanism at Local Government (rural level) for Adaptive Delta Management	4	5	4	3	3	3	3	3	3	5	3	4	High	High	3	1	3	1	0.09	No	Multiple	Institutional	Not feasible	No

Final Selection of Projects

Based on the process described above, 80 out of the 133 projects were included the Investment Plan. Table B.26 presents all the tables received and indicates whether they are or are not included in the current Investment Plan. For the projects that are excluded, there is an explanation of why. The project can then be adjusted and reconsidered for consideration in the Investment Plan.

Table B.26: Selection of Projects for the Investment Plan

#	Project Code	Project Name	Included/ Excluded	Explanation
Coastal Zones				
1	CZ1.1	Construction of Ganges Barrage and Ancillary Works	Included	
2	CZ1.11	Improved Drainage in the Bhabadha Area	Included	
3	CZ1.12	Construction of 11 Cross Dams in the Meghna - Tentulia Estuary	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
4	CZ1.26	Development of Water Management Infrastructure in Bhola Island	Included	
5	CZ1.3	Char Development and Settlement Project- V	Included	
6	CZ1.4	Study on Integrated Management of Drainage Congestion for Greater Noakhali	Included	
7	CZ1.5	Study on Tidal River Management	Included	
8	CZ1.6	Integrated Land Reclamation Project of Hatiya-Dhamar Char-Nijhum Dwip	Included	
9	CZ1.8/1.21	West Gopalganj Integrated Water Management Project	Included	
10	CZ1.10	Rehabilitation of Polder 36/1	Excluded	Excluded as it is already financed
11	CZ1.30	Rehabilitation of Water Management Infrastructure in Bhola District	Included	
12	CZ1.38	TRM of 7 Beels in Coastal Zone	Excluded	Excluded as it is combined by GED with another project
13	CZ1.39	Morphological Dynamics of Meghna Estuary for Sustainable Char Development	Included	
14	CZ1.40	Rationalization of Polders in Gorai-Passur Basin	Included	

#	Project Code	Project Name	Included/ Excluded	Explanation
15	CZ1.41	Program for Implementation of Rationalized Water Related Interventions in Gorai-Passur Basin	Included	
16	CZ1.44	Rationalization of Polders in Baleswar - Tentulia Basin	Included	
17	CZ1.45	Program for Implementation of Rationalized Water Related Interventions in Baleswar-Tentulia Basin	Included	
18	CZ1.47	Rationalization of Polders in Gumti - Muhuri Basin	Included	
19	CZ1.48	Program for Implementation of Rationalized Water Related Interventions in Gumti - Muhuri Basin	Included	
20	CZ1.52	Land beyond Land, Efforts to Reclaim lands at near Coast; Preparatory Surveys and Studies	Included	
21	CZ1.53	Structural interventions for managing sea level rise: preparatory surveys & studies	Included	
22	CZ1.7	Urirchar-Noakhali Cross Dam Project	Included	
23	CZ1.9	Sureswar Flood Control, Drainage and Irrigation Project	Excluded	Excluded as it is already financed
24	CZ12.6	Integrated Coastal Zone Land Use Planning in Bangladesh using GIS and RS Technology	Included	
25	CZ12.8	Southern Agricultural Improvement Project (SAIP)	Included	
26	CZ17.1	Exploration of the Production Potential of Coastal Saline Soils of Bangladesh	Included	
27	CZ4.1	Development of Climate Smart Integrated Coastal Resources Database (CSICRD)	Included	

#	Project Code	Project Name	Included/ Excluded	Explanation
River Systems and Estuaries				
28	MR1.1	River Bank Improvement Program	Included	
29	MR1.46	Integrated Jamuna-Padma Rivers Stabilization and Land Reclamation Project	Included	
30	MR 1.5	Study for harnessing the waters of the Brahmaputra River	Included	
31	MR1.6	Development of Chandona-Barasia River Basin System	Included	
32	MR3.1	Sustainable Restoration of Connectivity of Major Navigation Routes	Included	
33	MR1.2	Study of Integrated River System Management and Protection of Accreted Land	Included	
34	MR1.5	Study of Harnessing of Brahmaputra Water	Included	
35	MR12.1	Enhancement of Agricultural Productivity towards Food Security in Char Lands	Included	
36	MR15.2	Eco-management Zoning of Char and Ecosystem for Biodiversity Protection	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
Urban Areas				
37	UA1.1	Protection of Rivers System around Dhaka City with Their Ecological Restoration	Included	
38	UA1.2	Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road Multipurpose Project	Included	
39	UA1.3	Drainage Improvement of Dhaka-Narayanganj-Demra Project (Phase 2)	Included	

#	Project Code	Project Name	Included/ Excluded	Explanation
40	UA10.1	Improvement of Drainage Congestion and Flood Control for Chattogram City Corporation Area	Included	
41	UA11.1	Improvement of Drainage Congestion, Canal Dredging and Flood Control for Barishal CC area	Included	
42	UA23.1	Khulna Water Supply Project Phase II	Included	
43	UA23.2	Financial performance improvement of a Water Utility in a medium size city	Included	
44	UA27.1	Creating integrated base maps	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
45	UA27.2	Capacity development for integral urban design and spatial planning	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
46	UA27.3	Integrated strategy for urban drainage, including increasing the urban water storage capacity	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
47	UA27.4	Integrated Waterfront development	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).

#	Project Code	Project Name	Included/ Excluded	Explanation
48	UA27.5	Integrated sustainable wetland development	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
49	UA27.6	National and regional spatial strategies	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
50	UA27.7	National Comprehensive Development Planning Interfaced Land Use Plan for the Whole Country	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
51	UA27.8	Prioritizing economic zones	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
52	UA27.9	Vision development for sustainable urban areas	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
53	UA3.1	Improvement of drainage network, flood control and solid waste management for Khulna City	Included	
54	UA9.1	Water Supply project for the city corporation areas in Bangladesh (Phase I & II)	Included	
55	UA9.1 (20.1)	Greater Dhaka Integrated Water and Sewage Improvement Project	Included	
56	UA9.2	Improvement of sanitation system in city corporation areas of Bangladesh	Included	

#	Project Code	Project Name	Included/ Excluded	Explanation
57	UA9.3	Project for improvement of storm water drainage facilities in the city corporation area	Included	
Barind and Drought Prone Areas				
58	DP1.1	North Rajshahi Irrigation Project	Included	
59	DP1.2	Revitalization and Restoration of Beel Halti	Included	
60	DP1.21	Rationalized Water Related Interventions in Hurasagar basin	Included	
61	DP1.3	Revitalization and Restoration of Hurasagar and Atrai rivers	Included	
62	DP1.4/1.5	Kurigram Irrigation Project	Included	
63	DP1.6	Teesta Irrigation project (phase-2)	Excluded	Excluded as it is already financed
64	DP15.3	Barind Area Fisheries Development Project	Included	
65	DP25.1	WMOs and Participatory Management Model, North Rajshahi Irrigation with Ganges Barrage	Included	
66	DP25.2	Development WMOs for Cost Recovery for O&M for the Mahananda Irrigation Scheme	Included	
67	DP25.3	WMOs and Participatory Management Model, for O&M for the Kurigram Irrigation Schemes (I & II)	Included	
68	DP3.2	Establishment of Inland Container Terminals at Nagarbari / Baghabari and Balashi / Chilmari in the northern region of Bangladesh	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
Chattogram Hills Tracts				
69	CH1.1	Prospects for Promoting Soil Conservation and Watershed Protection in Chattogram Hill Tracts	Included	
70	CH1.10	Rationalization of Polders in Chattogram Coastal Plain	Included	
71	CH1.11	Program for Implementation of Rationalized Water Related Interventions in Chattogram Coastal Plain Basin	Included	
72	CH12.4	Enhancement of Livelihood in the Chattogram Hill Tracts Through Good Agricultural Practice	Included	
73	CH26.1	Kaptai Lake Rehabilitation Study and Pilot Project	Included	

#	Project Code	Project Name	Included/ Excluded	Explanation
74	CH26.2	Development Catchment and Sub-Catchment Management Plans	Included	
75	CH26.3	Sustainable tourism CHT feasibility study	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
76	CH26.4	Promoting Sustainable cultivation practices, including agro-forestry	Excluded	Does not meet the "Efficiency and Stakeholder Support" criteria. The project scores below the critical threshold value for these criteria. Excluded in selection phase of the MCA (MCA stage 1)
77	CH26.5	Flow control and water storage structures for water availability in the dry season	Included	
78	CH9.2	Water Supply and Environmental Sanitation in Pourashavas Under CHTs	Included	
Haor and Flash Flood Areas				
79	HR1.1	Program for Implementation of Rationalized Water Related Interventions in Upper Meghna Basin	Included	
80	HR14.1	Ecosystem habitat preservation program for plants, wildlife, fisheries, and migratory birds	Included	
81	HR14.3	Management of Commercially Important Wetland Ecosystem	Included	
82	HR15.4/5	Sustainable Haor Wetland/Rivers and Fish Habitat Management	Included	
83	HR2.1/2.2	Village Protection against Wave Action in Haor Area and Improved Water Management in Haor Basins	Included	
84	HR2.4	Elevated Village Platforms for the Haor Areas	Included	
Cross-Cutting				
85	CC1.2	Pre-Feasibility Study for Development of Small-Scale Water Reservoir	Excluded	Excluded because it is only a prefeasibility study for a specific project with no associated knowledge generation project
86	CC1.3	Dynamic Climate Smart Knowledge Portal and Hydro-geological Database for MoWR and BWDB	Included	
87	CC1.4	Development/Improvement of Multi-Purpose Disaster Shelters and its Management Information System (MDS&MIS)	Included	

#	Project Code	Project Name	Included/ Excluded	Explanation
88	CC1.41	Program for Implementation of Rationalized Water Related Interventions in Dhaleswari Basin	Included	
89	CC1.43	Revitalization of Khals all Over the Country	Included	
90	CC1.44	Institutional Capacity Building for Groundwater Management and Preparation of Water Budget and Water Allocation Plans at Upazila Level of Bangladesh	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
91	CC1.45	Expansion and Modernization of Network and Tools for Groundwater Monitoring Including Establishment of a National Coordination Mechanism	Included	
92	CC1.46	Managed Aquifer Recharge for Artificial Storage (MARAS) of Water to Improve Groundwater Table and Quality Conditions in Vulnerable Areas	Included	
93	CC1.47	Institutional and Policy Reform Initiatives for Coordinated Ground Water Management	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
94	CC12.37	Integrated Agricultural Development in moderately Cyclone affected area	Included	
95	CC16.19	Climate Resilient Livestock Production	Included	
96	CC18.5	Improvement of Urban Drainage in District and Upazila level municipalities of Bangladesh	Included	
97	CC18.9	Capacity Building of Upazila Parishads for Adaptive Delta Management	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
98	CC25.1	Delta Projects Enabling Public Private Partnership(PPP) Facility	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).

#	Project Code	Project Name	Included/ Excluded	Explanation
99	CC25.10	Providing Delta related Information at Community Doorsteps through Union Digital Centres (UDCs) Supporting E-governance and Decentralisation	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
100	CC25.11	Revitalised and New Look BWDB – Strengthening of Functionalization	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
101	CC25.12	Establishment of Issue Based Problem Solving Coordination Mechanism at Field Level	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
102	CC25.13	Digitisation of Land Records of Newly Accreted Riverine and Coastal Areas, Erosion prone Areas and Coastal & Riverine Chars and Islands under the BDP 2100 Programme Supporting on-going National Efforts	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
103	CC25.14	Strengthening of Coast Guard for Improvement of Safety and Security Supporting the Newly Emerging 'Blue Economy'	Excluded	Does not meet the "Efficiency" and ADM criteria. The project does not match the critical threshold value for these criteria. Excluded in selection phase of the MCA (MCA stage 1)
104	CC25.18	Develop Institutional Arrangement and Coordination Mechanism at Local Government (rural level) for Adaptive Delta Management	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
105	CC25.2	Feasibility Study for Innovation & Demonstration Fund for Water Projects Bangladesh	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).

#	Project Code	Project Name	Included/ Excluded	Explanation
106	CC25.3	Developing Green Climate Fund Strategy & Facility	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
107	CC25.4	Integrated Modelling to Support Adaptive Delta Management (ADM) for Water Sector	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
108	CC25.4	Support to the Establishment of the Delta Commission to Implement the BDP 2100	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
109	CC25.5	Development and Setting up of Geo-Management Information System (GMIS) and Digital Office of the Bangladesh Delta Commission	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
110	CC25.6	Capacity Building for Delta Commission Personnel and related Committee	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
111	CC25.7	Macro Planning in the Water Sector: Supporting Dialogue to Re-establish Place and Position of WARPO	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
112	CC25.8	Evolving Governance Framework for Decentralised and Devolved Water Resources Management	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)

#	Project Code	Project Name	Included/ Excluded	Explanation
113	CC25.9	Establishment of Governance Framework for Enhancement of 'Blue Economy'	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
114	CC3.10	Charting of Inland Waterways through Comprehensive Hydrographic Survey	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
115	CC3.11	Institutional Readiness for Implementation of the Delta Plan 2100: Proposal for Restructuring BIWTA for Present and Future Needs	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
116	CC3.12	Development & Improvement of 1200 way side landing stations in the rural areas of Bangladesh	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
117	CC3.13	Development and Modernization of 24 Inland River Ports in Bangladesh	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
118	CC3.14	Origin-Destination (O-D) survey of IWT Traffic in Bangladesh waterways.	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).
119	CC3.6	Modernizing Existing DGPS System and Replacement of Electronic Positioning System of BIWTA	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
120	CC3.7	Digitization of Gauge Stations and Collection of Data from Gauge Stations through Global System for Mobile (GSM)	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)

#	Project Code	Project Name	Included/ Excluded	Explanation
121	CC3.8	Maintenance Navigability of 88 River Routes of IWT Network	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
122	CC3.9	Development and Rehabilitation of Existing Ferry Points at Road-Heads	Excluded	Does not meet ADM criterion. The project scores below the critical threshold value for this criterion. Excluded in selection phase of the MCA (MCA stage 1)
123	CC9.10	Piped Water Supply project in 100 Pourashavas	Included	
124	CC9.11	Water Supply project in the Urban areas of Bangladesh (secondary towns)	Included	
125	CC9.12	Improvement of sanitation system in urban areas of Bangladesh	Included	
126	CC9.13	Village Piped water supply system project (Phase I & II)	Included	
127	CC9.15	WASH education and facilities in secondary schools	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
128	CC9.16	WASH education and facilities in Primary Schools & Madrashas	Excluded	Does not meet the "Efficiency "criterion. The project scores below the critical threshold value for this criterion. That is, economic costs are expected to be larger than economic benefits. Excluded in selection phase of the MCA (MCA stage 1)
129	CC9.17	Project for improvement of water supply and sanitation facilities in char area	Included	
130	CC9.18	Project for improvement of storm water drainage facilities in pourashava (Phase I)	Included	
131	CC9.4	Water Supply, Sanitation, Drainage and Solid Waste Management for Small Pourashavas (2018-2030)	Excluded	Excluded as it is already financed
132	CC9.5	Water Supply and Sanitation	Excluded	Excluded as it is already financed
133	CZ14.7	Restoration of Ecologically Important Coastal Islands	Excluded	Excluded from the Knowledge, Institutional, and Planning category because it is a medium-to-high risk project (high capacity required). Excluded in categorization phase (MCA stage 2).

B.5 Sequencing of Projects

The projects that have been selected to be included in the IP are sequenced using the adaptation pathways as a starting point. As elaborated in Section B.2, the IP-projects are matched with project archetypes and placed into one of three clusters that represent different strategic approaches (Cluster 0+, Cluster 1, Cluster 2) to address the three themes (Preventing 'too much' water, supplying sufficient quantity of water, supplying sufficient quality of water). For each specific theme-hotspot combination, the clusters are placed in an adaptation pathway (detailed in Section B.2.2). The adaptation pathways presented in the 18 factsheets suggest which cluster of measures is considered appropriate for a specific time interval.

The project sequencing follows the principle that Cluster 0+ projects are planned in the immediate short-term (from 2018), as these include the projects that generally have certain impact and low risk[45]. Following the adaptation pathways, the default sequencing is as follows: after the Cluster 0+ have been implemented, Cluster 1, and subsequently Cluster 2 projects are planned when the respective tipping points are reached.

There will be situations on local scale and for specific issues, where projects may be prioritized differently compared to the suggested sequencing in the pathways. For instance, if no related Cluster 0+ project precedes a proposed Cluster 1 or Cluster 2 project, these projects may be started in an earlier phase then what is shown in the 'default' pathways. The following sections describe the project sequencing for each hotspot and the cross-cutting IP projects, and provides specific elaboration on the projects where the proposed sequencing differs from the default sequence.

B.5.1 Project sequencing for the Coastal Zone hotspot

The project sequencing for the coastal zone hotspot is provided in Figure 3.2 of the Investment Plan. All 20 projects in Cluster 0+ are planned in the immediate short-term (2018). Half of the projects require an initial or updated feasibility study.

Two Cluster 1 projects were selected in the IP for the coastal zone: CZ 1.6 (Integrated Land Reclamation Project of Hatiya-Dhamar Char-Nijhum Dwip) and CZ 1.7 (Urirchar-Noakhali Cross Dam Project), which concern land reclamation. Feasibility studies for both projects are planned after the short-term, in 2022, when Cluster 0+ project CZ1.39 (Morphological Dynamics of Meghna Estuary for Sustainable Char Development) is completed. The knowledge that will be developed in this project is expected to be relevant for the design of both land reclamation projects. The findings from Cluster 0+ project CZ 1.52 (Land beyond Land, Efforts to Reclaim lands at near Coast; Preparatory Surveys and Studies, planned from 2018 onwards) can be used to benefit projects CZ 1.6 and CZ 1.7 as well.

45 CH1.1, Prospects for Promoting Soil Conservation and Watershed Protection in Chattogram Hill Tracts, is the only 0+ project that is not planned in the short-term. The project requires the catchment and sub-catchment management plans provided by project CH26.2, Development of Catchment and Sub-Catchment Management Plans. Thus, the project starts after the completion of project CH26.2.

One Cluster 2 project was selected in the IP in the coastal zone: CZ 1.1 (Construction of Ganges Barrage and Ancillary Works). As stated in the IP CBA report, "this is a large structural work that has a long-life cycle and leaves little flexibility for adaptive delta management, since the construction cannot be easily adapted as needed because of changing circumstances related to climate change, water availability, and demand. The construction of a large barrage will therefore imply the risk of over- or under-investment. If it is decided to construct the barrage, then the development scenario for the regions downstream will change drastically." Several Cluster 0+ projects have a relation with the Ganges barrage, or (partially) aim to address the same theme: supplying sufficient quantity of water. The feasibility study for the construction of the Ganges barrage is therefore planned when projects CZ 12.8 (Increase agricultural productivity through better management and utilization of land and water resources, and promotion of climate smart technology in the southern region of Bangladesh) and CZ 17.1 (Exploration of the Production potential of Coastal Saline Soils of Bangladesh) are in its final stages, as the successful completion of both projects can influence the need (tipping point) for a Ganges Barrage and the appropriate design of such intervention. Planning the updated feasibility study of the Ganges Barrage from the medium- to short-term (2023) allows to include potential insights and changes in the coastal water system that can follow from the various polder rationalization and water management projects (CZ1.8/1.21. CZ 1.11, CZ 1.41, CZ 1.44, CZ 1.45) and other related aspects in the feasibility study.

B.5.2 Project sequencing for the River System and Estuaries hotspot

The project sequencing for the River System and Estuaries hotspot is provided in Figure 3.2 of the Investment Plan. Six of the seven projects are in Cluster 0+. As there are no reasons to divert from the default project sequencing that follows form the hotspot's adaptation pathways, all Cluster 0+ projects are planned in the immediate short-term (2018). The only Cluster 1 project, MR1.46, Integrated Jamuna-Padma Rivers Stabilization and Land Reclamation Project, requires a feasibility study planned in 2020. It is expected to start in 2023.

B.5.3 Project sequencing for the Urban Areas hotspot

The project sequencing for the Urban Area hotspot is provided in Figure 3.2 of the Investment Plan. All 9 projects in Cluster 0+ are planned in the immediate short-term (2018). All projects require an initial feasibility study.

Three Cluster 1 projects (UA 1.2, UA 23.1 and UA 1.1) were selected in the IP for the Urban Areas hotspot. All three projects are planned in the short-term as they offer certain and much needed impact to address the respective themes. Moreover, no other Cluster 0+ projects in the IP logically precede these projects or have the same effects under the specific geographic circumstances of the projects' area.

Project UA1.2 (Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road Multipurpose Project) is a typical Cluster 1 project as the construction of the embankment represents a significant change in the local water system. The embankment could have adverse effects to local wetlands, would decrease available floodplains and could potentially fuel (unplanned) urban sprawl in eastern Dhaka. As the IP CBA report states: "The project does not consider other alternatives that

provide more gradual opportunities for the city to grow. No clear indications are given in relation to the assessment of the urban development plan for Dhaka. With different measures, zoning is possible. Zoning of smaller compartments will provide a more gradual growth scenario and will decrease uncertainties related to water security. Management of smaller compartments will also be less complex and lead to more controllable risks". These considerations will have to addressed in the updated feasibility study of the project, as there are currently no alternative projects in the IP that offer the same flood risk reduction in eastern Dhaka. Therefore, this updated feasibility study is planned in the immediate short-term (2018).

Project UA 23.1 (Khulna Water Supply Project Phase II) comprises the development of surface water sources for potable water use and a piped water system in Khulna. As the availability of fresh and safe ground water is (increasingly) constrained in and around Khulna, and there are no related Cluster 0+ projects in the IP selection, the project is planned in the immediate short-term (2018).

Project UA 1.1 (Protection of Rivers System around Dhaka City with Their Ecological Restoration) is a project of high complexity that addresses various components of the supplying sufficient quantity of water and supplying sufficient quality of water themes. The project is planned in the short-term as there are no alternative Cluster 0+ projects available. The project's feasibility study should address the project's complexity and relation to Dhaka's spatial growth.

B.5.4 Project sequencing for the Barind and Drought prone Areas hotspot

The project sequencing for the Barind and Drought prone Areas hotspot is provided in Figure 3.2 of the Investment Plan. All eight Cluster 0+ projects are planned in the immediate short-term (2018). Three of the projects require an initial feasibility study.

Project DP 1.3 (Revitalization and Restoration of Hurasagar and Atrai rivers) is a Cluster 1 project of large scale and complexity. Construction of the project is planned after construction on the related Cluster 0+ project DP1.21 (Rationalized Water Related Interventions in Hurasagar basin) has commenced, so potential factors that can limit the need for DP 1.3 can be considered in the feasibility study.

B.5.5 Project sequencing for the Chattogram Hill Tracts hotspot

The project sequencing for the Chattogram Hill Tracts hotspot is provided in Figure 3.2 of the Investment Plan. Six out of the total of seven Cluster 0+ projects are planned in the immediate short-term (2018), four of which requiring an initial feasibility study.

Project CH26.5 (Flow control and water storage structures for water availability in the dry season) is a Cluster 1 project, which specifically requires drafted catchment and sub-catchment management plans as a prerequisite. Logically, the project is planned after project CH26.2 "Development Catchment and Sub-Catchment Management Plans". Cluster 0+ project CH1.1 "Prospects for Promoting Soil Conservation and Watershed Protection in Chattogram Hill Tracts" is planned after the completion project CH 26.2 for the same reason.

B.5.6 Project sequencing for the Haor and Flash Flood Areas hotspot

The project sequencing for the Haor and Flash Flood Prone Area hotspot is provided in Figure 3.2 of the Investment Plan. The four Cluster 0+ projects are planned in the immediate short-term (2018), all require an initial feasibility study.

One of these Cluster 0+ projects, HR 1.1 (Program for Implementation of Rationalized Water Related Interventions in Upper Meghna Basin), provides a wide baseline study, integral assessment and strategy for water management in the region, including flash flood control and ecosystem services. Project HR 2.4 (Elevated Village Platforms for the Haor Areas) proposes local adaptation to flooding that could be caused by issues that play on a regional scale level. Project HR 14.3 (Management of Commercially Important Wetland Ecosystem) also has a relation with many aspects that are the matter of strategy formulation in project HR 1.1. Therefore, both projects are planned when project HR 1.1 is underway and, for example, the potential need for water management interventions with regional effects (for example dams, dredging of congested rivers) has been assessed. The complexity of project HR 14.3 requires an elaborate feasibility study, and would benefit if HR 1.1 is in a more advanced state.

B.5.7 Project sequencing for the Cross-Cutting projects

The project sequencing for the Cross-Cutting projects is provided in Figure 3.2 of the Investment Plan. All fourteen Cluster 0+ projects are planned in the immediate short-term (2018), all of which but one (CC16.19) require an initial feasibility study.

Cluster 1 Project CC1.46 (Managed Aquifer Recharge for Artificial Storage (MARAS) of Water to Improve Groundwater Table and Quality Conditions in Vulnerable Areas of Bangladesh) is planned in the immediate short-term as well, as there are no related Cluster 0+ projects in the present IP in the geographical regions concerned.

Project Costs

Table B.27 shows the estimated capital costs, feasibility study costs, and operating and maintenance costs for each project included in the Investment Plan.

Table B.27: Summary of Project Costs

Project Code	Project Name	FS (BDT mil)	FS ($ mil)	Capex (BDT mil)	Capex ($ mil)	O&M (BDT mil)	O&M ($ mil)
CZ 1.8/CZ1.21	West Gopalganj Integrated Water Management Project	-	-	2,735	34	68	1
CZ 1.11	Improved Drainage in the Bhabadha Area	-	-	1,557	20	42	1
CZ 1.26	Development of Water Management Infrastructure in Bhola Island	-	-	14,651	185	281	4
CZ 1.3	Char Development and Settlement Project	-	-	1,138	14	23	0
CZ1.48	Program for Implementation of Rationalized Water Related Interventions in Gumti - Muhuri Basin	280	4	13,988	176	240	3
CZ1.41	Program for Implementation of Rationalized Water Related Interventions in Gorai-Passur Basin	291	4	14,570	184	250	3
CZ1.44	Rationalization of Polders in Baleswar - Tentulia Basin	3,170	40	158,502	1,997	2,500	32
CZ1.40	Rationalization of Polders in Gorai - Passur Basin	2,132	27	106,604	1,343	1,800	23
CZ1.45	Program for Implementation of Rationalized Water Related Interventions in Baleswar-Tentulia Basin	176	2	8,800	111	880	11
CZ1.47	Rationalization of Polders in Gumti - Muhuri Basin	1,287	16	64,328	811	1,100	14
CZ1.30	Rehabilitation of Water Management Infrastructure in Bhola District	468	6	23,419	295	1,988	25
CZ12.6	Integrated Coastal Zone Landuse Planning in Bangladesh using GIS and RS Technology	-	-	899	11	-	-
CZ1.39	Morphological Dynamics of Meghna Estuary for Sustainable Char Development	-	-	72	1	-	-
CZ1.52	Land beyond Land, Efforts to Reclaim lands at near Coast; Preparatory Surveys and Studies	-	-	927	12	-	-
CZ1.53	Structural interventions for managing sea level rise: preparatory surveys & studies	-	-	1,024	13	-	-
CZ4.1	Development of Climate Smart Integrated Coastal Resources Database (CSICRD)	-	-	122	2	-	-
CZ 1.4	Study on Integrated Management of Drainage Congestion for Greater Noakhali	-	-	16	0	-	-
CZ 1.5	Study on Tidal River Management	-	-	1,250	16	-	-
CZ 1.7	Urirchar-Noakhali Cross Dam Project	87	1	4,353	55	87	1
CZ 1.6	Integrated Land Reclamation Project of Hatiya-Dhamar Char-Nijhum Dwip	11	0	550	7	12	0
CZ12.8	Southern Agricultural Improvement Project (SAIP)	784	10	39,184	494	784	10
CZ17.1	Exploration of the Production potential of Coastal Saline Sois of Bangladesh	-	-	98	1	-	-
CZ 1.1	Construction of Ganges Barrage and Ancillary Works	8,174	103	408,713	5,150	9,904	125
MR 1.2	Pre-Feasibility Study on Integrated River System Management and Protection of Accreted Land	-	-	3,854	49	-	-
MR 1.5	Study for harnessing the waters of the Brahmaputra River	-	-	435	5	-	-
MR 1.1	River Bank Improvement Program1	2,814	35	140,694	1,773	4,221	53
MR 1.46	Integrated Jamuna-Padma Rivers Stabilization and Land Reclamation Project	5,796	73	289,800	3,651	28,980	365
MR 3.1	Sustainable Restoration of Connectivity of Major Navigation Routes	459	6	22,948	289	688	9
MR 1.6	Development of Chandona-Barasia River Basin System	9	0	461	6	11	0
MR12.1	Enhancement of Agricultural Productivity towards Food Security in Char Lands	301	4	15,039	189	1,504	19
UA 1.3	Drainage Improvement of Dhaka-Narayangonj-Demra Project (Phase 2)	114	1	5,711	72	92	1
UA 10.1	Improvement of Drainage Congestion and Flood Control for Chittagong City Corporation Area	616	8	30,805	388	1,140	14
UA 11.1	Improvement of Drainage Congestion, Canal Dredging and Flood Control for Barisal CC area	90	1	4,522	57	150	2
UA 3.1	Improvement of drainage network, flood control and solid waste management for Khulna City	1,465	18	73,226	923	15	0
UA 9.3	Project for improvement of storm water drainage facilities in the city corporation area	231	3	11,545	145	150	2
UA 1.2	Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road Multipurpose Project	1,161	15	58,060	732	372	5
UA 9.1 (20.1)	Greater Dhaka Integrated Water and Sewage Improvement Project	7,560	95	378,000	4,763	7,560	95
UA 9.1	Water Supply project for the city corporation areas in Bangladesh (Phase I & II)	625	8	31,255	394	60	1
UA 23.2	Financial performance improvement of a Water Utility in a medium size city	8	0	383	5	9	0
UA 23.1	Khulna Water Supply Project Phase II	533	7	26,662	336	12	0
UA 9.2	Improvement of sanitation system in city corporation areas of Bangladesh	468	6	23,400	295	60	1
UA 1.1	Protection of Rivers System around Dhaka City with Their Ecological Restoration	296	4	14,788	186	141	2

Project Code	Project Name	FS (BDT mil)	FS ($ mil)	Capex (BDT mil)	Capex ($ mil)	O&M (BDT mil)	O&M ($ mil)
DP1.21	Program for Implementation of Rationalized Water Related Interventions in Hurasagar basin	319	4	15,934	201	250	3
DP 1.3	Revitalization and Restoration of Hurasagar and Atrai rivers	1,790	23	89,522	1,128	25,694	324
DP 1.1	North Rajshahi Irrigation Project	-	-	19,910	251	147	2
DP 1.2	Revitalization and Restoration of Beel Halti	-	-	4,762	60	111	1
DP 1.4/1.5	Kurigram Irrigation Project	-	-	26,992	340	359	5
DP25.1	Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M under the North Rajshahi Irrigation with Ganges Barrage	-	-	101	1	-	-
DP25.2	Development of Scheme WMOs and Agreement with Individual LLP Owners/Operators for Cost Recovery for O&M for the Mahananda Irrigation Scheme	-	-	61	1	-	-
DP25.3	Development of WMOs and Participatory Scheme Management Model, with Cost Recovery for O&M for the Kurigram Irrigation Schemes (I & II)	-	-	102	1	-	-
DP 15.3	Barind Area Fisheries Development Project	72	1	3,580	45	179	2
CH1.11	Program for Implementation of Rationalized Water Related Interventions in Chittagong Coastal Plain Basin	16	0	811	10	20	0
CH1.10	Rationalization of Polders in Chittagong Coastal Plain	848	11	42,376	534	850	11
CH26.2	Development Catchment and Sub-catchment Management Plans	-	-	16	0	-	-
CH 9.2	Water Supply and Environemntal Sanitation in Pourashavas Under CHTs	-	-	5,433	68	543	7
CH12.4	Enhancement of Livelihood in the Chittagong Hill Tracts Through Good Agricultural Practice	190	2	9,519	120	190	2
CH26.1	Kaptai Lake Rehabilitation Study and Pilot Project	-	-	10	0	1	0
CH1.1	Prospects for Promoting Soil Conservation and Watershed Protection in CHT	0	0	8	0	1	0
CH26.5	Flow control and water storage structures for water availability in the dry season	13	0	625	8	10	0
HR 2.1/2.2	Village Protection against Wave Action in Haor Area and Improved Water Management in Haor Basins	146	2	7,286	92	193	2
HR 1.1	Program for Implementation of Rationalized Water Related Interventions in Upper Meghna Basin	116	1	5,780	73	100	1
HR 2.4	Elevated Village Platforms for the Haor Areas	-	-	3,942	50	394	5
HR 14.1	Ecosystem habitat preservation program for plants, wildlife, fisheries, and migratory birds	8	0	386	5	29	0
HR 15.4/5	Sustainable Haor Wetland/Rivers and Fish Habitat Management	194	2	9,700	122	194	2
HR 14.3	Management of Commercially Important Wetland Ecosystem	8	0	417	5	31	0
CC18.5	Improvement of Urban Drainage in District and Upazila level municipalities of Bangladesh	3,153	40	157,650	1,986	15,756	199
CC12.37	Integrated Agricultural Development in moderately Cyclone affected area	328	4	16,398	207	328	4
CC1.4	Development/Improvement of Multi-purpose Disaster Shelters and its Management Information System (MDS&MIS)	6,152	78	307,624	3,876	30,762	388
CC1.3	Dynamic Climate Smart Knowledge Portal and Hydro-geological Database for MoWR and BWDB	-	-	191	2	-	-
CC 1.41	Program for Implementation of Rationalized Water Related Interventions in Dhaleswari Basin	37	0	1,838	23	35	0
CC 1.43	Revitalization of Khals all Over the Country	92	1	4,577	58	400	5
CC9.18	Project for improvement of storm water drainage facilities in pourasava (Phase I)	470	6	23,485	296	660	8
CC9.10	Piped Water Supply project in 100 Pourasavas	501	6	25,031	315	240	3
CC9.11	Water Supply project in the Urban areas of Bangladesh (secondary towns)	934	12	46,688	588	420	5
CC9.17	Project for improvement of water supply and sanitation facilities in char area	194	2	9,720	122	972	12
CC9.13	Village Piped water supply system project (Phase I & II)	1,068	13	53,376	673	1,200	15
CC 1.45	Expansion and Modernization of Netwrok & Tools for Groundwater Monitoring Including National Coordination Mechanism	81	1	4,033	51	47	1
CC1.46	Managed Aquifer Recharge for Artificial Storage (MARAS) of Water to Improve Groundwater Table and Quality Conditions in Vulnerable Areas of Bangladesh	27	0	1,334	17	133	2
CC9.12	Improvement of sanitation system in urban area of Bangladesh	443	6	22,173	279	18	0
CC 16.19	Climate Resilient Livestock Production	-	-	1,190	15	24	0

Appendix C: Agencies Consulted

Table C.1 shows the agencies that were consulted for formulation of the Investment Plan, in alphabetical order by type of organization.

Table C.1: Agencies Consulted for Formulation of the Investment Plan

Number	Agency Name
Government Agencies	
1	Bangladesh Agricultural Development Corporation
2	Bangladesh Agricultural Research Council
3	Bangladesh Bank
4	Bangladesh Bureau of Statistics
5	Bangladesh Economic Zones Agency
6	Bangladesh Inland Water Transport Authority
7	Bangladesh Inland Water Transport Corporation
8	Bangladesh Institute of Planners
9	Bangladesh Water Development Board
10	Cabinet Division
11	Department of Agriculture Extension
12	Department of Environment
13	Department of Fisheries
14	Department of Haor and Wetland
15	Department of Livestock
16	Department of Urban Development
17	Dhaka WASA
18	Economic Relations Division
19	General Economics Division, Planning Commission
20	Joint Rivers Commission
21	Local Government Engineering Department
22	Ministry of Agriculture
23	Ministry of Disaster Management and Relief
24	Ministry of Environment and Forests
25	Ministry of Fisheries and Livestock
26	Ministry of Foreign Affairs
27	Ministry of Land
28	Ministry of Local Government, Rural Development, and Cooperatives
29	Ministry of Roads and Bridges
30	Ministry of Shipping
31	Ministry of Water Resources
32	Planning Commission
33	Prime Minister's Office
34	Public Private Partnership Authority
35	Water Resources Planning Organization

Number	Agency Name
Academic/Research/Civil Society Organizations	
36	BanDuDeltAs
37	Bangladesh Forest Research Institute
38	Bangladesh Institute of Development Studies
39	Bangladesh SEID
40	Bangladesh University of Engineering and Technology
41	Bangladesh University of Engineering and Technology, Institute of Water and Flood Management
42	BRAC University
43	Center for Environmental and Geographic Information Services
44	Center for Urban Studies
45	Institute of Water Modelling
46	International Rice Research Institute
47	Policy Research Institute
48	Space Research and Remote Sensing Organization
Private Sector	
49	Abdul Monem Ltd.
50	Bangladesh Infrastructure Finance Fund Ltd.
51	BGMEA
52	BRAC Bank
53	BRAC EPL Investments Ltd.
54	City Capital Investment Bank
55	DBI Group
56	Ecoflag Bangladesh
57	Environment & Infrastructure Management Solutions
58	ETBL Holdings
59	Grameen Bank
60	Infrastructure Development Company Limited
61	International Chamber of Commerce
62	Islami Bank Bangladesh Ltd
63	Metro Group
64	Orion Group
65	Sigma Pumps
66	Standard Chartered Bank
Development Partners	
67	Agence Française de Développement
68	Asian Development Bank
69	Department for International Development
70	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
71	Embassy of the Kingdom of the Netherlands

72	Embassy of the People's Republic of China
73	European Union
74	Green Climate Fund
75	Islamic Development Bank
76	Japan International Cooperation Agency
77	KfW
78	United Nations
79	World Bank Group

Appendix D: Climate Change Adaptation Program

The Bangladesh Delta is more at risk from climate change than almost anywhere else in the world. The Bangladesh Delta must adapt successfully to climate change, or the lives and livelihoods of hundreds of millions are at risk.

A Climate Change Adaptation Program (CCAP) is woven into the IP for the Bangladesh Delta Plan. This adaptation program comprises a portfolio of specific projects, embedded within an adaptation-based investment planning and implementation approach, and complemented by a suite of institutional and policy reforms.

This Annex summarizes the significant climate risks the Bangladesh Delta faces. Sources of climate finance available to help fund the CCAP are summarized, and the guiding principles of the CCAP are presented, along with the proposed coordination mechanisms, institutions, and policies. The projects that form part of the CCAP are listed in Table D.3.

Climate change risks

Bangladesh is one of the most vulnerable countries to climate change worldwide and ranks sixth in the Global Climate Risk Index of most affected countries over the period of 1996-2015[46]. These vulnerabilities must be considered at both the national and regional scale.

Vulnerability on national scale

Over many centuries, sediments transported by the Ganges, Brahmaputra, and Meghna built up the Bengal Delta[47]. These rivers and their many tributaries and distributaries make Bangladesh a 'Land of Rivers'. It is this fascinating landscape of rivers and sediment movements that determine the socio-economic boundary condition of the country[48].

The Bangladesh Delta has a unique natural resource base, with 80 percent of Bangladesh consisting of wetlands and floodplains within a riverine network of approximately 300 rivers[49]. Over 160 million people inhabit this unique Delta, making it the densest populated delta in the world[50].

The number of people living in the Bangladesh Delta, its low elevation above sea levels, and the highly variable flows of the massive rivers running through it have long posed risks as well as opportunities for Bangladeshis.

46 Bangladesh CRI score of 22.67. See: Germanwatch 2016. Global Climate Risk Index 2017: Who suffers most from extreme weather events? Weather-related loss events in 2015 and 1996 to 2015. Briefing paper written by: Sönke Kreft, David Eckstein and Inga Melchior.
47 Prof. dr. H. de Vriend, Deltare 2009. Towards sustainable development of deltas: Aquaterra research on trends and responses.
48 BDP2100 Baseline Study River Morphology 2015.
49 Brouwer, R. et al. 2007. Socioeconomic Vulnerability and Adaptation to Environmental Risk: A Case Study of Climate Change and Flooding in Bangladesh. Risk Analysis, Volume 27(2), pp. 313–326.
50 Sieghart, L. and D. Rogers 2015. Why climate change is an existential threat to the Bangladesh Delta. Blog at The World Bank. http://blogs.worldbank.org/endpovertyinsouthasia/why-climate-change-existential-threat-bangladesh-delta

These risks are now exacerbated by climate changes which are projected to increase the ocurence of both floods and droughts, increase monsoon river flows, and increase salt water intrusion[51]. The most important predicted climate change impacts are:

- Precipitation intensity and river floods
- Temperature increase
- Cyclones
- Droughts
- Salinity intrusion.

Precipitation intensity and river floods

Global climate change leads to an increase in precipitation extremes (both low-dry and high-wet), with an increase in precipitation mainly in the pre-monsoon (March-May) and monsoon (June-September) periods, and more droughts in the winter season.

On average, rainfall in the pre-monsoon and monsoon periods has increased by about 10 percent over the last 60 years. However, dealing with climate change is not so much about the average trends, but instead about changes in the frequency of occurrence of weather extremes[52]. Erratic rainfall and associated extreme weather events affect, amongst others, ecosystems, water availability, and the productivity of land. The predicted increase in monsoon rainfall will result in higher discharges in the rivers of Bangladesh. This will in turn affect the water (flood) levels as well as the sediment transport (erosion/sedimentation).

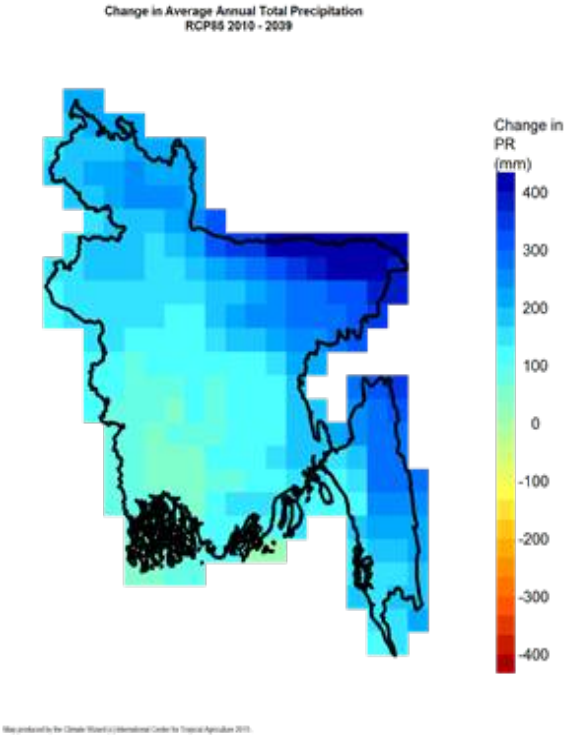
For illustration purposes, Figure D.1 shows the expected change in average annual total precipitation. It is based on computer simulations using the daily bias-corrected spatial disaggregation (BCSD) statistical downscaling method[53]. The change is expressed in mm/y for the period until 2039 and relative to the average in the period 1960-1990. The Figure shows that especially in the North-East, the average annual precipitation is expected to increase significantly (more than 400mm/y). However, there are wide margins of uncertainty around these forecasts. It is this uncertainty that necessitates an adaptive approach to decision making when considering investments: Adaptive Delta Management (refer to Appendix B for more details).

51 IPCC 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 151.

52 Islam, A.K.M.S., S.B. Murshed, Md. S.A. Khan and M.A. Hasan 2014. Impact of climate change on heavy rainfall in Bangladesh. Final report, Institute of Water and Flood Management (IWFM), Bangladesh University of Engineering and Technology.

53 World Bank Climate Analysis Tool – Powered by Climate Wizard. (http://climatewizard.ciat.cgiar.org/wbclimateanalysistool/Bangladesh_Regions_2025/)

Figure D.1: Change in average future total annual rainfall 2010 to 2039[54]



Temperature increase

Statistics show that maximum and minimum temperatures have increased 1oC in the last 60 years.[55] Computer models indicate that temperatures will increase in the future, leading to higher river flows as well, because of higher upstream discharges[56]. Significant warming in Bangladesh is mainly related to global warming, and to some extent related to local factors (for example, land-use change and rapid urbanization)[57].

Cyclones

Heavy rainfall is associated with an increasing frequency and intensity[58] of tropical cyclones that develop over the Bay of Bengal[59].

54 World Bank Climate Analysis Tool – Powered by Climate Wizard. (http://climatewizard.ciat.cgiar.org/wbclimateanalysistool/Bangladesh_Regions_2025/)
55 BDP2100 Baseline Study Climate Change 2015. Report by BanDuDeltAS, June 2015.
56 Dasgupta, S., M. Huq, Z. H. Khan, Md. S. Masud, M. M. Z. Ahmed, N. Mukherjee and K. Pandey 2010. Climate proofing infrastructure in Bangladesh: The incremental cost of limiting future inland monsoon flood damage. Policy Research Working Paper 5469.
57 BDP2100 Baseline Study Climate Change 2015. Report by BanDuDeltAS, June 2015.
58 Asian Development Bank, September 2016, Disaster risk financing in Bangladesh.
59 Roy, M., B. Biswas and S. Ghosh 2015. Trend analysis of climate change in Chattogram Station in Bangladesh, International Letters of Natural Sciences, Vol. 47, pp. 42-52.

Nearly every year, cyclones hit the coastal regions in the early summer (April–May) or the late rainy season (October–November), making the country vulnerable to tropical cyclones[60]. Between 1877 and 1995, Bangladesh was hit by 154 cyclones (including 43 severe cyclonic storms and 68 tropical depressions). There has been one severe cyclone every 3 years, either before or after the monsoon. Cyclones often cause damage because of the extreme wind speeds, but they also cause a temporary (days) increase in water levels due to wind set-up along the coast and atmospheric pressure drop. Storm surges that are in addition to the 'normal' tidal water levels fluctuations can be several meters high, depending on the severity and travel direction of the cyclone[61]. In the Bangladesh Delta, these storm surges encounter a highly-populated coast, often with devastating impacts.

Computer models suggest that cyclone intensity is likely to increase in the future. The wide range of uncertainty about how much intensity would increase again underpins the importance of the Government's commitment to Adaptive Delta Management.

The observed relative sea level rise in Bangladesh is 3mm to 8mm/year. Two-thirds of Bangladesh is less than 5m above sea level, making the country vulnerable to sea-level rise[62]. Eustatic sea-level rise projections are 37cm to 75cm till 2100[63]. Rises of this level would affect the lives and livelihoods of 11 million people living in the coastal area.

Droughts

Bangladesh also suffers from seasonal droughts, especially in the North-western region. Precipitation decreases, as a cause of changing precipitation patterns, occur mostly during the dry season (winter) and the start and end of the monsoon season (April and October)[64].

Additionally, global temperature rise causes a retreat of glaciers in the Himalayas, which will directly impact water supplies in the Bangladesh Delta. In the short-term, this will lead to increased river discharge, because of an increase in melting water. In the long-term, however, when glaciers may have disappeared, the river discharge reduces as well, resulting in freshwater shortages[65].

60 World Bank 2010. Economics of adaptation to climate change.

61 Dasgupta, S., Huq, M., Khan, Z.Q., Ahmed, M., Mukkherjee, N., Khan, M., Pandey, K. 2011. Cyclones in a Changing Climate. The Case of Bangladesh.

62 Dasgupta, S., M. Huq, Z. H. Khan, Md. S. Masud, M. M. Z. Ahmed, N. Mukherjee and K. Pandey 2010. Climate proofing infrastructure in Bangladesh: The incremental cost of limiting future inland monsoon flood damage. Policy Research Working Paper 5469

63 World Bank Group 2013. Warming climate to hit Bangladesh hard with sea level rise, more floodsand clyclones, World Bank Report says. Press release, World Bank. http://www.worldbank.org/en/news/press-release/2013/06/19/warming-climate-to-hit-bangladesh-hard-with-sea-level-rise-more-floods-and-cyclones-world-bank-report-says

64 BDP2100 Baseline Study Climate Change 2015. Report by BanDuDeltAS, June 2015.

65 S. Dasgupta. 2015. Left attended, 5.3 Million of Bangladesh's poor will be vulnerable to the effects of climate change by 2050. World Bank Group Blog. https://blogs.worldbank.org/developmenttalk/left-unattended-53-million-bangladesh-s-poor-will-be-vulnerable-effects-climate-change-2050

Monsoon failure reduces crop production drastically, which in worst cases could bring famine to the affected regions[66].

Salinity intrusion

With expected changing patterns of local precipitation and expected changes in the water discharge distributions of the rivers, ground and surface water salinity patterns are also expected to change. This poses a serious threat to economic well-being, affecting agriculture and aquaculture, and the availability of fresh water[67].

There is evidence that salinity intrusion has already increased because of, amongst others, reduced freshwater inflows from the Ganges, siltation of the tributaries of the Ganges, and siltation of other rivers following the construction of polders. This increase is expected to be more severe in the future because of gradual sea level rise, and further decreased river flows from the Himalayas[68].

Impacts of climate change

A combination of above climate change impacts, including oceanic temperature increase[69], sedimentation, droughts, floods, and salinity intrusion, will continue to affect all livelihoods in Bangladesh in the future. Climate change will have especially severe impacts on water resources management, flood risk management, agriculture, and aquaculture production. Moreover, erratic rainfall and river bank erosion will impact inland water navigability. Existing civil measures such as river embankments are used to protect agricultural land, urban areas, and small towns. These embankments will need to be strengthened and upgraded to cope with the expected increased hydraulic loads (water levels, flow velocities). Additionally, drainage within coastal polders needs to be managed more efficiently because of potential drainage congestion[70].

Approximately 5 percent of annual global GDP is at risk from climate change in any given year, according to the Global Assessment Report for Disaster Risk Reduction[71]. Without further action, climate change in Bangladesh would cause total economic losses of 9.4 percent of total GDP in Bangladesh, as estimated by the Asian Development Bank[72]. Other estimates suggest that total

66 Dey, N. C., M. S. Alam, A. K. Sajjan, M A. Bhuiyan, L. Ghose, Y. Ibaraki and F. Karim 2011. Assessing Environmental and Health Impact of Drought in the Northwest Bangladesh, J. Environ. Sci. & Natural Resources, 4(2): 89-97, 2011.

67 Dasgupta, S., Md. M. Hossain, M. Huq and D. Wheeler 2014. Climate change, groundwater salinization and road maintenance costs in coastal Bangladesh. Policy Research Working Paper 7147, World Bank Group.

68 Dasgupta, S. F.A. Kamal, Z.H. Khan, S. Choudhury and A. Nishat 2014. River salinity and climate change: Evidence from coastal Bangladesh. The World Bank Development Research Group, Environment and Energy Team, Policy Research Working Paper 6817.

69 IWMI, The World Bank Group 2016, South Asia Water Initiative.

70 Dasgupta, S., M. Huq, Z. H. Khan, Md. S. Masud, M. M. Z. Ahmed, N. Mukherjee and K. Pandey (2010). Climate proofing infrastructure in Bangladesh: The incremental cost of limiting future inland monsoon flood damage. Policy Research Working Paper 5469.

71 GCF 2016, Analysis of the Expected Role and Impact of the Green Climate Fund.

72 BDP2100 Baseline Study Climate Change 2015. And estimations by the Asian Development Bank: Ahmed, M. and S. Suphachalasai 2014. Assessing the costs of climate change and adaptation in South Asia. Mandaluyong City, Philippines: Asian Development Bank.

economic losses could be up to 23 percent in worst case scenarios[73]. The following sectors and domains depend largely on weather conditions: agriculture, water supply, spatial planning (flood risks), human health, energy demand, and ecosystems services. About 80 percent of Bangladesh's people are directly and indirectly dependent on agriculture[74].

Vulnerability on regional scale

The Bangladesh Delta Plan distinguishes six regional hotspots within the Bangladesh Delta, specified into four geographical areas: the coastal region, rivers and flood-prone areas, drought-prone areas, and urban areas. The six regional hotspots are: Coastal Zone, Rivers and Estuaries, Barind and Drought-prone areas, Urban Areas, Chattogram Hill Tracts and Coastal Plains, and Haor Region. Each regional hotspot has its own specific climate vulnerabilities:

- **Coastal Zone:** The coastal zone is particularly vulnerable to the effects of storm surges, cyclones, high river discharges, monsoon precipitation, and increased ground and surface water salinity[75]. Coastal embankments are vulnerable to hydraulic forces from by cyclones[76]. Some 30 percent of the Bangladesh cultivable land is in coastal areas, where tidal flooding and direct inundation caused by storm surges gradually make the groundwater more saline during the dry season, negatively affecting agricultural production.
- **River System and Estuaries:** The areas around the rivers are prone to flooding, river bank erosion, and waterlogging, especially during monsoon season (Kharif). During the dry season, water scarcity and salinization increases the vulnerability of the area.
- **Barind and Drought Prone areas:** Water scarcity and droughts complicate irrigation in the northwestern part of Bangladesh. Although drought is also an issue in other comparable areas of the country, it is most predominant in the Barind[77]. Drought occurs particularly in the winter season, pre-monsoon (pre-Kharif), and monsoon (Kharif). Drought causes land degradation and increases erosion.
- **Urban areas:** Urbanization and land scarcity increases uncontrolled urban expansion in floodplains, leading to unsustainable river management, which increases flood risks in urban areas. Climate change increases the intensity and frequency of major river floods and precipitation events. Dhaka, the capital of Bangladesh and one of the world's rapidly

73 BDP2100 Baseline Study Climate Change 2015. And estimations by the Asian Development Bank: Ahmed, M. and S. Suphachalasai 2014. Assessing the costs of climate change and adaptation in South Asia. Mandaluyong City, Philippines: Asian Development Bank.

74 Roy, M., B. Biswas and S. Ghosh 2015. Trend analysis of climate change in Chattogram Station in Bangladesh, International Letters of Natural Sciences, Vol. 47, pp 42-52.

75 Dasgupta, S., Md. M. Hossain, M. Huq and D. Wheeler 2014. Climate change, groundwater salinization and road maintenance costs in coastal Bangladesh. Policy Research Working Paper 7147, World Bank Group.

76 Dasgupta, S., Md. M. Hossain, M. Huq and D. Wheeler 2015. Climate change and soil salinity: The case of coastal Bangladesh, A Journal of the Human Environment, Vol. 44 (4).

77 BDP2100 Baseline Study Climate Change.

growing megacities, is an urban hotspot for climate risks. "Around 40 per cent of the country's urban population lives in slums, facing overcrowding, inadequate infrastructure and insufficient building standards", according to GIZ[78]. Recent floods have been worse in terms of inundation and duration of floodwater in the city's fringe areas, and extreme rainfall events appear to be increasing in frequency[79]. The cost of meeting Dhaka's current adaptation deficit without climate change would total approximately BDT2.7 billion, while the added cost of closing the climate change gap would require another BDT1.3 billion, for a total estimated cost of about BDT4.0 billion[80].

- **Chattogram Hill Tracts:** The hill tracts face an increase in soil erosion and landslides, especially in the rainy season. This will increase due to the expected increase in precipitation frequency and intensity. In the pre-monsoon periods, this area will face increased droughts as well. The flood plains at the coast are susceptible to flooding due to flash floods and monsoon floods, as well as related to cyclones, storm surges, and water logging[81].

- **Haor and Flash Flood Areas:** The Haor Region is highly vulnerable to flash floods from the hills. These flash floods occur are expected to increase because of intense rainfall and low conveyance capacity of rivers[82]. Increased sedimentation and drainage congestion decreases the conveyance capacity of rivers. The Haor Region has been identified in the BDP2100 as one of the highly food insecure regions. Increased flooding and salinization decrease agricultural production, which increases the food insecurity of the area. Climate change will exacerbate these effects.

Climate finance instruments relevant for Bangladesh

For many years, Bangladesh has been active in climate finance[83]. Further, Bangladesh has taken several steps in embedding climate policy in national strategies such as the 7th 5-Year Plan (FY2016-2020), the Climate Fiscal Framework approved by the Government of Bangladesh (June 2014), the nomination of the Economic Relations Division (ERD) of the Ministry of Finance as the National Designated Authority (NDA) to the Green Climate Fund (GCF) in 2014, the Perspective Plan of Bangladesh (2010-2021), the Bangladesh Climate Change Strategy and Action Plan (BCCSAP, 2009), and the National Adaptation Programme of Action (2005). The CCAP, as part of the IP to the BDP2100, is a logical next step in national policy and strategies on climate change adaptation.

78 Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ): https://www.giz.de/en/downloads/giz2015-en-giz-in-bangladesh.pdf

79 Dasgupta, S., A. Zaman, S. Roy, M. Huq, S. Jahan, and A. Nishat. Urban Flooding of Greater Dhaka in a Changing Climate: Building Local Resilience to Disaster Risk. World Bank Group.

80 Dasgupta, S., A. Zaman, S. Roy, M. Huq, S. Jahan, and A. Nishat. Urban Flooding of Greater Dhaka in a Changing Climate: Building Local Resilience to Disaster Risk. World Bank Group.

81 BDP2100 Main Report.

82 BDP2100 Main Report.

83 Tashmin, N. 2015. Can climate finance in Bangladesh be helpful in making transformational change in ecosystem management? Environmental Systems Research 5:2.

"Climate finance refers to local, national or transnational financing, which may be drawn from public, private and alternative sources of financing"[84]. Climate finance includes large-scale investments that are required to adapt to the effects of climate change. With the Paris Agreement, signed at the CoP21 (UNFCCC) in December 2015, developed countries agreed to continue to take the lead to mobilize climate finance from different sources, instruments, and channels, including supporting country-driven strategies[85].

Significant volumes of climate finance are becoming available globally:

- The UNFCCC estimated global climate financing between US$340 billion to US$650 billion in 2012, of which US$40 billion to US$175 billion flowed from developed to developing countries.[86]
- The Climate Policy Initiative (CPI) estimated global climate financing at US$392 billion in 2014. However, they noted that 'real' total climate financing was likely much higher: at least US$485 billion.[87]
- In 2015, the Organisation for Economic Co-operation and Development (OECD) estimated that the aggregate volume of public and private climate finance mobilised by developed countries for developing countries reached US$62 billion in 2014, up from US$52 billion in 2013. [88]
- Public climate finance specifically for climate change adaptation projects in developing countries reached US$22.5 billion in 2014.[89]

A study from the World Bank estimated that the scale of adaptation finance required in Bangladesh at US$5.7 billion by 2050.[90]

Climate finance includes local, national, and international sources from both public and private actors. The majority of the funds are operated by financial development institutions. In 2015, a total amount of US$81 billion of climate finance was mobilized by the world's six largest multilateral

84 UNFCCC 2014. Climate Finance. http://unfccc.int/focus/climate_finance/items/7001.php

85 Article 9 of the Paris Agreement 2015. https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf

86 UNFCCC 2014. 2014 Biennial Assessment and Overview of Climate Finance Flows."

87 Buchner, Barbara K., Chiara Trabacchi, Federico Mazza, Dario Abramskiehn, and David Wang 2015. Global Landscape of Climate Finance 2015. Climate Policy Initiative (CPI), 2015.

88 OECD 2015. Climate finance in 2013-14 and the US$ 100 billion goal, a report by the Organisation for Economic Co-operation and Development (OECD) in collaboration with Climate Policy Initiative (CPI): http://www.oecd.org/environment/cc/OECD-CPI-ClimateFinance-Report.htm

89 As estimated in The Adaptation Gap: Finance Report. United Nations Environment Programme (UNEP), Nairobi, Kenya, 2016.

90 World Bank Group 2011. The Cost of Adapting To Extreme Weather Events in a Changing Climate. Washington: World Bank.

development banks[91]. Climate funds aim to decrease barriers to investment in adaptation projects by increasing capacity of local stakeholders and creating incentives for investors to invest (for example, by developing co-financing structures).

Relevant financial climate funding for the Bangladesh Delta are:

- UNFCCC financial mechanisms:
  - The Green Climate Fund (GCF)[92]. The financial resources of the GCF is eqully split between adaptation and mitigation
  - The Global Environment Facility (GEF): Includes the Least Developed Country Fund (LDCF), and Special Climate Change Fund (SCCF), GEF Trust Fund. The LDCF is one of the smallest global funds. The cap on LDCF was US$20 million by 2014[93]
  - The Adaptation Fund (AF): Was established under the Kyoto Protocol of the UNFCCC

- United Nations (UNFCCC excluded): The International Fund for Agricultural Development (IFAD), includes the Adaptation for Smallholder Agriculture Programme (ASAP) [94]

- Multilateral development banks:
  - The World Bank Group: Climate Investment Funds (CIFs): for example, Pilot Program for Climate Resilience (PPCR) within the Strategic Climate Fund (SCF), the Global Facility for Disaster Reduction and Recovery (GFDRR), Climate Change Action Plan. The Climate Change Action Plan of the World Bank Group distinguishes four priority areas for climate investment in Bangladesh: flood management, coastal management and resilience, climate smart agriculture, and water management[95]
  - Asian Development Bank: Climate Change Fund (CCF)
  - The African Development Bank, European Bank for Reconstruction and Development, European Investment Bank, the Inter-American Development Bank, etc.

- Bilateral institutions: Apart from the financial sources above, there are numerous bilaterals potentially providing climate funding. Amongst these are:

91 The six world's largest multilateral development banks are: African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank, and the World Bank Group. Based on: World Bank Group 2016. Climate Finance, Overview: http://www.worldbank.org/en/topic/climatefinance/overview

92 GCF 2016. Complementary and coherence with other funds. https://www.greenclimate.fund/documents/20182/226888/GCF_B.13_08_-Complementarity_and_coherence_with_other_funds.pdf/ba069fd3-2fca-4316-a99f-2cb62f1a2041

93 Boyd, E. 2017. Climate adaptation: Holistic thinking beyond technology. Nature: Climate change 7, 97-98. Published online at: http://www.nature.com/nclimate/journal/v7/n2/full/nclimate3211.html

94 Boyd, E. 2017. Climate adaptation: Holistic thinking beyond technology. Nature: Climate change 7, 97-98. Published online at: http://www.nature.com/nclimate/journal/v7/n2/full/nclimate3211.htm

95 World Bank Group, 2016. World Bank Group Climate Change Action Plan, April 2016.

- Germany's International Climate Initiative (IKI) [96]
- UK's International Climate Fund (ICF) [97]
- Norway's International Climate and Forest Initiative (ICFI) [98]
- European Union's Global Climate Change Alliances (GCCA). The GCCA focuses its technical support on three areas: climate change mainstreaming and poverty reduction, increasing resilience to climate-related stresses and shocks, and sector-based climate change adaptation and mitigation strategies.[99]

Although other financial sources will not be ignored, the GCF is particularly important for the CCAP because of its significant potential funding, its large impact potential, and the scale of the transformational projects included in the CCAP.

The GCF uses the following instruments: grants, concessional loans, equity, and guarantees[100]. The terms are determined on a case-by-case basis. Co-financing with the GCF buys down upfront cost, increases risk tolerance, and improves cash flows[101].

Instrument types

Different financial instruments distribute the risks in a project in different ways, influencing private and public co-investments differently[102]. An example of an innovative way to mobilise additional resources by co-financing are the efforts by the International Finance Corporation (IFC) to co-invest donor funds on concessional terms in addition to its own commercial fund in climate projects. This co-financing decreases and reduces market barriers and investment risks. The IFC plans to grow its commitment with climate co-benefits to 28 percent (US$3.5 billion by 2020), from the current levels of US$2.3 billion. To do so, IFC will create products that attract larger institutional sources of capital through aggregation and securitization, create de-risking vehicles that use blended finance, and increase its climate-related PPPs[103].

96 IKI 2016: https://www.international-climate-initiative.com/en?iki_cookie_check=1

97 Government of the United Kingdome, 2016: https://www.gov.uk/government/publications/international-climate-fund/international-climate-fund

98 Norwegian Agency for Development Cooperation 2016: https://www.norad.no/en/front/thematic-areas/climate-change-and-environment/norways-international-climate-and-forest-initiative/

99 GCCA 2016. See: http://www.gcca.eu/about-the-gcca/what-is-the-gcca

100 For more information see the website of the GCF. http://www.greenclimate.fund/home

101 For more information see the website of the GCF. http://www.greenclimate.fund/home

102 For more information on the Climate Finance Landscape of 2014 and different instrument types used, see: http://www.climatefinancelandscape.org/#/reading/article-4

103 World Bank Group 2016. The World Bank Group Climate Change Action Plan, April 2016.

Another innovative construction is making use of a climate bond (or green bond). Climate bonds are fixed income securities, with a competitive financial return[104]. They act like ordinary bonds, by having the same yield and rating, and are linked to climate activities[105]. The major difference between a climate bond and an ordinary bond is their long-term revenue provision. Investors can invest both in individual climate bonds and in climate bond indexes[106]. Investing in climate bond indexes has the advantage of risk diversification.

Other financial instruments include[107]:

- Investment loans: These loans require repayment, and finance infrastructural and institutional development
- Policy-based loans: These loans provide flexible support for institutional and policy reforms
- Budget support: financing a country's budget through a transfer of resources from an external financing agency to the national budget of the Government of Bangladesh
- Grants: transfers without requirement of repayment. These are provided for investment support, or policy-based support (for example, grants through the GCF)
- Guarantees: commercial/political risk assumed by a multilateral development bank
- Equity: ownership interest representing a claim on the assets in proportion to what is owned (for example, green bond)
- Lines of credit: provides a guarantee that funds will be made available.

104 Abramskiehn, D., B. Buchner, & B. Buchner 2015. The Landscape of Climate Exposure for Investors.

105 Kidney, S., 2015. Bonds and Climate Change, London. Mathews, J. a & Kidney, S., 2012. Financing climate-friendly energy development through bonds. Development Southern Africa, 29(2), pp. 337–349. Available at: http://www.tandfonline.com/doi/abs/10.1080/0376835X.2012.675702.

106 Abramskiehn, D., Buchner, B. & Buchner, B., 2015. The Landscape of Climate Exposure for Investors.

107 MDBs 2016. Joint report on multilateral development banks' climate finance. This report was written by a group of multilateral development banks (MDBs), composed of the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank Group (IDBG), and the World Bank Group (WBG).

Box D.1: Green Climate Fund (GCF) Financing Instruments

The following financing instruments are used by the Green Climate Fund:

- Concessional loans (senior and subordinate)
- Grants
- Equity
- Guarantees.

The next step in applying for GCF funding for projects within the CCAP involves developing a GCF program concept note. While developing the program concept note, the different contributions of financing sources will be further developed. This involves investigating several GCF financing instruments as well. The current state of project information does not allow for developing linkages between projects and GCF financing instruments.

Guidelines for accessing (international) funds

The process of applying for climate funds (for example, the GCF) is sometimes challenging[108]. However, based on experience of the Adaptation Fund, the process of developing funding proposals has inherent co-benefits beyond accessing finance. It potentially generates knowledge, and strengthens institutions and (implementation) capacity as well.

Questions to be answered when writing a funding proposal are:

- What are the key criteria that should be focused on? How do the project objectives relate to the key criteria of the fund?
- Which projects of the CCAP have similarities and could thus be grouped in a funding proposal?
- Who puts the proposal forward? Which actor takes responsibility?

Below is a first attempt to answer these key questions as a first step towards developing a proposal for international funds, such as GCF.

Key criteria of the GCF

The GCF discloses a wide range of information through its website[109], for example, more information on the accreditation process, investment framework, etc. Information on the GCF website includes, but is not limited to, decisions of the Board, policy papers, and project-related information that provides details on all GCF-funded projects and programs.

108 ICCAD (International Centre for Climate Change and Development) and IIED (International Institute for Environment and Development) 2015. The Green Climate Fund accreditation process: barrier or opportunity? Briefing: Climate change, policy and planning.

109 Website of the GCF: www.greenclimate.fund

As an example, BDP 2100 projects all fit in each of the four adaptation impact areas as selected by the GCF: increased resilience of livelihoods, communities, infrastructure, built environment, health, food, water security, ecosystems, and ecosystem services[110].

Additionally, the guiding principles of the CCAP are well aligned with the investment criteria of the GCF. The following adaptation investment criteria are outlined by the GCF: adaptation impact, paradigm shift potential, sustainable development, needs of the recipient, and economic efficiency and effectiveness. The CCAP meets the benchmarks for each criterion, as presented by the GCF's assessment methodology[111]. Additionally, the CCAP meets the GCF's requirement of country-driven programming.

Framework project proposals GCF and next steps

The application for GCF funding involves a six-stage process, including concept development by means of a concept note[112]. Applications must include a clear explanation on how the project or program fits with the country's national priorities[113]. The following steps are:

- First, projects within the CCAP with similar characteristics do not need separate funding proposals. These projects can be grouped into one funding proposal per group. The following characteristics will be used to group projects:
  - Investment needs (estimated project costs)
  - Readiness (for example, capacity needs, budget)
  - Scale
  - Type (infrastructure/institutional/knowledge)
  - Crosscutting themes (too much water/too little water/sufficient water quality, (refer to Appendix B))

  Groups include projects with similarities on listed characteristics, and can be further developed into a funding proposal.

- Second, the application should ensure full country ownership, which requires consulting with the funding sources in early stages of the development process. The focal agency and GCF point of contact is the National Designated Authority (NDA) of Bangladesh[114], which is the Senior Secretary of Economic Relations Division of Ministry of Finance of

110 GCF 2015. GCF adaptation results areas, investment criteria, results and indicators: an overview. http://unfccc.int/files/adaptation/application/pdf/nwa_8.2_gcf.pdf

111 GCF 2016, Initial assessment methodology (option A).

112 A format of the GCF concept note can be found on the GCF website: http://www.greenclimate.fund/documents/20182/473770/GCF_Concept_Note_Template.docx/18570723-5f7c-44c9-aacb-8c68fe99fce8

113 GCF 2016, Project Preparation Facility Guidelines.

114 GCF 2016, Project Preparation Facility Guidelines.

Bangladesh[115]. The NDA develops work programmes and oversees GCF proposals. Additionally, national and local entities should be involved to secure (local) stakeholder support and involvement during the process.

- Third, detailed feasibility studies are required to define the cost and benefits of each of the projects within the CCAP. Social costs and social benefits of projects need to be quantified to gain more insights in the impact of each project. This is necessary information to be included in the GCF proposal.
- Fourth, the project files of pipeline projects should agree with the guiding principles/ investment criteria of the GCF.
- Strategy of the CCAP
- The climate change adaptation needs in Bangladesh relate to "the difference between the level of actual implemented adaptation and the nationally determined needs […] related to climate change impacts, as well as resource limitations and competing priorities"[116].
- At the 21st session of the Conference of the Parties (CoP21) in Paris[117], the importance of an integrated and holistic approach to tackle nationwide climate change issues was emphasized. However, adaptation in many countries currently has a predominant technological focus: "identifying and reducing exposure to shocks and stresses; limiting the impact of unavoidable shocks and stresses; and building capacity to respond and recover in the medium-term"[118]. Institutional development, for example, as well as a more holistic approach to climate change adaptation, can be significantly improved[119]. Fragmented and ad hoc resilience projects will not lead to integration or mainstreaming of climate adaptation, nor will it result in (needed) radical transformations[120]. The attractiveness and efficiency of the CCAP increases when it is designed as a coherent and integrated program including a pipeline of (climate) adaptation related projects[121].

115 UNDP 2015. Getting Bangladesh Ready for Direct Access to Green Climate Fund, found at: http://www.bd.undp.org/content/bangladesh/en/home/presscenter/pressreleases/2015/01/28/getting-bangladesh-ready-for-direct-access-to-green-climate-fund-gcf-.html

116 UNFCCC 2016. The Adaptation Gap. Nairobi.

117 UNFCCC 2015. Adoption of the Paris Agreement. Conference of the Parties, twenty-first session. Found on the World Wide Web at: http://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf

118 Boyd, E. 2017. Climate adaptation: Holistic thinking beyond technology. Nature: Climate change 7, 97-98. Published online at: http://www.nature.com/nclimate/journal/v7/n2/full/nclimate3211.html

119 Boyd, E. 2017. Climate adaptation: Holistic thinking beyond technology. Nature: Climate change 7, 97-98. Published online at: http://www.nature.com/nclimate/journal/v7/n2/full/nclimate3211.html

120 Boyd, E. 2017. Climate adaptation: Holistic thinking beyond technology. Nature: Climate change 7, 97-98. Published online at: http://www.nature.com/nclimate/journal/v7/n2/full/nclimate3211.html

121 Boyd, E. 2017. Climate adaptation: Holistic thinking beyond technology. Nature: Climate change 7, 97-98. Published online at: http://www.nature.com/nclimate/journal/v7/n2/full/nclimate3211.html

The strategy of the CCAP is to use a holistic and integrated approach to climate adaptation, not solely focusing on technology and water management solutions but also on infrastructural, institutional, and social resilience. This strategy follows the BDP2100 goal to "… ensure long-term water and food security, economic growth and environmental sustainability while effectively coping with natural disasters, climate change, and other delta issues through robust, adaptive and integrated strategies, and equitable water governance". By developing the CCAP, as part of the IP, collective climate risk in Bangladesh is tackled in an integrated way.

Guiding principles for the CCAP

The following guiding principles (adapted/aligned to GCF investment criteria)[122] are used to flag the projects from the six regional hotspot programs for climate financing:

- Impact potential
- Paradigm shift potential
- Sustainable development potential
- Potential of leveraging other sources of finance (private, public, donors) using climate finance as a co-financing strategy to unlock other financing sources.

Table D.1 gives a definition of each of these four guiding principles and on what parameters the whole set of BDP2100 projects have been evaluated.

Table D.1: Guiding Principles for Selection of Pipeline Projects of the CCAP[123]

Guiding principle	Definition	Indicators/definition
Impact potential	Expected reduction in vulnerability by enhancing the adaptive capacity of a system and reduced exposure to climate risk	Expected decrease in vulnerability
Paradigm shift potential	Potential to catalyse impact beyond a one-off project or program investment	Potential for scaling up
		Potential for knowledge developing
		Contributing to institutional and regulatory framework
Sustainable development potential	Wider benefits and priorities, including environmental, social, and economic co-benefits	Expected co-benefits for the environment
		Expected co-benefits for society and health
		Expected co-benefits for economic development in the area
Potential of leverage other sources of finance	Potential to leverage and mobilize other financing sources (including private finance)	Attractiveness of the project to leverage other sources of finance

122 Based on the investment criteria of the Green Climate Fund, and adapted by Arcadis/Castalia.

123 Based on the investment criteria of the Green Climate Fund, and adapted by Arcadis/Castalia.

Involving private businesses

The CCAP aims to increase private sector involvement in climate adaption. This is important for three main reasons.

- First, the private sector is a key driver of economic growth in Bangladesh[124]. Therefore, when private businesses are limited in their operations due to more frequent extreme weather extremities, the overall economy suffers as well.
- Second, developing new technologies that deal with climate change adaptation creates new business models from which the economy can profit[125]. Working on climate change adaptation can be very beneficial for private sector enterprises because of the huge potential in required future technologies that can drive change towards a more future-proof economy.[126]
- Third, private sector money is required to fill in the global financial adaptation gap. Financing needs for resilient growth and climate adaptation are much larger than available public resources[127]. Policy and institutional support for national climate adaptation investment plans and strategic use of private sector finance will be critical to having sufficient impact at the required (national) scale[128].

The CCAP includes government initiatives to involve private businesses in climate adaptation and developing climate resilience. The largest barrier for private businesses to engage in adaptation is the lack of awareness on how to prioritise and invest in those projects with the largest returns[129]. The CCAP aims at enhancing awareness among business about how they need to adapt, and the opportunities for climate finance open to them, as well as business opportunities within the overall CCAP investment program.

The CCAP increases the potential access to additional climate financing, such as the Green Climate Fund (GCF) and the private sector. The pipeline of dedicated and integrated climate change adaptation projects, which forms the core of the CCAP within the IP, helps to mobilize and channel both public and private sector financial resources.

124 DCED (the Donor Committee for Enterprise Development) 2016. Private sector adaptation to climate change and development agency support. DCED Synthesis Note, December 2016. CDKN 2016 Climate change – A new market for Bangladeshi businesses

125 Stern, N. 2016. Economics: Current climate models are grossly misleading. Nature 530, 407-409. Found on the World Wide Web at: http://www.nature.com/news/economics-current-climate-models-are-grossly-misleading-1.19416

126 UNFCCC 2016. The Adaptation Gap. Nairobi

127 World Bank Group 2016. The World Bank Group Climate Change Action Plan, April 2016.

128 World Bank Group 2016. The World Bank Group Climate Change Action Plan, April 2016.

129 CDKN 2016 Climate change – A new market for Bangladeshi businesses.

Pipeline projects of the CCAP

Individual projects from the regional hotspot programs have been evaluated, using the climate financing guiding principles in Table D.2. These guiding principles are used to assign priority investment areas under the CCAP. The CCAP aims to prioritize climate adaptation projects as such, focusing on a few cross-cutting themes: too much water, sufficient fresh water quantity, and water quality.

Table D.3 presents an overview of proposed pipeline projects of the CCAP based on projects and/or project components selected from the six hotspot programs, following the climate financing guiding principles described. Furthermore, pipeline projects have been categorized based on types (infrastructure, institutional, and/or knowledge & information) and cross-cutting theme (too much water, sufficient fresh water quantity, and improving water quality)[130]. The projects are scored on each guiding principle based on information obtained during the IP-process, using the scales as presented in Table D.2.

Table D.2: Scale Scoring Guiding Principles of Pipeline Projects in the CCAP

Score	Impact potential	Paradigm shift potential	Sustainable development potential	Potential to leverage other sources of finance
0	Uncertain/ no decrease in vulnerability to climate risk	Uncertain/ no potential for upscaling, knowledge development or institutional reform	Uncertain/ no expected co-benefits for environment, society, health, and/or economic development in the area	Uncertain/ project not attractive to leverage other sources of finance
+	Moderate decrease in vulnerability to climate risk	Moderate potential for upscaling, knowledge development or institutional reform	Moderate expected co-benefits for environment, society, health, and/or economic development in the area	Project moderately attractive to leverage other sources of finance
++	Significant decrease in vulnerability to climate risk	Significant potential for upscaling, knowledge development or institutional reform	Significant expected co-benefits for environment, society, health, and/or economic development in the area	Project highly attractive to leverage other sources of finance

Table D.3: Proposed Pipeline Projects CCAP

Potential pipeline projects for the CCAP	Function (Infrastructure/ institutional/ knowledge)	Impact potential	Paradigm shift potential	Sustainable development potential	Potential to leverage other sources of finance
UA1.2: Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road Multipurpose Project	Infrastructure	++	0	++	+

130 This includes projects pre-selected from the BDP2100 by the General Economics Division of the Government of Bangladesh (indicated with * in the table)

Potential pipeline projects for the CCAP	Function (Infrastructure/ institutional/ knowledge)	Impact potential	Paradigm shift potential	Sustainable development potential	Potential to leverage other sources of finance
UA1.2: Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road Multipurpose Project	Infrastructure	++	0	++	+
CZ1.8/1.21: West Gopalganj Integrated Water Management	Infrastructure	++	+	+	+
CZ1.5 Tidal River Management	Institutional/knowledge	+	++	+	+
UA11.1: Improvement of Drainage Congestion, Canal Dredging and Flood Control for Barishal CC area	Infrastructure	++	+	+	+
UA3.1: Improvement of drainage network, flood control and solid waste management for Khulna City	Infrastructure	++	+	+	+
UA9.3: Project for improvement of storm water drainage facilities in the city corporation area	Infrastructure	++	+	+	+
HR1.1: Program for Implementation of Rationalized Water Related Interventions in Upper Meghna Basin	Infrastructure	++	+	+	+
HR2.4: Elevated Village Platforms for the Haor Areas	Infrastructure	++	0	+	+
CC18.5: Improvement of Urban Drainage in District and Upazila level municipalities of Bangladesh	Infrastructure	++	+	+	+
CC1.4: Development/ Improvement of Multipurpose Disaster Shelters and its Management Information System (MDS&MIS)	Infrastructure	+	+	+	+
CC9.18: Project for improvement of storm water drainage facilities in pourashavas (Phase I)	Infrastructure	++	+	+	+

Potential pipeline projects for the CCAP	Function (Infrastructure/ institutional/ knowledge)	Impact potential	Paradigm shift potential	Sustainable development potential	Potential to leverage other sources of finance
UA1.3: Drainage Improvement of Dhaka-Narayanganj-Demra (DND) Project - Phase 2	Infrastructure	++	+	+	0
MR1.1: River Management Improvement Program (River Bank Management Program)	Infrastructure	++	+	+	0
MR1.2 Integrated River System Management and Protection of Accreted Land	Knowledge	+	++	+	0
MR1.5 Harnessing of Brahmaputra Water		Knowledge	+	++	+
MR1.46 Integrated Jamuna-Padma Rivers Stabilization and Land Reclamation Project	Infrastructure	++	+	+	++
CC1.41 Program for Implementation of Rationalized Water Related Interventions in Dhaleswari Basin	Infrastructure	+	+	+	+
CZ1.3: Char development and Settlement Project – V	Infrastructure	++	++	+	+
CZ1.7: Urirchar-Noakhali Cross Dam Project	Infrastructure	+	+	+	+
CZ1.6: Integrated Land Reclamation Project of Hatiya-Dhamar Char-Nijhum Dwip	Infrastructure	+	+	+	+
CZ1.38: TRM in four (4) beels in the coastal area	Infrastructure	++	+	++	0
CZ1.11: Improved drainage problem in the Bhabadha Area	Infrastructure	++	0	+	0
CZ1.26: Development of Water Management Infrastructure in Bhola Island	Infrastructure	++	+	+	0

Potential pipeline projects for the CCAP	Function (Infrastructure/ institutional/ knowledge)	Impact potential	Paradigm shift potential	Sustainable development potential	Potential to leverage other sources of finance
DP1.21: Program for Implementation of Rationalized Water Related Interventions in Hurasagar basin	Infrastructure	+	+	+	0
CZ1.11: Addressing Water logging and flood problem in Bhabadah Area through Improved Drainage and TRM*	Infrastructure and knowledge & information	++	+	+	0
HR14.3: Management of Commercially Important Wetland Ecosystem*	Infrastructure and knowledge & information	+	+	+	+
CZ4.1: Development of Climate Smart Integrated Coastal Resources Database (CSICRD)	Knowledge & information	+	++	+	0
CZ1.41: Program for Implementation of Rationalized Water Related Interventions in Gorai-Passur Basin	Infrastructure, knowledge & information, and institutional	+	+	++	+
CZ1.44: Rationalization of Polders in Baleswar - Tentulia Basin	Infrastructure, knowledge & information, and institutional	++	+	+	+
CZ1.45: Program for Implementation of Rationalized Water Related Interventions in Baleswar-Tentulia Basin	Infrastructure, knowledge & information, and institutional	++	+	+	+
CZ1.47: Rationalization of Polders in Gumti - Muhuri Basin	Infrastructure, knowledge & information, and institutional	++	+	+	+
CZ1.48: Program for Implementation of Rationalized Water Related Interventions in Gumti - Muhuri Basin	Infrastructure, knowledge & information, and institutional	++	+	+	+

Potential pipeline projects for the CCAP	Function (Infrastructure/ institutional/ knowledge)	Impact potential	Paradigm shift potential	Sustainable development potential	Potential to leverage other sources of finance
CH1.11: Program for Implementation of Rationalized Water Related Interventions in Chattogram Coastal Plain Basin	Infrastructure, institutional, and knowledge & information	+	+	+	0
CH1.10: Rationalization of Polders in Chattogram Coastal Plain**	Infrastructure, institutional, and knowledge & information	+	+	+	+
CZ1.30: Rehabilitation of Water Management Infrastructure in Bhola District	Infrastructure	++	+	+	+
CZ1.4: Study on Integrated Management of Drainage Congestion for Greater Noakhali	Knowledge & information	+	++	+	+
UA1.1: Protection of rivers system around Dhaka City with their Ecological Restoration.	Infrastructure	++	0	+	0
MR1.1: River Management Improvement Program (River Bank Management Program)	Infrastructure	++	0	+	+
MR12.1: Enhancement of Agricultural Productivity towards Food Security in Char Lands	Infrastructure, institutional, and knowledge & information	+	++	+	+
MR3.1: Sustainable Restoration of Connectivity of Major Navigation Routes	Infrastructure	++	0	+	0
MR1.6: Development of Chandona-Barasia River Basin System	Infrastructure	++	0	+	0
CZ1.1: Ganges barrage	Infrastructure	++	0	+	+
HR2.1/2.2: Village Protection against wave action in Haor area & Improved Water Management in Haor Basins	Infrastructure	++	0	+	0

Potential pipeline projects for the CCAP	Function (Infrastructure/ institutional/ knowledge)	Impact potential	Paradigm shift potential	Sustainable development potential	Potential to leverage other sources of finance
DP1.1: North Rajshahi Irrigation Project	Infrastructure	++	+	+	0
DP1.2: Revitalization and Restoration of Chalan Beel*	Infrastructure	+	+	+	0
DP1.3: Revitalization and Restoration of Hurasagar and Atrai rivers	Infrastructure	+	+	+	0
DP1.4/1.5: Kurigram Irrigation Project	Infrastructure	++	+	+	0
CZ1.40: Rationalization of Polders in Gorai - Passur Basi*	Infrastructure, knowledge & information, and institutional	++	+	+	+
UA23.1: Khulna Water Supply Project Phase II	Infrastructure	++	+	+	+
CC1.3: Dynamic Climate Smart Knowledge Portal and Hydro-geological Database for MoWR and BWDB	Knowledge & information	0	+	+	0
CC12.37: Integrated Agricultural Development in moderately Cyclone affected area	Infrastructure and knowledge & information	+	+	+	0
CH12.4: Enhancement of Livelihood in the Chattogram Hill Tracts Through Good Agricultural Practice	Infrastructure, knowledge & information, and institutional	++	+	+	0
CC9.17: Project for improvement of water supply and sanitation facilities in char area	Infrastructure	+	+	+	+
UA9.1(20.1): Greater Dhaka Integrated Water and Sewage Improvement Project	Infrastructure	++	+	+	+
UA10.1: Improvement of Sanitation, Drainage Congestion and Flood Control for Chattogram City Corporation Area	Infrastructure	++	+	+	+

***: Already selected by the Government of Bangladesh as projects that may be (partly) funded by the GCF.**

Within the CCAP, sub-programs will be formed in areas such as:

- Revitalization of polders
- Irrigation
- Drainage control
- Tidal river management (TRM)
- Ecosystem preservation
- Knowledge projects
- Sewerage and sanitation

Governance of the CCAP

The CCAP will be coordinated by the Delta Commission, which will work in cooperation with existing sector coordinating institutions and implementing agencies, notably:

- BWDB (Bangladesh Water Development Board)
- WARPO (Water Resources Planning Organization)
- WASAs (Water Supply and Sewerage Authorities)
- The Joint Rivers Commission
- DoE (Department of the Environment)
- DAE (Department of Agricultural Extension)
- Bangladesh Water Multi-Stakeholder Partnership (BMWSP).

Proposed Climate Change Adaptation Program coordination mechanism

Table D.4 provides an overview of the proposed lead agencies for the potential pipeline projects, clustered by cross-cutting theme, in the Climate Change Adaptation Program. The pipeline projects themselves are summarized in Table D.3.

Table D.4: Lead Agencies for the Climate Change Adaptation Program

Cross-cutting Theme	Lead Agencies
Too much water: Improving flood safety and reduction of water logging	BWDB BWDB
Sufficient fresh water quantity: Improving fresh water supply	BWDB BIWTA
Sufficient water quality: Improving water quality	WASAs Department of Public Health Engineering

To arrange for proper implementation of projects, appropriate coordination mechanisms will be put into place. These coordination mechanisms are based on the general governance and institutional reform issues as addressed in the Bangladesh Delta Plan (refer also to next section of this Appendix), as well as specific requirements in view of a GCF funding of the Climate Change Adaptation Program. The Delta Commission will coordinate between the Lead Agencies, the National Implementing Entities (NIEs), and the Economic Relations Division of the Ministry of Finance, which is responsible for mobilizing GCF funding.

National Policy and Institutional Reforms

Because climate change affects almost every aspect of life in Bangladesh, it is important for climate change issues to be considered in project and policy decisions. In addition to the coordination and capacity building initiatives listed, Bangladesh will undertake several policy and institutional reforms to mainstream climate change adaptation in the near-term (next 1 to 2 years) and longer-term (after 2 years).

Near-Term Actions

The Ministry of Environment and Forests developed the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2009 to build the capacity and resilience of the country to meet the challenges of climate change. This BCCSAP will be updated to incorporate the principles of adaptive management and to incorporate new information such as the adoption of the United Nations Framework Convention on Climate Change Paris Agreement in 2015.

Bangladesh has already developed numerous climate change adaptation plans and laws, including the National Adaptation Plan, the Gender Action Plan on Climate Change, the Disaster Management Act, and the Climate Fiscal Framework (2014). These plans will be reviewed, updated, and implemented.

Line ministries and agencies across all sectors require training and capacity building to promote and evaluate climate change risks and plan adaptation measures. A program will be developed to first identify specific needs within each agency, and then to provide the necessary training and capacity building. One key area will be integrating adaptive flood risk management measures in water resource planning, since flooding is one of the major climate change impacts on Bangladesh.

To build capacity, a National Climate Change Cell will be established within the Department of Environment of the Ministry of Environment and Forests. This National Climate Change Cell will perform technical capacity and knowledge responsibilities to support the Ministry of Planning, Ministry of Finance, and line ministries.

To identify appropriate climate change adaptation activities, a Project Preparation Facility will also be established to help with project design and project proposal review. This Facility will support pre-project economic, social, and environmental screening and impact assessments. It will help identify external financing sources and serve as a clearinghouse for technologies and best practices, external financing options, and project selection criteria. The Facility will review and improve proposal designs and analyses. The Facility will also design implementation and monitoring, reporting, and verification strategies. By advising other ministries and agencies with these steps, the Facility will also help build capacity across ministries on all aspects of climate change adaptation project cycle management.

Longer-Term Actions

In the longer-term, once the BCCSAP has been updated, it will be implemented and reflected, where appropriate, in all sector strategies, policies, and legislation. Programs will be implemented to establish and build the capacity of Climate Change Focal Points within ministries and line ministries and agencies.

Climate change adaptation measures may disrupt lives of people living in areas with implemented infrastructure projects and may require relocations from high-risk areas. Studies will be conducted to assess the feasibility and costs of relocating people from high-risk areas like the Sundarbans, and for people affected by polder abandonment and beel operations. Compensation schemes will be developed for those affected.

Appendix E: Institutional Structure for Program Management

The Investment Plan uses a programmatic approach, as set out in section 2 of the Investment Plan. Figure E.1 shows the structure of the hotspots and sub-programs.

Figure E.1: Overview of the Investment Plan Hotspots and Sub-Programs

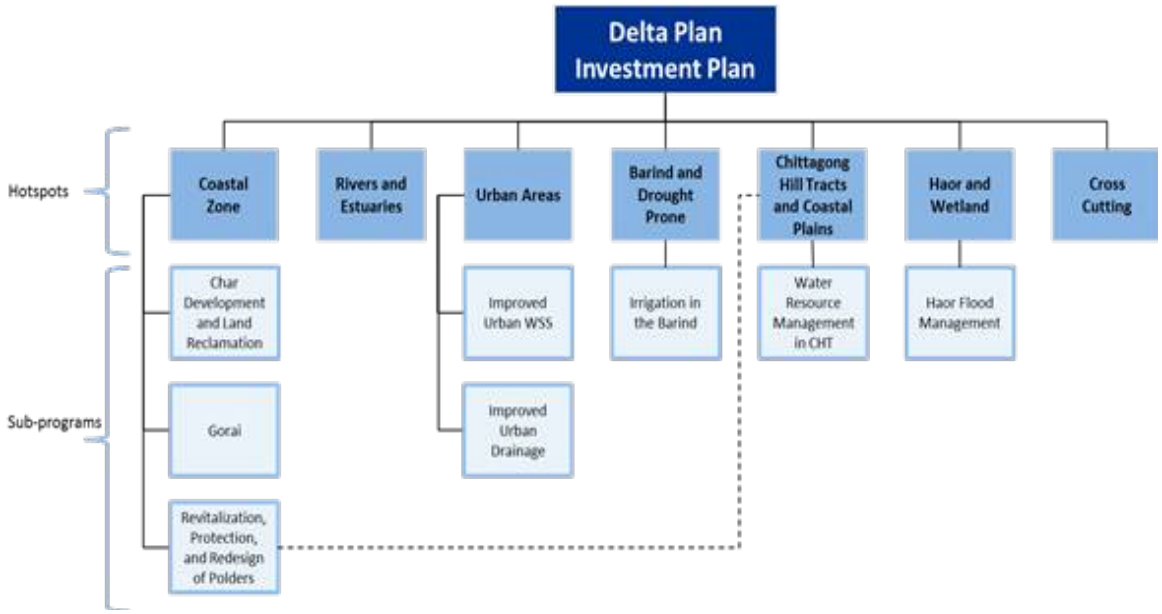


Table E.1 summarizes the Investment Plan hotspot sub-programs. It describes each hotspot sub-program and its linkages to the Delta Plan goals and strategies.

Table E.1: Investment Plan Hotspot Sub-programs

Program	Hotspot	Description	Delta Plan Goals	Related Delta Strategy(ies)
Char Development and Land Reclamation	Coastal Zone	Increases sustainable char development to improve the living standards of the char area and coastal zone population Includes projects that: • Protect newly accreted chars in the coastal zone from erosion, floods, and storm surges • Develop new chars and reclaim land	• (1) Ensuring safety from floods and climate change related disasters • (6) Achieving optimal and integrated use of land and water resources	• Increase drainage capacity and reduce flood risk at coastal
Gorai	Coastal Zone	• Enhances sustainable and efficient water resources management in the Gorai by modernizing existing water infrastructure	• (1) Ensuring safety from floods and climate change related disasters • (2) Enhancing water security and efficiency of water usages • (3) Ensuring sustainable and integrated river systems and estuaries management • (5) Developing effective institutions and equitable governance for water resources management • (6) Achieving optimal and integrated use of land and water resources	• Increase drainage capacity and reduce flood risk at coastal zone, and balance water supply and demand for sustainable growth
Revitalization, Protection, and Redesign of Polders	Coastal Zone	• Revitalizes, protects, and redesigns existing and new polders in the Coastal Zone and in the Chattogram Coastal Plains to reduce loss of assets, salt water intrusion, and drainage congestion • Rationalizes water resource management in the polders	• (1) Ensuring safety from floods and climate change related disasters • (2) Enhancing water security and efficiency of water usages • (6) Achieving optimal and integrated use of land and water resources	• Increase drainage capacity and reduce flood risk at coastal zone

Program	Hotspot	Description	Delta Plan Goals	Related Delta Strategy(ies)
Water Resource Management in CHT	Chattogram Hill Tracts and Coastal Plains	Develops water resource management plans for the area Rationalizes water resource management by improving infrastructure Includes projects that: • Develop catchment and sub-catchment water resources management plans • Enhance the hills-plain interaction • Provide for regional cooperation	• (2) Enhancing water security and efficiency of water usages • (3) Ensuring sustainable and integrated river systems and estuaries management • (5) Developing effective institutions and equitable governance for water resources management • (6) Achieving optimal and integrated use of land and water resources	• Protect economic zones and towns from flood and storm surge and Ensure integrated river management
Improved Urban WSS	Urban Areas	• Improves existing urban water supply and sanitation systems to provide safe, potable, adequate water service for the growing population, including low income people, and to ensure uninterrupted water supply • Improves health and environment through better sanitation management	• (2) Enhancing water security and efficiency of water usages	• 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 • 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

Program	Hotspot	Description	Delta Plan Goals	Related Delta Strategy(ies)
Improved Urban Drainage	Urban Areas	Improves drainage management in urban areas through measures such as: • Rehabilitation and (re)-excavation of drains • Easy and quick disposal of storm and domestic wastewater to permanent disposal channels	• (1) Ensuring safety from floods and climate change related disasters • (3) Ensuring sustainable and integrated river systems and estuaries management	• Increase drainage capacity and reduce flood risk at urban area
Irrigation in the Barind	Barind and Drought Prone	Decreases the vulnerability of the Barind region to droughts by improving the design and management of irrigation schemes	• (2) Enhancing water security and efficiency of water usages • (6) Achieving optimal and integrated use of land and water resources	• Balancing supply and demand for sustainable and inclusive growth and ensuring water supply and sanitation
Haor Flood Management	Haor and Wetland	Decreases the vulnerability of the Haor region to floods by increasing the amount of protected area and improving protection levels	• (1) Ensuring safety from floods and climate change related disasters • (4) conserving and preserving wetlands and ecosystems	• Protect agriculture and vulnerable communities from floods in the Haor Region

A steering committee and implementing agency will be appointed for each hotspot program or sub-program. The steering committee and implementing agency for each program and sub-program will provide the institutional framework to coordinate implementation. Table E.2 shows the structure of the steering committee and implementation agencies for each sub-program.

Table E.2: Institutional Structure for Investment Plan Sub-Programs

Program	Hotspot	Steering Committee Members	Implementation Agency(ies)
Char Development and Land Reclamation	Coastal Zone	• Bangladesh Water Development Board • Ministry of Water Resources • Local Government Engineering Department • Ministry of Agriculture • Department of Fisheries and Livestock • Department of Disaster Management	• Bangladesh Water Development Board
Gorai	Coastal Zone	• Bangladesh Water Development Board • Local Government Engineering Department • Water Resources Planning Organization • Bangladesh Agricultural Development Corporation • Roads and Highways Department • Department of Public Health Engineering • Department of Agricultural Extension • Department of Fisheries • Finance Division • Department of Livestock Services	• Bangladesh Water Development Board
Revitalization, Protection, and Redesign of Polders	Coastal Zone	• Bangladesh Water Development Board • Water Resources Planning Organization • Local Government Engineering Department • Roads and Highways Department • Department of Public Health Engineering • Department of Environment • Department of Fisheries • Department of Disaster Management • Finance Division • Department of Livestock Services	• Bangladesh Water Development Board

Program	Hotspot	Steering Committee Members	Implementation Agency(ies)
Water Resource Management in CHT	Chattogram Hill Tracts and Coastal Plains	• Bangladesh Water Development Board • Meteorology Department • Ministry of Land • Ministry of Environment and Forest • Ministry of Water Resources • Ministry of Agriculture • SRDI • NARS Institute • BARC • Chattogram Hill Tracts Council • LGED • Forestry Department	• Bangladesh Water Development Board • Meteorology Department
Improved Urban WSS	Urban Areas	• Mayor • Bangladesh Water Development Board • Water Supply and Sewerage Authority • Development Authority • Port Authority • Department of Environment • District administration • Law enforcement agencies	• Chattogram City Corporation • Dhaka City Corporation • Khulna City Corporation • Other city corporations
Improved Urban Drainage	Urban Areas	• Mayor • Bangladesh Water Development Board • Water Supply and Sewerage Authority • Development Authority • Port Authority • Department of Environment • District administration • Law enforcement agencies	• Chattogram City Corporation • Dhaka City Corporation • Khulna City Corporation • Other city corporations • Pourashavas (municipalities)
Irrigation in the Barind	Barind and Drought Prone	• Bangladesh Water Development Board • Ministry of Water Resources • Ministry of Agriculture	• Bangladesh Water Development Board
Haor Flood Management	Haor and Wetland	• Haor and Wetland Development Department (DBHWD) • Local Government Engineering Department • Ministry of Water Resources • Bangladesh Water Development Board • Bangladesh Agricultural Development Corporation • Water Resources Planning Organization • Roads and Highways Department • Department of Public Health Engineering • Department of Agricultural Extension • Department of Fisheries • Finance Division • Department of Livestock Services	• Haor and Wetland Development Department (DBHWD)

Appendix F: Policy and Institutional Reforms Matrix

To ensure the successful implementation and sustainability of the Investment Plan, policy and institutional reforms are needed to incorporate ADM principles into the program lifecycle. As the IP helps Bangladesh grow economically, these policy and institutional reforms will help maximize the development impact of the IP, achieve the Delta Plan goals, ensure efficient use of public funds, and mobilize private financing.

The intended reforms are summarized in a Policy and Institutional Reform Matrix in Table F.1. This section discusses the structure of the policy matrix and the analytical basis for the recommendations. It then discusses the reforms that are recommended in the policy sphere and in the institutional sphere.

F.1 Policy and Institutional Reform Matrix Structure

During consultations within Government and state agencies, and with private sector stakeholders, on the IP, four broad themes emerged as critical areas for reform. These are:

- Integrating water resource and land use management
- Adapting to climate change
- Integrating ADM principles into public financial management (PFM)
- Improving the environment for private sector participation.

Bangladesh is a country of land and water. Developments in one inevitably have effects on the other. Saline intrusion hurts farmlands. Settlements in low-lying areas increases flood risks by increasing the amount of damage caused by flood events. In addition, upstream developments can have significant impact on downstream areas. Therefore, there is a need to integrate planning in the water and land use sectors, and to integrate river system and estuary management. These initiatives will contribute to the sixth Delta Plan goal, achieving optimal and integrated use of land and water resources. They will also facilitate combining related projects into programs for implementation.

Bangladesh is one of the most vulnerable countries in the world to the effects of climate change. Effects are predicted to include increased river flooding from rainfall, more frequent and intense periods of drought, coastal flooding and salinity intrusion from sea level rise, and more frequent and intense cyclones and storm surges. Although it is difficult to predict the exact impact of these changes, Bangladesh can adapt more quickly through ADM measures. ADM will allow Bangladesh to implement needed interventions more quickly, and to react more flexibly to changing circumstances. Doing so will help ensure safety from floods and climate change-related disaster (Delta Plan goal 1), and enhance water security and efficiency of water usages (Delta Plan goal 2).

An important part of increasing flexibility in implementing plans and projects is flexible and long-term budgeting. To integrate ADM principles into Bangladesh's PFM system, budgeting and planning should be done on a multi-year basis, with sufficient knowledge management processes to identify, monitor, evaluate, and act when tipping points are near.

Public sector finance alone will not be sufficient to successfully implement the IP for the Bangladesh Delta Plan. There is significant opportunity to increase private sector participation in the financing and implementation of IP projects. For this to materialize, however, reforms are needed to provide adequate assurances to the private sector and to enable the Government to properly monitor and hold the private sector accountable for implementing projects and providing services.

The specific policy and institutional reforms recommended under these four areas are derived from in-depth consultations within Government agencies, with development partners, and with private sector agencies, and from extensive review of existing Government policies and plans. As such, they reflect both measures that have already been identified as priorities but not yet implemented, and additional measures specific to the successful implementation of the IP. Furthermore, these reforms will help Bangladesh achieve the SDG outcomes summarized in Box F.1.

Box F.1: SDG Outcomes Targeted by Sector Policy Reforms

Goal 6: Ensure access to water and sanitation for all

- By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse
- By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate
- By 2030, protect and restore water-related ecosystems
- Fully involve local communities in the operation and maintenance of water-related infrastructure, including water and sanitation, through local water bodies
- Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- By 2030, ensure access by all people to safe, nutritious, and sufficient food all year round
- By 2030, double the agricultural productivity and incomes of small-scale food producers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
- By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality

Source: http://www.un.org/sustainabledevelopment/

F.2 Policy Reforms

To help ensure that ADM principles become an integral part of planning and implementing programs going forward, existing policies and regulations should be updated to incorporate ADM. Because the Bangladesh Delta Plan addresses many water resources and water management issues, one key policy reform will be to mainstream ADM principles into existing water-sector related policies and regulations, particularly the National Water Policy (1999). The National Water Policy objectives are to address water management issues, ensure availability of water, accelerate the development of water delivery systems, decentralize water management, develop a sound legal and regulatory environment, and build knowledge for water resource management. All these elements are critical for successful implementation of the IP. WARPO is responsible for periodically updating the National Water Policy[131]. Capacity building should be provided to WARPO to carry out this update to incorporate ADM principles. During this process, a system should be set up to carry out regular reviews and revisions going forward.

Water and land issues are inextricably linked in Bangladesh. Therefore, although the IP for the Bangladesh Delta Plan are water-centric, it is necessary to consider land management and policy issues. The National Land Use Policy should be reviewed and updated just as the National Water Policy is. In particular, the National Land Use Policy should:

- Establish principles that will guide management of land use planning, including land tenure reform, displacement and settlement issues, and natural disaster planning [132]
- Reform the land administration and land zoning process to provide greater legal clarity
- Implement computer systems for land registration and record, land surveys, and a Digital Land Management System to integrate land ownership records nationally and to provide easily accessible records for the people
- Review and update laws and regulations related to alluvion and diluvian to ensure property rights and prevent land grabbing.

As Bangladesh embarks on more land reclamation projects, it will be important to draft and enact national legislation on the land reclamation process and rights to newly formed land. This is important to ensure equitable benefits, provide adequate protection against possible negative social and environmental effects, and provide a legal framework for engaging with the private sector in case there is the opportunity to develop any such projects as PPPs.

A river basin settlement policy is also needed for environmental protection, land use planning, and to help limit economic and social damages from flooding. The policy should include protecting rivers from encroachment and demarcating river banks, courses, and wetlands.

131 National Water Policy (1999) Section 4.2(b)

132 National Water Management Plan, Volume 2, p. 12

In addition to policies, ADM principles need to be integrated into public financial management (PFM) to ensure the sustainability of the IP for the Bangladesh Delta Plan. The Bangladesh Delta Plan already includes recommendations for the institutional reforms. Additional policy and institutional reforms in the near term may include:

- Harmonizing ADM principles into the 2013 Water Act (or Bangladesh Delta Act)
- Implementing the recommendations from the Public Investment Management Review Reform Roadmap to increase flexibility in planning on a multi-year basis
- Identifying measures to increase flexibility in the budgeting process.

It will take some time to identify and then transition to this multi-year planning and budgeting process. Periodically on an ongoing process, the Bangladesh Delta Plan should also be reviewed and updated, with coordination mechanisms adjusted as appropriate.

Additionally, as recommended in the "Climate Fiscal Framework" developed by the Finance Division of the Ministry of Finance[133], climate change considerations should be fully integrated into the project planning process. Baseline data gathering processes are also needed to monitor, evaluate, and act to adapt to tipping points.

These PFM reforms will help achieve the sixteenth and seventeenth SDGs. Specifically, for SDG 16: promote just, peaceful and inclusive societies, these reforms will help develop effective, accountable and transparent institutions at all levels. They will also help ensure responsive, inclusive, participatory and representative decision-making at all levels. For SDG 17: revitalize the global partnership for sustainable development, these reforms will help strengthen domestic resource mobilization.

In addition to introducing more flexible, long-term financial management practices, it is important to secure financing for full cost recovery O&M. Without full cost recovery, water-related infrastructure cannot be properly maintained, and the effectiveness or quality of service decreases. If beneficiaries of these services do not have a financial stake in the provision of services, they are also not incentivized to use services and resources efficiently. Therefore, implementation of the beneficiary pays principle is key to ensuring long-term sustainability of IP projects. This is particularly applicable in the water and sanitation services sector. As a start in the near-term, a time-bound policy should be developed to require all WASAs to cover 100 percent of O&M costs. Then, a plan should be developed to help WASAs achieve full cost recovery through cost recovery tariffs, and to monitor and enforce service quality standards. Once full O&M cost recovery has been achieved, WASAs can pilot service charges to recover some capital costs for urban water and sanitation services. These pilots can be conducted started with the well-off service areas of the four WASAs. In the long-term, the goal is for the WASAs to provide high-quality, universal access to water and sanitation services in a financially sustainable way.

133 Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh. (June 2014). Bangladesh Climate Fiscal Framework.

Public engagement and support is also essential to sustaining good water management practices. Capital investments and infrastructure are not enough if individual practices do not also adapt. A widespread public awareness initiative must be developed and implemented to promote sustainable, adaptive water resource practices. Some examples may include:

- Improving agricultural water use efficiency and water productivity by shifting to less water-intensive crops, implementing more efficient irrigation techniques, and applying other existing technology solutions
- Investing in sustainable wastewater treatment models to increase urban wastewater treatment and recycling
- Applying subsidies, valuation, and other levers to incentivize sustainable, adaptive water use.

Additional policy reforms may be proposed to mainstream ADM principles into the planning process, and to facilitate implementation of IP projects. Such reforms may include:

- **Undertaking strategic environmental and social assessments for key sectors:** Water, environment, agriculture, and irrigation are key sectors of the IP. To promote holistic planning, strategic assessments should be undertaken for each of these sectors. Environmental impact assessments (EIAs) are an essential part of the ADM planning process and are a requirement for projects to be included in the IP. Social impact assessments are also important to ensure that projects are truly beneficial to the people of Bangladesh. Environmental and social aspects must both be considered for IP projects.
- **Reviewing and developing sustainable aquaculture policies:** Fisheries and aquatic crops form an increasingly important part of Bangladesh's economy. Therefore, it is important to have policies in place to ensure sustainable, environmental practices.
- **Reviewing and developing policies for sediment management:** Accretion and erosion are major forces in the Bangladesh Delta. Therefore, it will be important to have a clear national policy for how to manage and adapt to these forces.
- **Establishing a Sundarbans Planning Agency and developing an Integrated Coastal Zone Management Plan:** The Sundarbans are a vital ecological asset for Bangladesh. It has incredible biodiversity and helps dampen the impact of cyclones. The Sundarbans is the world's largest mangrove ecosystem. Having an agency for this unique area will provide dedicated resources to the study, restoration, and preservation of the Sundarbans. An Integrated Coastal Zone Management Plan that provides for mangrove conservation and plantation will help ensure that initiatives are aligned and cohesive across the coastal zone.

F.3 Institutional Reforms

Policy reforms are not enough if institutions are not properly structured and empowered to carry out their functions. During consultations to develop the IP, line ministries raised a common challenge to implementing plans and projects: overlapping and sometimes contradictory mandates across implementing agencies. Therefore, in the near-term, the current mandates of all agencies and governance bodies related to adaptive water management should be reviewed and assessed. The assessment should focus on areas of overlap, conflicts of interest, areas of inflexibility, and gaps in representation.

Some areas have already been identified in previous reviews and the Bangladesh Delta Plan. Examples include:

- **National Agricultural Extension:** Improving coordination and resolving conflict of interest among agencies related to crops, livestock, fisheries, and water resources at the local and national levels[134]
- **Inland Water Transport:** Improving coordination and clarifying allocation of responsibilities for navigation other inland water issues between the BDWB, Department of Shipping, BIWTA, BIWTC, and the port authorities.

Another common issue raised during stakeholder consultations is the need for participatory water management. Without the engagement of local stakeholder and beneficiaries, it is very difficult to operate and maintain water-related works properly. Bangladesh already has developed Guidelines for Participatory Water Management[135]. These have not been fully implemented, however. In carrying out the IP, the Guidelines should be reviewed, updated, and then implemented with a focus on:

- Establishing local water bodies to manage the operations and maintenance of water-related infrastructure
- Aligning Water Management Organizations with the institutional framework and providing formal service agreements defining their roles, responsibilities, and financial arrangements
- Identifying knowledge gaps and providing training and capacity building to Water Management Organizations, particularly on implementing projects following the ADM approach
- Empowering and encouraging local government institutions to follow ADM principles in managing water resources
- Ensuring representatives of water users are also included in water resource planning.

134 BDP 2100 DRAFT, Chapter 13.

135 Ministry of Water Resources, Government of the People's Republic of Bangladesh. (November 2000). Guidelines for Participatory Water Management.

The implementing agencies for the current IP require capacity building initiatives to implement the proposed projects successfully. Capacity building for monitoring and evaluating projects is also needed. Some of these capacity building needs have already been identified and should be implemented in the near-term:

- The BWDB Water Management Improvement Project recommends capacity building to help BWDB assess ecological, environmental, and social components of water management projects. These components are essential to planning and implementing projects in an adaptive and holistic manner[136]
- Capacity building for the Implementation Monitoring Evaluation Division (IMED), WARPO, and relevant monitoring and evaluation (M&E) units of other agencies to fully assess the effects (positive and negative) of adopting ADM measures. Currently, M&E focuses on tracking expenditure against project budgets. To improve the effectiveness and usefulness of M&E, this should be expanded to track project performance against quantifiable development results.

M&E capacity building must be coordinated with knowledge gathering and data management initiatives to ensure adequate and accurate information for measuring results. Having adequate, reliable data is essential to the M&E process. Therefore, as the scope of M&E expands, it is necessary for the knowledge base to match. The creation of a Delta Knowledge Bank managed by WARPO can facilitate this. To analyze the impact of water resources practices, the Knowledge Bank would collect data on issues such as total groundwater availability, sustainable yield of groundwater abstraction, surface/groundwater interactions, and surface and groundwater quality. Good quality M&E will allow implementing agencies to adapt projects to changing circumstances. A sound knowledge base will also provide implementing agencies with the best information to develop new projects in line with ADM principles.

In support of policy and institutional reforms, various development partners offer instruments such as development policy operations and "programs-for-results" (P4R). Development policy operations typically involve a government program of institutional and policy reform actions, focused on economy-wide reforms or more narrowly-defined sectoral or thematic reforms. Development partners will sometimes provide general budget support financing to help ease the transition to full implementation of those reforms. This can facilitate the political economy of the reform process. The financing is not tied to particular goods and services, and therefore does not involve the procurement rules of the development partners. P4R financing also does not involve such procurement rules, and disbursements of financing for particular investments are made based on the achievements of pre-specified disbursement-linked indicators, which are either upfront policy and institutional actions necessary for the overall success of the program, or the progressive achievement of output or outcome indicators (such as land area irrigated, or number of water supply connections implemented). Both development policy operations and P4R financing provide governments with a lot of flexibility and ease of implementation, in support of their reform actions or investments. These instruments are generally appropriate in support of far-reaching policy and institutional reforms or large-scale programmatic investments.
The matrix in Table F.1 summarizes all the policy and institutional reform recommendations in the IP.

136 Final Report on Institutional Improvement of BWDB, November 2014. Water Management Improvement Project.

Table F.1: Policy and Institutional Reforms Matrix

Policy Area	Near-Term Actions	Longer-Term Actions
Integrated Water Resource and Land Use Management	• Review and revise the National Water Policy (NWP) of 1999 and other related policies and regulations to incorporate adaptive delta management (ADM) principles[i] [ii] – Build the capacity of WARPO to carry out regular reviews and revisions • Assess current mandates of all agencies and governance bodies related to adaptive water management and identify/address areas of overlap, conflict of interest, areas of inflexibility, or gaps in representation[iii]. For example: – Ensure coordination between agencies related to National Agricultural Extension (i.e. crop, livestock, fisheries, and water resources agencies at local and national levels)[iv] [v] – Increase coordination and clarify allocation of responsibilities for inland water issues such as navigation and water channels among institutions including the BWDB, Department of Shipping, and Bangladesh Inland Water Transport Authority (BIWTA)[vi] • Review, update, and implement the Guidelines for Participatory Water Management, with a focus on: – Establishing local water bodies that are run as private cooperative enterprises to manage O&M of water-related infrastructure – Aligning Water Management Organizations (WMOs) with the Integrated Water Resource Management Framework[vii] – Identifying knowledge gaps and providing training to Water Management Organizations (on ADM in particular) – Empowering and encouraging local government institutions to follow ADM principles in implementation of water resource management [viii] – Ensuring water user representatives are included in water resource planning[ix] • Operationalize the beneficiary pays principle for water and sanitation services.[x] Adopt a time-bound policy requiring all public urban water and sanitation services to cover 100 percent of the O&M costs.	• Review and revise the NWP every 5-10 years, based on the evolving experience of applying ADM principles • Continually monitor, benchmark, and adapt flood risk management measures[xxi] • Establish a plan to achieve full cost recovery of water supply and water sanitation services, such as through a national regulator for water and sanitation to monitor service quality and set cost recovery tariffs [xxii] • Starting with the well-off service areas of the four WASAs, implement service charges to recover capital costs for urban water and sanitation services • Develop and implement an Integrated Coastal Zone Management Plan, including mangrove conservation and plantation [xxiii]

Policy Area	Near-Term Actions	Longer-Term Actions
	• Create and maintain a widespread public awareness initiative to promote sustainable, adaptive water resource practices such as[xi]: – Improving agricultural water use efficiency and water productivity through existing technology solutions or gradually shifting to other crop patterns/land use – Increasing urban wastewater and effluent treatment and reuse through increased investment in sustainable sewage/effluent business models • Assess and create an incentives framework to promote sustainable, adaptive water use such as subsidies, valuation, and other levers[xii] • Update and implement the BWDB Water Management Improvement Project Recommendations to provide the capacity building needs (e.g. ecological, environmental, social) for BWDB to implement water management in an adaptive manner [xiii] • Identify capacity building needs and provide resources for the Implementation Monitoring Evaluation Division, WARPO, and relevant M&E units of other agencies to improve monitoring and evaluation of government policies and programs to strengthen implementation [xiv] and assess how they can fully consider the effects (positive and negative) of adopting ADM. Agree on a measurable development results framework • Coordinate development of the M&E development results framework with knowledge projects to ensure adequate and accurate data for measuring results [xv] • Integrate adaptive flood risk management measures in current water resource planning [x vi] • Review and update the National Land Use Policy, with a particular view to: – Establish principles that will guide management of land use planning including land tenure reform, displacement/settlement issues, and natural disaster planning[xvii] – Reform the land administration and land zoning process – Implement computer systems for land registration and record, land surveys, and a Digital Land Management System[xviii] – Review and update laws and regulations related to alluvion and diluvion to ensure property rights and prevent land grabbing	

Policy Area	Near-Term Actions	Longer-Term Actions
	• Develop and implement a river basin settlement policy, including protecting rivers from encroachment and demarcating river banks, courses, and wetlands • Draft and enact national legislation on land reclamation and newly formed land • Improve data collection and research coordination for the Delta Knowledge Bank managed by WARPO to collect data on issues such as total groundwater availability, sustainable yield of groundwater abstraction, surface/groundwater interactions, and surface water and groundwater quality to analyze impact of water resources practices [xix] [xx] • Undertake Strategic Environmental Assessments for key sectors (e.g. water, environment, agriculture, irrigation) • Review and develop sustainable aquaculture policies • Review and develop policies to promote sediment management • Establish a Sundarbans Planning Agency	
Climate Change Adaptation	• Review and update the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009-2018 based on new information such as the adoption of the UNFCCC Paris Agreement 2015 and incorporate ADM principles.[xxiv] • Identify training and capacity building needs to promote and evaluate climate change risks and adaptation measures in planning across all sectors • Provide training and capacity building needs to promote and evaluate climate change risks and adaptation/mitigation measures • Review and update the National Adaptation Plan • Implement the Gender Action Plan on Climate Change • Implement the Disaster Management Act • Operationalize the recommendations of the Climate Fiscal Framework 2014 – Establish a Climate Fiscal Cell in the Finance Division of the Ministry of Finance (MoF)[xxv] • Establish a National Climate Change Cell within the Department of Environment of the Ministry of Environment and Forests to perform technical capacity and knowledge responsibilities, including providing technical support to the Ministry of Planning, Ministry of Finance, and line ministries[xxvi]	• Implementation of BCCSAP and its reflection, where appropriate, in all sector strategies, policies, and legislation. – Build the capacity of Climate Change Focal Points within ministries and agencies[xxviii] • Assess feasibility of implementing high-risk area relocations (e.g. Sundarbans) • Assess implementation of compensation schemes for those affected by selective polder abandonment or beel operations

Policy Area	Near-Term Actions	Longer-Term Actions
	• Establish a Project Preparation Facility for climate change adaptation activities that[xxvii] : – Provides support for project design and project proposal review – Supports pre-project economic, social, and environmental screening and impact assessments – Provides technical assistance to identify external financing – Serves as a clearinghouse for technologies and best practices, external financing options, and project selection criteria – Designs implementation and monitoring, reporting, and verification strategies – Builds capacity on all aspects of project cycle management – Reviews and improves proposal designs and analyses	
Integrate ADM Principles into Public Financial Management (PFM)	• Establish a Delta Plan wing in GED to draft the Bangladesh Delta Act, with a view to: – Establish a Bangladesh Delta Commission to carry out functions of national level coordination in planning; programming; resource mobilization; facilitating program/project preparation, implementation, and evaluation; conducting research; knowledge management; and preparing policies and guidelines. – Establish Bangladesh Delta Fund to replace fragmented ministry level allocations of uncoordinated/non-linked individual programs with an integrated program that is prepared ahead of the financing allocation. The Bangladesh Delta spending programs will be prepared and updated on an annual basis by the Delta Commission and will include investments, O&M funding, research, capacity building and institutional development – Harmonize ADM principles into the Delta Act and provide resources to revise and strengthen implementation and enforcement of the Delta Act – Establish local water bodies that are run as private cooperative enterprises to represent beneficiary stakeholders linked with coastal management, river management, fresh water wetlands (haors and haor) management, large irrigation schemes, and flood control. Review best international practices to define the local water bodies' membership, selection process, functions, financing, and accountabilities	Review and update the BDP2100 Investment Plan on a regular basis – Evaluate and add new projects – Adjusting coordination mechanisms as appropriate • Implement measures to increase flexibility in the budgeting process[xxxii] • Gradually transfer O&M funding responsibility and financing for smaller projects from the Delta Fund to municipalities and local water bodies[xxxiii]

Policy Area	Near-Term Actions	Longer-Term Actions
	• Implement recommendations from the Public Investment Management (PIM) Review Reform Roadmap to increase flexibility in planning on a multi-year basis [xxix] • Identify measures to increase flexibility in the budgeting process • Integrate climate change considerations into the project planning process[xxx] • Initiate baseline data gathering process to identify, monitor, evaluate, and act to adapt to tipping points [xxxi]	
Private Sector Participation	• Include in the investment planning guidelines that, as part of project preparation, the PPP Authority helps assess whether private finance of each project would be possible and would offer net benefits • The PPP Authority works with project implementing agencies to develop and implement Investment Plan projects in accordance with the PPP process set out in the PPP Law (2015) • The PPP Authority conducts market assessments to identify private sector concerns and incentives for investing [xxxiv] [xxxv] – Financing mechanisms – Political environment • The PPP Authority initiates baseline data gathering process to identify and evaluate options for private sector participation, in accordance with the PPP Law (2015) • Increase the capacity of the PPP authority with additional resources and training to handle the volume of transactions expected in the Investment Plan • Identify gaps in PPP knowledge in line ministries • The PPP Authority launches a PPP knowledge dissemination campaign • Identify capacity building needs to monitor and enforce regulations – Increase the capacity of the Department of Shipping to supervise, inspect, and enforce regulations[xxxvi] – Review structure of private irrigation ownership and identify measures to monitor and enforce water extraction regulations	• Based on private sector market assessments, structure viable PPP arrangements for water sector projects – Establish long-term financing mechanisms – Appropriate risk sharing arrangements • Implement capacity building initiatives for monitoring and enforcing regulations

[i] National Water Policy, Ministry of Water Resources, 1999.
[ii] 2030 Water Resources Group, Bangladesh Multi-Stakeholder Partnership for Water Governance and Sustainability
[iii] Water Supply and Sanitation Sector in Bangladesh: Sector Development Plan (FY 2011-25), p.111
[iv] National Agricultural Extension Policy pp. 3, 8
[v] Ministry of Agriculture, Government of the People's Republic of Bangladesh and the Food and Agriculture Organization of the United Nations. (June 2012). Master Plan for Agricultural Development in the Southern Region of Bangladesh. p. 32
[vi] World Bank, Inland Water Transport Strategy, pp. xvi, xviii, 29-33
[vii] ADB Innovations for More Food with Less Water, p. 11
[viii] Draft Concept Note for Task Force on Strengthening Water Resources Management in Bangladesh v1d, pp. 3-5
[ix] Draft Concept Note for Task Force on Strengthening Water Resources Management in Bangladesh v1d, pp. 3-5
[x] General Economics Division, Bangladesh Planning Commission, Government of the People's Republic of Bangladesh. Bangladesh Delta Plan 2100. p. xxv
[xi] 2030 Water Resources Group, Consolidation and Analysis of Information on Water Resources Management in Bangladesh, p. 40-48
[xii] 2030 Water Resource Group, Working Paper for Water Governance and Sustainability Work-Stream Meeting, Bangladesh Water Multi-Stakeholder Partnership
[xiii] ADB, Innovations for More Food with Less Water, p. 39
[xiv] General Economics Division, Bangladesh Planning Commission, Government of the People's Republic of Bangladesh. Bangladesh Delta Plan 2100. Chapter 13.
[xv] General Economics Division, Bangladesh Planning Commission, Government of the People's Republic of Bangladesh. Bangladesh Delta Plan 2100. Chapter 13.
[xvi] World Bank, Cities and Flooding: A Guide to Integrated Flood Risk Management for the 21st Century, p. 586-591
[xvii] National Water Management Plan Volume 2 p. 12
[xviii] General Economics Division, Bangladesh Planning Commission, Government of the People's Republic of Bangladesh. Bangladesh Delta Plan 2100. Chapter 13.
[xix] 2030 Water Resources Group, Consolidation and Analysis of Information on Water Resources Management in Bangladesh, p. 40-48
[xx] General Economics Division, Bangladesh Planning Commission, Government of the People's Republic of Bangladesh. Bangladesh Delta Plan 2100. Chapter 12.
[xxi] World Bank, Cities and Flooding: A Guide to Integrated Flood Risk Management for the 21st Century, pp. 586-591
[xxii] 2030 Water Resources Group, Consolidation and Analysis of Information on Water Resources Management in Bangladesh, p. 40-48
[xxiii] General Economics Division, Bangladesh Planning Commission, Government of the People's Republic of Bangladesh. Bangladesh Delta Plan 2100. pp. 138–139
[xxiv] Ministry of Environment and Forests. (September 2009). Bangladesh Climate Change Strategy and Action Plan.
[xxv] Ministry of Environment and Forests. (September 2009). Bangladesh Climate Change Strategy and Action Plan. p. 5
[xxvi] Climate Economic Analysis for Development, Investment, and Resilience (CEADIR). (June 2016). Climate Finance in Bangladesh: Situation Analysis. p. 25
[xxvii] Climate Economic Analysis for Development, Investment, and Resilience (CEADIR). (June 2016). Climate Finance in Bangladesh: Situation Analysis. p. 26
[xxviii] Ministry of Environment and Forests. (September 2009). Bangladesh Climate Change Strategy and Action Plan. p. 72
[xxix] World Bank Strengthening Public Expenditure Management Program (SPEMP). (May 2014). People's Republic of Bangladesh: A Public Investment Management Review and Reform Roadmap for Bangladesh.
[xxx] Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh. (June 2014). Climate Fiscal Framework. p. 36
[xxxi] Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh. (June 2014). Climate Fiscal Framework. p. 31
[xxxii] Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh. (June 2014). Climate Fiscal Framework.
[xxxiii] General Economics Division, Bangladesh Planning Commission, Government of the People's Republic of Bangladesh. Bangladesh Delta Plan 2100. Chapter 12.
[xxxiv] 2030 Water Resource Group, Working Paper for Water Governance and Sustainability Work-Stream Meeting, Bangladesh Water Multi-Stakeholder Partnership
[xxxv] 2030 Water Resource Group, Working Paper for Water Governance and Sustainability Work-Stream Meeting, Bangladesh Water Multi-Stakeholder Partnership
[xxxvi] World Bank, Inland Water Transport Strategy, p. 52

Appendix G: Results Framework and Monitoring Report Template

Table G.1 illustrates a possible approach to the IP M&E, based on a Development Results Framework (DRF).

The approach is related to the overall BDP2100 M&E DRF, as indicated in Chapter 13 of the Bangladesh Delta Plan.

Table G.1: Investment Plan Monitoring and Evaluation Results Framework

	Indicator			Unit		Values										
						2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
P1	Projects Started (Indicates the number of IP Projects that have actually started)	Investment Plan Total by type of Project:														
			- Physical	# of Projects	Target											
					Actual											
			- Institutional/Knowledge	# of projects	Target											
					Actual											
			- Total by type	# of projects	Target											
					Actual											
		Investment Plan Total by Hotspot:														
			- Coastal Zones	# of Projects	Target											
				# of Projects	Actual											
			- Major Rivers	# of Projects	Target											
				# of Projects	Actual											
			- Urban Area	# of Projects	Target											
				# of Projects	Actual											
			- Barid and Drought Prone	# of Projects	Target											
				# of Projects	Actual											
			- Chittagong Hill Tracts	# of Projects	Target											
				# of Projects	Actual											
			- Haor and Wetland	# of Projects	Target											
				# of Projects	Actual											
			- Cross Cutting	# of Projects	Target											
				# of Projects	Actual											
P2	Projects Delayed (Indicates the number of IP Projects that have been delayed by more than 3 months relative to initial planning)	Investment Plan Total by Hotspot:														
			- Coastal Zones	# of projects delayed by more than 3 months	Actual											
				Avg delay in % of the expected construction/preparation le	Actual											
			- Major Rivers	# of projects delayed by more than 3 months	Actual											
				Avg delay in % of the expected construction/preparation le	Actual											
			- Urban Area	# of projects delayed by more than 3 months	Actual											
				Avg delay in % of the expected construction/preparation le	Actual											
			- Barid and Drought Prone	# of projects delayed by more than 3 months	Actual											
				Avg delay in % of the expected construction/preparation le	Actual											
			- Chittagong Hill Tracts	# of projects delayed by more than 3 months	Actual											
				Avg delay in % of the expected construction/preparation le	Actual											
			- Haor and Wetland	# of projects delayed by more than 3 months	Actual											
				Avg delay in % of the expected construction/preparation le	Actual											
			- Cross Cutting	# of projects delayed by more than 3 months	Actual											
				Avg delay in % of the expected construction/preparation le	Actual											
P3	Feasibility Studies (Indicates the number of IP Projects of which the Feasibility Study/ Risk Assessment is completed)	Investment Plan Total by type of Project:														
			- Physical	# of Projects	Target											
					Actual											
			- Institutional/Knowledge	# of projects	Target											
					Actual											
			- Total by type	# of projects	Target											
					Actual											
		Investment Plan Total by Hotspot:														
			- Coastal Zones	# of Projects	Target											
				# of Projects	Actual											
			- Major Rivers	# of Projects	Target											
				# of Projects	Actual											
			- Urban Area	# of Projects	Target											
				# of Projects	Actual											
			- Barid and Drought Prone	# of Projects	Target											
				# of Projects	Actual											
			- Chittagong Hill Tracts	# of Projects	Target											
				# of Projects	Actual											
			- Haor and Wetland	# of Projects	Target											
				# of Projects	Actual											
			- Cross Cutting	# of Projects	Target											
				# of Projects	Actual											

P4	Projects Implemented (Indicates the number of IP Projects that are operating or have actually been completed)	Investment Plan Total by type of Project:															
			- Physical	# of Physical Projects Operating	Target												
					Actual												
			- Institutional/Knowledge	# of Projects Completed	Target												
					Actual												
			- Total by type	# of Projects Completed and Operating	Target												
					Actual												
		Investment Plan Total by Hotspot:															
			- Coastal Zones	# of Projects Completed and Operating	Target												
				# of Projects Completed and Operating	Actual												
			- Major Rivers	# of Projects Completed and Operating	Target												
				# of Projects Completed and Operating	Actual												
			- Urban Area	# of Projects Completed and Operating	Target												
				# of Projects Completed and Operating	Actual												
			- Barid and Drought Prone	# of Projects Completed and Operating	Target												
				# of Projects Completed and Operating	Actual												
			- Chittagong Hill Tracts	# of Projects Completed and Operating	Target												
				# of Projects Completed and Operating	Actual												
			- Haor and Wetland	# of Projects Completed and Operating	Target												
				# of Projects Completed and Operating	Actual												
			- Cross Cutting	# of Projects Completed and Operating	Target												
				# of Projects Completed and Operating	Actual												
P5	Project Evaluation (Indicates the number of IP Projects for which evaluation has taken place)	Investment Plan Total by type of Project:															
			- Physical	# of Projects	Target												
					Actual												
			- Institutional/Knowledge	# of Projects	Target												
					Actual												
			- Total by type	# of Projects	Target												
					Actual												
		Investment Plan Total by Hotspot:															
			- Coastal Zones	# of Projects	Target												
				# of Projects	Actual												
			- Major Rivers	# of Projects	Target												
				# of Projects	Actual												
			- Urban Area	# of Projects	Target												
				# of Projects	Actual												
			- Barid and Drought Prone	# of Projects	Target												
				# of Projects	Actual												
			- Chittagong Hill Tracts	# of Projects	Target												
				# of Projects	Actual												
			- Haor and Wetland	# of Projects	Target												
				# of Projects	Actual												
			- Cross Cutting	# of Projects	Target												
				# of Projects	Actual												
F1	Capex (Indicates the actual amount of capital expenditure for BDP IP-Projects)	Investment Plan Total by type of Project:															
			- Physical	BDT (mil)	Target												
					Actual												
			- Institutional/Knowledge	BDT (mil)	Target												
					Actual												
			- Total by type	BDT (mil)	Target												
					Actual												
		Investment Plan Total by Hotspot:															
			- Coastal Zones	BDT (mil)	Target												
				BDT (mil)	Actual												
			- Major Rivers	BDT (mil)	Target												
				BDT (mil)	Actual												
			- Urban Area	BDT (mil)	Target												
				BDT (mil)	Actual												
			- Barid and Drought Prone	BDT (mil)	Target												
				BDT (mil)	Actual												
			- Chittagong Hill Tracts	BDT (mil)	Target												
				BDT (mil)	Actual												
			- Haor and Wetland	BDT (mil)	Target												
				BDT (mil)	Actual												
			- Cross Cutting	BDT (mil)	Target												
				BDT (mil)	Actual												

F2	Deviation Capex (Indicates the actual amount of capital expenditure relative to the planned budget)	Investment Plan Total by type of Project:														
			- Physical	Capex as % of GDP	Target											
					Actual											
			- Institutional/Knowledge	Capex as % of GDP	Target											
					Actual											
			- Total by type	Capex as % of GDP	Target											
					Actual											
		Investment Plan Total by Hotspot:														
			- Coastal Zones	BDT higher or lower than original capex estimate	Actual											
				% Capex higher or lower than original estimate	Actual											
			- Major Rivers	BDT Capex higher or lower than original estimate	Actual											
				% Capex higher or lower than original estimate	Actual											
			- Urban Area	BDT Capex higher or lower than original estimate	Actual											
				% Capex higher or lower than original estimate	Actual											
			- Barid and Drought Prone	BDT Capex higher or lower than original estimate	Actual											
				% Capex higher or lower than original estimate	Actual											
			- Chittagong Hill Tracts	BDT Capex higher or lower than original estimate	Actual											
				% Capex higher or lower than original estimate	Actual											
			- Haor and Wetland	BDT Capex higher or lower than original estimate	Actual											
				% Capex higher or lower than original estimate	Actual											
			- Cross Cutting	BDT Capex higher or lower than original estimate	Actual											
				% Capex higher or lower than original estimate	Actual											
F3	Private Investments (Indicates the actual amount of private investments in BDP IP-Projects)	Investment Plan Total by type of Project:														
			- Physical	BDT (mil) of Private Investments	Target											
					Actual											
			- Institutional/Knowledge	BDT (mil) of Private Investments	Target											
					Actual											
			- Total by type	BDT (mil) of Private Investments	Target											
					Actual											
			- Physical	Private Investments as % of GDP	Target											
					Actual											
			- Institutional/Knowledge	Private Investments as % of GDP	Target											
					Actual											
			- Total by type	Private Investments as % of GDP	Target											
					Actual											
		Investment Plan Total by Hotspot:														
			- Coastal Zones	BDT (mil) of Private Investments	Target											
				BDT (mil) of Private Investments	Actual											
			- Major Rivers	BDT (mil) of Private Investments	Target											
				BDT (mil) of Private Investments	Actual											
			- Urban Area	BDT (mil) of Private Investments	Target											
				BDT (mil) of Private Investments	Actual											
			- Barid and Drought Prone	BDT (mil) of Private Investments	Target											
				BDT (mil) of Private Investments	Actual											
			- Chittagong Hill Tracts	BDT (mil) of Private Investments	Target											
				BDT (mil) of Private Investments	Actual											
			- Haor and Wetland	BDT (mil) of Private Investments	Target											
				BDT (mil) of Private Investments	Actual											
			- Cross Cutting	BDT (mil) of Private Investments	Target											
				BDT (mil) of Private Investments	Actual											
F4	Accessing Climate Finance (Indicates the amount of climate finance related to BDP IP-Projects)	Investment Plan Total by type of Project:														
			- Physical	BDT (mil) of Climate Finance	Target											
					Actual											
			- Institutional/Knowledge	BDT (mil) of Climate Finance	Target											
					Actual											
			- Total by type	BDT (mil) of Climate Finance	Target											
					Actual											
		Investment Plan Total by Hotspot:														
			- Coastal Zones	BDT (mil) of Climate Finance	Target											
				BDT (mil) of Climate Finance	Actual											
			- Major Rivers	BDT (mil) of Climate Finance	Target											
				BDT (mil) of Climate Finance	Actual											
			- Urban Area	BDT (mil) of Climate Finance	Target											
				BDT (mil) of Climate Finance	Actual											
			- Barid and Drought Prone	BDT (mil) of Climate Finance	Target											
				BDT (mil) of Climate Finance	Actual											
			- Chittagong Hill Tracts	BDT (mil) of Climate Finance	Target											
				BDT (mil) of Climate Finance	Actual											
			- Haor and Wetland	BDT (mil) of Climate Finance	Target											
				BDT (mil) of Climate Finance	Actual											
			- Cross Cutting	BDT (mil) of Climate Finance	Target											
				BDT (mil) of Climate Finance	Actual											

F5	Public Investments (Indicates the actual amount of public investments in BDP IP-Projects)	Investment Plan Total by type of Project:														
			- Physical	BDT (mil) of Public Investment	Target											
					Actual											
			- Institutional/Knowledge	BDT (mil) of Public Investment	Target											
					Actual											
			- Total by type	BDT (mil) of Public Investment	Target											
					Actual											
			- Physical	Public Investment as % of GDP	Target											
					Actual											
			- Institutional/Knowledge	Public Investment as % of GDP	Target											
					Actual											
			- Total by type	Public Investment as % of GDP	Target											
					Actual											
		Investment Plan Total by Hotspot:														
			- Coastal Zones	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
			- Major Rivers	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
			- Urban Area	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
			- Barid and Drought Prone	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
			- Chittagong Hill Tracts	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
			- Haor and Wetland	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
			- Cross Cutting	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
F6	Opex (Indicates the amount of operating expenditure related to operating public projects)	Investment Plan Total by type of Project:														
			- Physical	Total Opex in BDT (mil)	Target											
					Actual											
			- Institutional/Knowledge	Total Opex in BDT (mil)	Target											
					Actual											
			- Total by type	Total Opex in BDT (mil)	Target											
					Actual											
		Investment Plan Total by Hotspot:														
			- Coastal Zones	Total Opex in BDT (mil)	Target											
				Total Opex in BDT (mil)	Actual											
				% of the Total Initial Capex	Target											
				% of the Total Initial Capex	Actual											
			- Major Rivers	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
				% of the Total Initial Capex	Target											
				% of the Total Initial Capex	Actual											
			- Urban Area	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
				% of the Total Initial Capex	Target											
				% of the Total Initial Capex	Actual											
			- Barid and Drought Prone	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
				% of the Total Initial Capex	Target											
				% of the Total Initial Capex	Actual											
			- Chittagong Hill Tracts	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
				% of the Total Initial Capex	Target											
				% of the Total Initial Capex	Actual											
			- Haor and Wetland	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
				% of the Total Initial Capex	Target											
				% of the Total Initial Capex	Actual											
			- Cross Cutting	BDT (mil) of Public Investment	Target											
				BDT (mil) of Public Investment	Actual											
				% of the Total Initial Capex	Target											
				% of the Total Initial Capex	Actual											

	projects)				Actual												
			- Institutional/Knowledge	BDT of Opex on Operating Public Projects	Target												
					Actual												
				% of Opex on Operating Public Projects	Target												
					Actual												
			- Total by type	BDT of Opex on Operating Public Projects	Target												
					Actual												
				% of Opex on Operating Public Projects	Target												
					Actual												
		Investment Plan Total by Hotspot:															
			- Coastal Zones	BDT of Opex on Operating Public Projects	Target												
				BDT of Opex on Operating Public Projects	Actual												
			- Coastal Zones	% of Opex on Operating Public Projects	Target												
				% of Opex on Operating Public Projects	Actual												
			- Major Rivers	BDT of Opex on Operating Public Projects	Target												
				BDT of Opex on Operating Public Projects	Actual												
			- Major Rivers	% of Opex on Operating Public Projects	Target												
				% of Opex on Operating Public Projects	Actual												
			- Urban Area	BDT of Opex on Operating Public Projects	Target												
				BDT of Opex on Operating Public Projects	Actual												
			- Urban Area	% of Opex on Operating Public Projects	Target												
				% of Opex on Operating Public Projects	Actual												
			- Barid and Drought Prone	BDT of Opex on Operating Public Projects	Target												
				BDT of Opex on Operating Public Projects	Actual												
			- Barid and Drought Prone	% of Opex on Operating Public Projects	Target												
				% of Opex on Operating Public Projects	Actual												
			- Chittagong Hill Tracts	BDT of Opex on Operating Public Projects	Target												
				BDT of Opex on Operating Public Projects	Actual												
			- Chittagong Hill Tracts	% of Opex on Operating Public Projects	Target												
				% of Opex on Operating Public Projects	Actual												
			- Haor and Wetland	BDT of Opex on Operating Public Projects	Target												
				BDT of Opex on Operating Public Projects	Actual												
			- Haor and Wetland	% of Opex on Operating Public Projects	Target												
				% of Opex on Operating Public Projects	Actual												
			- Cross Cutting	BDT of Opex on Operating Public Projects	Target												
				BDT of Opex on Operating Public Projects	Actual												
			- Cross Cutting	% of Opex on Operating Public Projects	Target												
				% of Opex on Operating Public Projects	Actual												

A1	**ADM Content Level** (IP projects scored on 4 ADM criteria)	**Investment Plan Total**															
			-Compliance with ADM in IP projects	**Range 4-20**	**Actual**												
T1	**Theme 1** (Preventing too much water)	**Investment plan total:**															
			-Impact Indicators	**# of people with reduced flood risk as a result of the plan**	**Target**												
					Actual												
T2	**Theme 2** (Supplying sufficient quantity of water)	**Investment plan total:**															
			-Impact Indicators	**Ha irrigated by IP projects done under the plan**	**Target**												
					Actual												
				# of people with improved water supply because of the plan	**Target**												
					Actual												
				Km of water with good navigability because of the plan	**Target**												
					Actual												
T3	**Theme 2** (Supplying sufficient quality of water)		**-Impact Indicators**	**# of people with improved sanitation as a result of the plan**	**Target**												
					Actual												
				MIG of effluent treated to national standards as a result of the plan	**Target**												
					Actual												

Hotspot Code

Coastal Zone
Major Rivers
Urban Areas
Barind and Drought Prone
Chittagong Hill Tracts
Haor and Wetlands
Cross Cutting

Target v Actual Code

Target
Actual

Theme Code

Theme 1
Theme 2
Theme 3

Project Type Code

Physical
Institutional/Knowledge
Total

Clarification of proposed indicators

P1 Projects started

Indicates the number of IP projects that have actually started. The indicator is specified for:

- Number of projects per project type (knowledge, infrastructure, institutional)
- Number of projects per hotspot.

P2 Projects delayed

Indicates the number of IP projects that have been delayed by more than three months relative to initial planning. The indicator is specified for:

- Total number of projects delayed by more than three months by hotspot
- Average delay in percentage of the expected construction/preparation length by hotspot.

P3 Feasibility Study Conducted

Indicates the number of IP projects of which the feasibility study / risk assessment is ready. The indicator is specified for:

- Number of projects per project type (knowledge, infrastructure, institutional)
- Number of projects per hotspot.

P4 Projects implemented: Completed

Indicates the number of IP projects that are operating or have actually been completed. The indicator is specified for:

- Number of projects completed and operating per project type (knowledge, infrastructure, institutional)
- Number of projects completed and operating per hotspot.

P5 Project evaluation: Completed

Indicates the number of IP projects for which an evaluation has taken place. The indicator is specified for:

- Number of projects per project type (knowledge, infrastructure, institutional)
- Number of projects per hotspot.

F1 Capex

Indicates the actual amount of capital expenditure for BDP IP-projects. The indicator is specified for:

- Capital expenditure per project type (knowledge, infrastructure, institutional)
- Capital expenditure per hotspot.

F2 Deviation Capex

Indicates the amount of actual capital expenditure relative to the planned budget. The indicator is specified for:

- Capex as a percentage of GDP per project type (knowledge, infrastructure, institutional)
- Total amount of capex difference from the planned budget by hotspot
- Total amount of capex difference as a percent from the planned budget by hotspot.

F3 Private investments

Indicates the amount of private investments in BDP IP-projects. The indicator is specified for:

- Total amount of private investments per project type (knowledge, infrastructure, institutional)
- Total amount of private investments per hotspot
- Amount of private investments as a percent of GDP per project type (knowledge, infrastructure, institutional).

F4 Accessing climate finance

Indicates the amount of climate finance, related to BDP IP-projects. The indicator is specified for:

- Total amount of climate finance per project type (knowledge, infrastructure, institutional)
- Total amount of climate finance per hotspot.

F5 Public investments

Indicates the amount of public investments in BDP IP-projects. The indicator is specified for:

- Total amount of public investments per project type (knowledge, infrastructure, institutional)
- Amount of public investments as a percent of GDP per project type (knowledge, infrastructure, institutional)
- Total amount of public investments per hotspot.

F6 Opex

Indicates the amount of operating expenditure related to operating public projects. The indicator is specified for:

- Total amount of operating expenditure per project type (knowledge, infrastructure, institutional)
- Total amount of operating expenditure per hotspot
- Amount of operating expenditure as a percent of total initial capital expenditure per hotspot.

F7 User charges

Indicates the total revenue from user charges on operating public projects. The indicator is specified for:

- Total amount of operating expenses on operating public projects per project type (knowledge, infrastructure, institutional)
- Percentage of operating expenses on operating public projects per project type (knowledge, infrastructure, institutional)
- Total amount of operating expenses on operating public projects per hotspot
- Percentage of operating expenses on operating public projects per hotspot.

A1 ADM-content, compliance with ADM in IP projects

This indicator is derived scoring IP projects on 4 ADM criteria:

- The project can be adapted/scaled up when circumstances require (such as climate change, national objectives, etc.)
- The intervention can be combined with additional measures to increase effectiveness
- The intervention allows for adopting technological innovations after implementation
- The intervention is synchronized with developments in other sectors.

Projects are scored on the following scale:

1. Totally incorrect
2. Slightly incorrect
3. Average
4. Slightly correct
5. Totally correct.

The indicator is specified for:

- ADM-content of all IP-projects
- ADM-content of IP-projects per hot spot.

T1) Theme 2, Preventing too much water

Indicates the number of people that are exposed to a lower flood risk because of the plan. This indicator is specified as:

- Number of people with reduced flood risk as a result of the plan.

T2) Theme 3, Supplying sufficient quality of water

Indicates the improved conditions in supplying water because of the plan. This indicator is specified as:

- Hectare irrigated by projects done under the plan
- Number of people with improved water supply because of the plan
- Kilometers of water with good navigability because of the plan.

T3) Theme 3, Supplying sufficient quality of water

Indicates the number of people with improved quality water supply. This indicator is specified as:

- Number of people with improved sanitation as a result of the plan
- Million imperial gallons of effluent treated to national standards as a result of the plan.

Appendix H: Use of Private Finance in Delta Investment Plan

H.1 Strategy of Resource Mobilization through Private Finance

The Government's strategy is to mobilize significant amounts of private capital for Delta Investment Plan Projects. The aim is to have, by 2025, private finance equivalent to half a percent of GDP flowing into Delta investments. This Appendix elaborates on the Government's strategy to attract private finance through Public Private Partnerships (PPPs), setting out

- The need for private finance and the benefits expected
- Project types with the most potential for PPPs, together with the pioneer projects of each type in the Investment Plan
- For each type of project, the likely project structure, along with international and local experience that has informed the Government's thinking
- The institutions, policies, project preparation and marketing strategies that will be adopted to make the PPP program a success.

H.1.1 The need for private finance and the benefits expected

The financing strategy for the Investment Plan includes mobilizing additional finance that would otherwise not be available for Delta investments—in particular, equity and commercial debt.

With an estimated US$22 trillion in global savings available for investment, the pool of capital looking for a home is virtually unlimited[137]. Global capital markets are experiencing an extended period of high liquidity and low interest rates which could last a decade or more[138]. Lower returns in developed markets means investors and financial institutions are seeking to invest in emerging and frontier markets.

Bangladesh will be able tap into this pool of capital by offering well-structured projects that have revenues greater than their operating and maintenance costs, and so generate free cashflow from operations. This free cash will allow a return on investment, and thus is the prerequisite for mobilization of genuinely additional resources from private investors.

Another advantage of private finance of projects found internationally is better on time, on budget delivery of capital projects[139]. Table H.1 shows how PPPs have come in closer to budget and schedule than publicly financed projects in the United Kingdom and Australia.

137 Investment Needs to Achieve the Sustainable Development Goals: Understanding the Billions and Trillions", Schmidt-Traub, Guido. Sustainable Development Solutions Network. SDSN Working Paper Version 2. 12 November 2015. Available at http://unsdsn.org/wp-content/uploads/2015/09/151112-SDG-Financing-Needs.pdf (accessed: 27 June 2016).

138 Kharas, H. Prizzon, A. and Rogerson, A. (2014). 'Financing the post-2015 Sustainable Development Goals: A rough roadmap'. London: Overseas Development Institute.

139 FHWA Report on Public-Private Partnerships for Highway Infrastructure: Capitalizing on International Experience (March 2009).

Table H.1: Comparing PPPs and Public Procurement in the UK and Australia

United Kingdom

Source	Comparison	Proportion of Projects Over Budget (%)		Proportion of Projects with Time Over-run (%)	
		PPP	Public	PPP	Public
National Audit Office, 2003	Contract award to final	22%	73%	24%	70%
National Audit Office, 2008	Contract award to final	35%	46%	31%	37%

Australia

Source	Comparison	Average Over Budget (% of original cost estimate)		Average Time Overrun (% of original time estimate)	
		PPP	Public	PPP	Public
Infrastructure Partnerships Australia, 2007	Original appr oval to final	12%	35%	13%	26%
	Contract to final	1%	15%	-3%	24%
Duffield review of PPP performance, 2008 [#62]	Original announcement to final	24%	52%	17%	15%
	Budget approval to final	8%	20%	12%	18%
	Contract to final	4%	18%	1.4%	26%

Source: ***PPP Reference Guide, World Bank***

PPPs have the potential to lower costs over a project's total life, since they bring in incentives to minimize operating costs, and to make optimal trade-offs between capital costs and recurrent costs. PPPs also create incentives to use assets efficiently to generate maximum revenues, including by finding additional valuable services that an asset can provide. The World Bank analyzed the effect of introducing private sector participation through concessions or full privatization of utilities for over 1,200 water and electricity utilities[140]. The study found significant efficiency gains when private sector participation was introduced including reduced water losses and increased staff efficiency. These gains came alongside improvements in service delivery, with increased coverage and daily hours of service.

Realism in planning and project appraisal can be enhanced with PPPs. When they are bid out, they are subject to scrutiny by multiple skilled, independent parties: the private sector investors and lenders. These parties undertake their own project analysis based on their experience. The PPP tendering process can therefore filter out non-viable projects. For example, a McKinsey report[141] on infrastructure productivity notes that several of the National Highways Authority of India (NHAI)'s toll road projects have not attracted bidders. In some cases, demand forecasts were too high. In other cases, bidders found NHAI's cost estimates to be low, and the project not viable on more realistic cost assumptions.

140 Gassner, Katharina, Alexander Popov & Nataliya Pushak (2009) 'Does Private Sector Participation Improve Performance in Electricity and Water Distribution', World Bank, Washington, D.C.

141 McKinsey Global Institute (2013) Infrastructure productivity: How to save $1 trillion a year, Seoul, San Francisco and London.

H.1.2 Project types and projects with the most potential for PPPs

The Government aims to develop a viable pipeline of PPP projects within the Delta Investment Plan by identifying the types of project that have the most potential, and creating standardized transaction designs for each type. Analysis of the projects in the Investment Plan reveals five significant project types, as follows:

- Large-scale irrigation: irrigation considerably increases the productive capacity of the land, and thus farmers' incomes. By charging commercial rates for irrigation services, it becomes possible to not only cover the operations and maintenance costs of the scheme, but also part of the capital costs.
- Inland water ports and terminals: improved transport infrastructure like water ports and terminals can create value through lower cost, and safer and faster journeys. Multi-modal links between new highways and improved river ports can further improve logistics links. Users can be charged for these transport services. Beyond charging users, Bangladesh can generate additional revenue through capturing the increases in property values around improved ports (for logistics parks) and ferry terminals (for passenger service businesses).
- Channel dredging and land reclamation: dredging can renew and expand water transport. Dredging can also generate revenue since dredged sand is valuable both as a building material and for land reclamation.
- Water supply and sewerage services: users can be charged for improved water supply and sewerage services, including for waste collection and treatment. Commercial users, including garment and tanning industries, will pay for effluent treatment services.
- Embankments with highways: building a highway on top of an embankment is an innovative multi-use approach to Delta investment planning which is of great relevance in Bangladesh, where there is considerable unmet demand for road transportation capacity, and where the space needed to build roads is at a premium. Charging tolls to highway users can defray part of the costs of building and maintaining the embankment.

Each of these types of project is expected to be broadly replicable. The strategy is therefore to develop the projects of these types that have already been identified in the Plan as pioneer projects. A pioneer project is a representative of its type that can be developed first to test project structures, risk allocation, and documentation. Once a successful precedent for a project type has been established, that precedent can be applied across multiple similar projects. This will increase investor confidence as they follow proven models and reduce transaction costs for the Government. The following section discuss the main type of projects, the models that the Government is minded to adopt, the pioneer projects, and the international precedents.

H.2 Irrigation

Irrigation projects can be undertaken as PPPs by engaging private firms to build and finance new irrigation infrastructure, operate and maintain the system, supply water to irrigators in accordance with specified schedules and quantities, and charge for the water supplied.

The following IP projects have significant irrigation components that are judged to have the potential to attract private finance:

- Kurigram Irrigation Project (DP 1.4/1.5). These projects (combined capital expenditure US$337 million) involve constructing a barrage, two pumping stations, canals, and associated infrastructure to irrigate a combined 68,000 hectares of land. A private operator (or private operators) can undertake these projects, with part of the cost recovered from users through charges, and possibly the lease of irrigated land.
- North Rajshahi Irrigation Project (DP 1.1). This project, with capital expenditure of US$250 million, involves constructing two pumping stations along with canals and associated infrastructure to irrigate 74,800 hectares of land. A private operator can be engaged to undertake the project, with users being charged fees that recover operating costs and provide a return on the private finance invested.

User payments for irrigation do not generally cover costs at present. However, farmers' willingness and ability to pay for large scale irrigation of commercial crops will often be above current charges. Reliable irrigation improves crop yields and allows farmers to sell more to the market, thus generating revenue to pay for the irrigation. The Government will explore the extent to which farmers are willing to pay closer to full cost-recovery rates to speed up the provision of irrigation schemes for commercial agriculture.

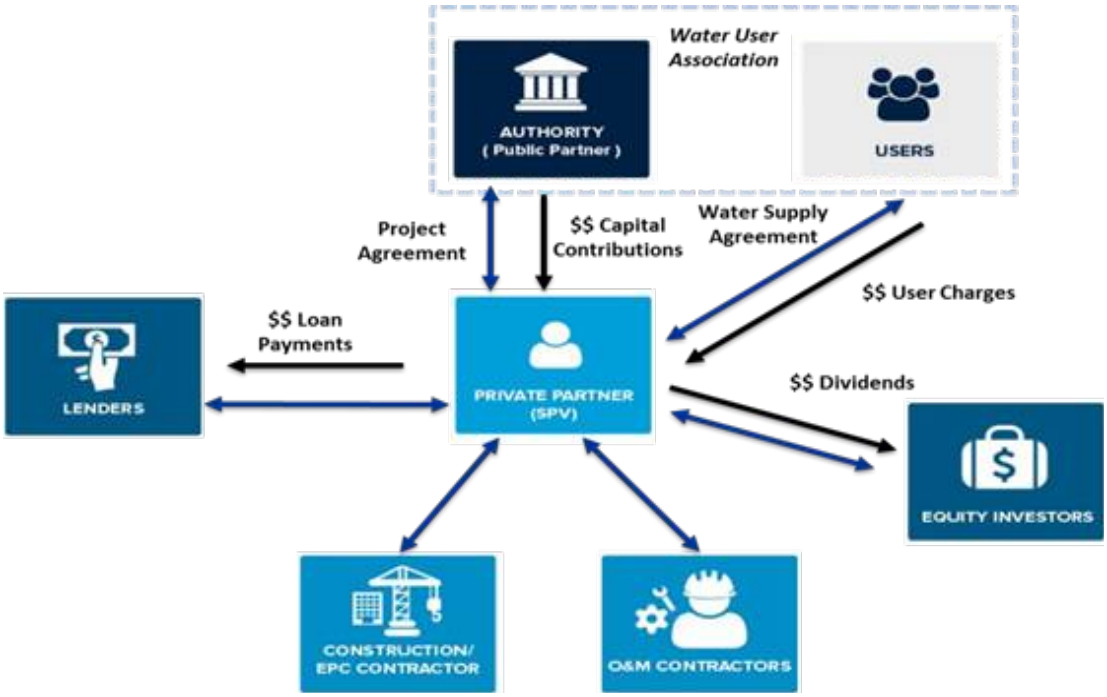
It is not expected that irrigation charges will be sufficient to allow irrigation schemes to be fully privately financed. Many small-holder farmers would struggle to pay full cost-recovery irrigation charges. Moreover, irrigation schemes are designed in part to boost livelihoods for often marginal small-holder farmers. These schemes may also provide public benefits in the form of flood protection and land drainage. For all these reasons, government contributions to the capital cost of the schemes are expected. These contributions may be in the form of land acquisition, as well as up-front capital contributions to cover the share of investment costs that cannot be privately financed.

H.2.1 Structuring and financial analysis for irrigation PPPs

A suitable structure for irrigation PPPs may be the DBFOM model. As illustrated in Figure H.1, a private company established for the purpose would Design the project, Build it, Finance it, Operate and Maintain it. The private company would be contractually obliged to provide water to farmers on specified terms, and be entitled to charge for the water supplied. The revenue generated would cover the operating and maintenance costs of the scheme, free cash from operations to service the company's loans, and provide dividends to its equity investors.

The private company would be held accountable by a Water Users Association formed by the beneficiary farmers. The Government would provide a capital contribution to ensure that irrigation charges remained affordable to farmers, and could also be represented on the Water Users Association.

Figure H.1: Project Structure for Privately Financed Irrigation Project



Source : ***Graphics adapted from APMG International 'APMG PPP Certification Guide', Section 6.1, accessible at: https://ppp-certification.com/ppp-certification-guide/61-introduction-basic-ppp-project-structure***

H.2.2 Kurigram Irrigation Project: Example of how a PPP could work

This describes how the Kurigram Irrigation Project (North Unit) Phase II ('the Project') can be developed as a PPP, including the level of private finance that could be raised. This section:

- Outlines the project and its main components
- Describes a potential PPP structure for the project
- Provides international precedents for structuring the project as a PPP
- Presents an indicative analysis of project cash flows.

Project description

The Kurigram North Irrigation Project Phase II aims to provide irrigation to crop farmers in the northern part of Kurigram district comprising parts of Fulbari, Nageswari, Bhurungamari, and Kurigram Sadar upazilas. Figure H.2 shows the project area.

The Project involves constructing two pump houses and 282km of main, secondary and tertiary canals along with associated infrastructure. By supplying farmers with surface water, the project will relieve pressure on diminishing groundwater resources and alleviate rural poverty through mitigating the effects of drought on farming.

Since the project is already a self-contained irrigation project, the project as a whole could be attractive for procurement as a PPP.

Structuring the irrigation project as a PPP

Government could transfer a significant portion of risks to the private sector by procuring the project using the design, build, finance, operate, and maintain (DBFOM) modality.

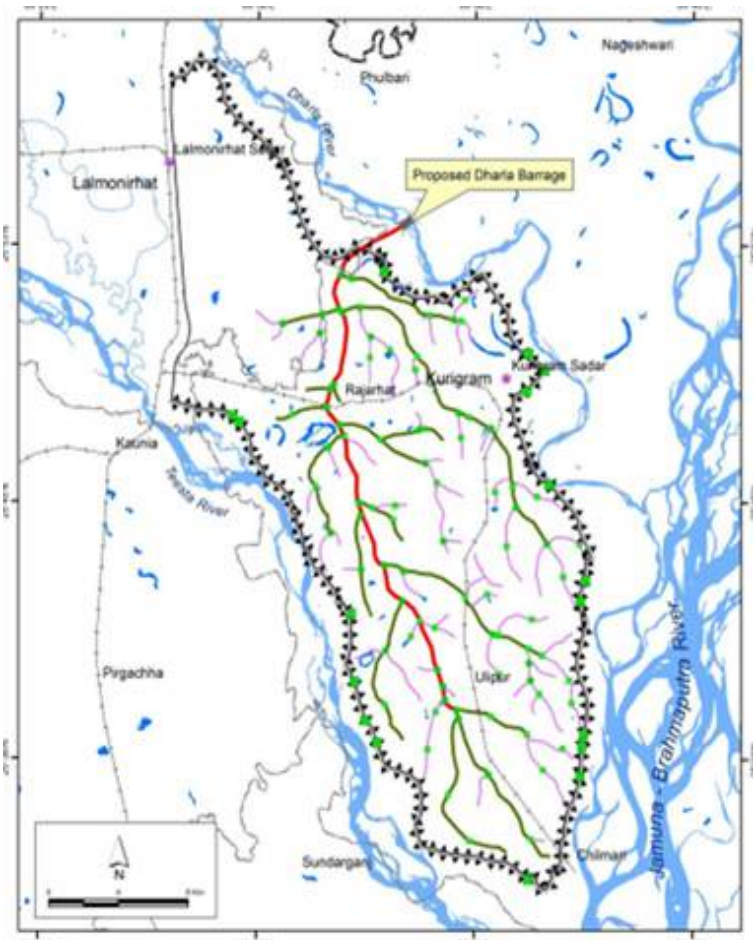


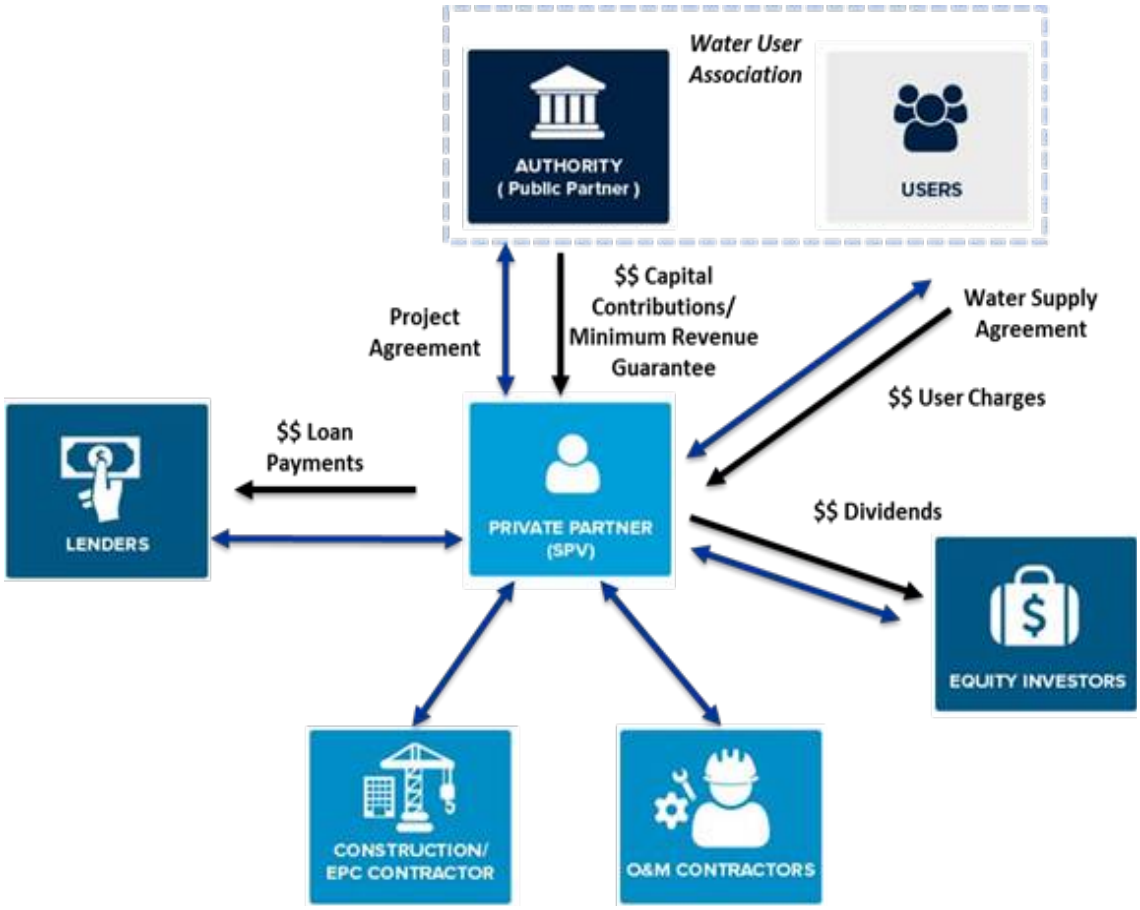
Figure - H2 : Project Area

Source: GED, Detailed Concept Note on Kurigram Irrigation Project (South Unit 2nd Phase), March 2016, p. 11

The private partner would enter into a PPP agreement with the Government for a long-term concession. The private company would be contractually obliged to provide water to farmers on specified terms, and be entitled to charge for the water supplied. The revenue generated would cover the operating and maintenance costs of the scheme, and provide a surplus to service the company's loans, and provide dividends to its equity investors. The private company would be held accountable by a Water Users Association formed by the beneficiary farmers. Depending on the viability of the project and Government policy objectives, the Government may provide a capital contribution to increase affordability of irrigation charges to farmers. The Government may also be represented on the Water Users Association.

The Government would share in the risk related to water demand by providing, for example, a minimum revenue guarantee. The Government would make payments to the private partner under the PPP agreement to cover any shortfall in revenues below a specified level. Figure H.3 illustrates a structure for the project.

Figure H.3: Project Structure



Source: Graphics adapted from APMG International 'APMG PPP Certification Guide', Section 6.1, accessible at: https://ppp-certification.com/ppp-certification-guide/61-introduction-basic-ppp-project-structure

Indicative financial modelling

Analysis of indicative cash flows suggests the Kurigram Irrigation Project can be structured and procured as a financially viable PPP with viability gap funding (VGF) of US$30 million at the irrigation charge that farmers are currently paying for groundwater-based irrigation in the region of the project area of US$100 (BDT8,333) per acre per season. That is, with current market prices, the project could attract US$32 million in private finance.

If the irrigation charges were higher than those assumed, the project could attract more private finance. While we know that farmers are ready and willing to pay US$100 per acre per season, we also expect farmers' willingness and ability to pay for large scale irrigation of commercial crops to be above this level. The current market charge of US$100 per acre per season is for small-scale private irrigation, with an average size of 10 acres. By contrast, large-scale farming operations tend to derive greater value from irrigation than small-scale farmers. That is because they tend to have higher productivity and lower land costs.

The benefits that large-scale irrigation can generate may justify the Government providing capital contributions to the project to maintain the affordability of the scheme and expand its impact. This aligns with the Government's policy objectives for the project, which include alleviating rural poverty. However, this analysis shows that the project is suited to procurement as a PPP and should attract private finance in any case. Figure H.4 presents the model.

Figure H.4: Model Calculations

	Units	Value	PV	2018	2019	2020	2021	2022	2023	2030	2040	2050	2051
Irrigation charge	BDT/acre	8,333.33		-	-	-	-	-	8,333.33	8,333.33	8,333.33	8,333.33	8,333.33
Irrigated area (gross)	thousand acr	105.72		-	-	-	-	-	105.72	105.72	105.72	105.72	105.72
Irrigaton Charge Revenue	US$ millions		$ 40.45	-	-	-	-	-	$ 10.57	$ 10.57	$ 10.57	$ 10.57	$ 10.57
	BDT millions		3,370.73	-	-	-	-	-	880.97	880.97	880.97	880.97	880.97
Opex	US$ millions		$ 8.63	-	-	-	-	-	$ 2.25	$ 2.25	$ 2.25	$ 2.25	$ 2.25
	BDT millions		718.86	-	-	-	-	-	187.88	187.88	187.88	187.88	187.88
FCF from Operations	US$ millions		$ 31.82	-	-	-	-	-	$ 8.32	$ 8.32	$ 8.32	$ 8.32	$ 8.32
	BDT millions		2,651.87	-	-	-	-	-	693.09	693.09	693.09	693.09	693.09
Capex	US$ millions		$ 62.67	$ 18.04	$ 18.04	$ 18.04	$ 18.04	$ 18.04	-	-	-	-	-
	BDT millions		5,222.71	1,503.61	1,503.61	1,503.61	1,503.61	1,503.61	-	-	-	-	-
Free Cash Flows	US$ millions		$ (30.85)	$ (18.04)	$ (18.04)	$ (18.04)	$ (18.04)	$ (18.04)	$ 8.32	$ 8.32	$ 8.32	$ 8.32	$ 8.32
	BDT millions		$(2,570.85)	$(1,503.61)	$(1,503.61)	$(1,503.61)	$(1,503.61)	$(1,503.61)	$ 693.09	$ 693.09	$ 693.09	$ 693.09	$ 693.09

In addition to the level of the irrigation charge, the project analysis relies on a set of assumptions:

- The capital cost is approximately US$90 million (BDT7,500 million), and annual operating costs are US$2.3 million (BDT188 million)
- The gross irrigated area is 106,000 acres
- Revenues are based on farmers paying for one season of irrigation per year. Irrigation generally adds a third available season to rice growing, although in many cases farmers switch from growing rice in the first season to the newly available third season. Farmers may also supplement production in the first and second seasons with irrigation, though we have assumed irrigation is paid for and supplied in one season per year in total.

To assess finance viability, we take present values (PV) of cash flows using a discount rate of 14 percent (real, US$). This is derived from a debt/equity ratio of 70/30, and an effective tax rate of 28 percent, resulting in a post-tax cost of debt of 10 percent and expected returns on equity of 21 percent (both in real terms). These cost of capital figures are the same as those used for other projects in this Appendix and are based on market sounding carried out for the Dhaka-Chattogram Expressway PPP. The PV of capex is US$62.7 million (BDT5,222 million). Operating expenses in PV terms across the life of the project are expected to be approximately US$8.6 million (BDT2,6551 million).

The irrigation charge of US$100 per acre per season is the current market rate. Providing VGF of US$30 million would create a NPV for the project of zero, indicating that at the market irrigation charge, the investor would be able to earn its target return equal to its WACC of 14 percent.

Government could enable the development of the project by making a VGF payment of 50 percent of capital costs. This contribution may be justified because the project will create economic benefits for Bangladesh and help to alleviate rural poverty.

H.2.3 North Rajshahi Irrigation Project: Indicative analysis of a possible PPP project

The North Rajshahi project aims to irrigate about 74,800ha. Part of this area is irrigated with groundwater, but much of the area has no or limited access to groundwater or tube wells during the pre-monsoon season. A comprehensive irrigation network will be constructed, enabling joint use of groundwater and surface water through the proposed irrigation and drainage interventions. The project includes construction of a pump house, pumping stations, and water control structures.

The project is expected to increase the value of crop production in the covered areas significantly. Given the projected increase in production value of crops due to the project, it is possible that farmers will be willing to pay for a constant, predictable, and high-quality water supply for irrigation.

A DBFOM structure could be adopted for the North Rajshahi scheme. The total capital cost of the project is US$256mn (in 2015 terms). Operation and maintenance costs of the project are forecast at BDT108 million per year (US$1.36 million).

The value of increased production due to the project is likely to be BDT1,291.27 million per year (US$16 million). If farmers are willing to pay 30 percent of increased value as water charges, the operator could recover US$4.8 million annually as user charges, which is higher than the forecast operating and maintenance costs of US$1.36 million. The free cash from operations would be US$3.44 million per year. At a commercial discount rate, this has a present value of around US$21 million.

The Government's strategy would be to bring in concessional debt finance to reduce the cost of capital. This could allow about 20 percent of the project to be privately financed. Government viability gap funding of the remaining capital costs would then be needed.

H.2.4 Precedents for PPPs in irrigation

Using PPPs for irrigation is an established practice internationally. In Morocco, for example, the Guerdane Irrigation Project irrigates 10,000 hectares of citrus farms, benefiting over 1,900 farmers[142]. Private investors provided US$37 million of finance, while government contributions helped maintain water affordability.

142 World Bank Group, 'Public-Private Partnership Briefs: Morocco – Guerdane Irrigation', 2013, accessible at: http://documents.worldbank.org/curated/en/873481468190767800/Morocco-guerdane-irrigation

In Peru, the Chavimochic Irrigation Project is currently being built to irrigate nearly 80,000 hectares of land[143]. Water resources will also feed run-of-river hydropower plants and water treatment facilities, with revenues coming from both users and the auctioning of irrigated land. Another Latin America success with privately financed irrigation is the Pontal Irrigation Project in Brazil. This is described further in Box H.1

Box H.1: Pontal Irrigation PPP Project, Brazil

Public irrigation projects in Brazil are not typically self-sustaining; a significant portion of the land in the country is idle; the operations and maintenance of the irrigation systems were ineffective and intermittent. Due to all these factors, small farmers frequently faced insolvency.

To address this problem, the Government of Brazil decided to invite large-scale private participation in irrigation and irrigated agriculture in June 2009.

The Pontal Irrigation Project is located near the city of Petrolina, a semi-arid region in the state of Pernambuco in northeastern Brazil. Expertise was sought from the private sector for the implementation (construction and operations) of the irrigation infrastructure needed to develop the land. In turn, the project was expected to provide two business opportunities for the private partners first, the development of agriculture, whereby the sale of agricultural products translates into revenue earnings and second, the development of infrastructure, which gives them the right to sell water to the users. The government contributes by way of providing access to the existing irrigation infrastructure, land and annual payments. The private party incurs expenditure on agriculture investments, provides water, and invests in operations for common irrigation infrastructure. The area covered under the Pontal project is more than 180,000 ha.

Crop selection is the prerogative of the farmers with a few agricultural restrictions, though without any governmental intervention. The responsibilities of the private operator include managing the occupation of the land, taking care of agriculture production, completing the construction of the main channel, and operating and maintaining the same according to specified performance standards, for a period of 25 years.

Source: Exploring PPPs in the Irrigation and Drainage Sector in India – A Scoping Study, ADB

Bangladesh has already started to use PPPs for irrigation, with the ANZDEC Project in the Muhuri area expected to double or triple the gross margin for various crops, including boro rice, through reduced water cost and increased water availability. In 2014, the Government and the BWDB awarded a PPP contract to Irrigation Management Operators (ANZDEC, a New Zealand based company) to rehabilitate and modernize the existing irrigation and energy infrastructure in the Muhuri area, estimated at 11,800ha, and to manage the phased increase of the irrigated area to 17,000ha. The contract was awarded in January 2016, and the project is expected to be completed by June 2019[144].

143 World Bank Group, 'PPPs in Irrigation', accessible at: https://ppp.worldbank.org/public-private-partnership/ppp-sector/water-sanitation/ppps-irrigation

144 How to Develop Sustainable Irrigation Projects with Private Sector Participation, World Bank, PPIAF, 2016.

ANZDEC will design and supervise construction of the modernization works, provide agriculture extension services, operate and maintain the pump systems, khals, and other infrastructure, and collect the irrigation service charge. They will be expected to finance the US$4.2 million in O&M costs, which they will recoup by levying a 10 percent administration fee for collecting the charges.

The PPP also incorporates the 'user pay' principle through a pre-paid metering system with smartcards. Farmers are expected to make a 3 percent contribution towards the rehabilitation of the tertiary level irrigation, and will pay for their water usage through these smartcards. Farmers can recharge their smartcards using hand-held "mobile vending units", which will be kept by local dealers. The Government now intends to build on this experience to attract increasing volumes of private finance to expand irrigation infrastructure and improve land productivity.

H.3 Inland Water Transport

Bangladesh's many rivers offer convenient and environmentally friendly transportation options. Relative under-investment has resulted in river transport losing modal share to roads for both freight and passenger transportation. Opportunities abound to create suitable passenger and freight terminals for inland water transportation. Combined with channel work to ensure that waterways are navigable (see section H.4), these can restore inland water transportation to its natural role in a deltaic country. The Government plans to seek private investment in ports and terminals through public-private partnerships undertaken as part of the Delta Investment Plan.

PPPs can be used to engage private firms to build and operate new ports and terminals, rehabilitate and expand existing ports and terminals, and develop surrounding land. PPPs can also be used to improve waterway navigability and increase waterway capacity discussed in the next section.

In the IP, the 'Protection of Rivers System around Dhaka City with Their Ecological Restoration' (UA 1.1) project has an inland water transport component that is judged to have the potential to attract private finance. This includes the management of passenger ferry scheduling and development of riverside land, including the construction of recreational facilities. Ferry terminal development might also be included, in addition to dredging to increase navigability. The project and has a total expected capital expenditure of US$185 million.

Bangladesh's existing passenger terminals are under-developed

As Figure H.5 illustrates, existing passenger terminals for inland water transport are often rudimentary in terms of passenger services and amenities. They have not fully exploited opportunities to increase service offerings and commercial revenues by providing retail space and restaurants to serve passengers.

Figure H.5: Ferry Terminal in Dhaka Illustrating Opportunities for Improvement

Source: David Ehrhardt, Castalia LLC

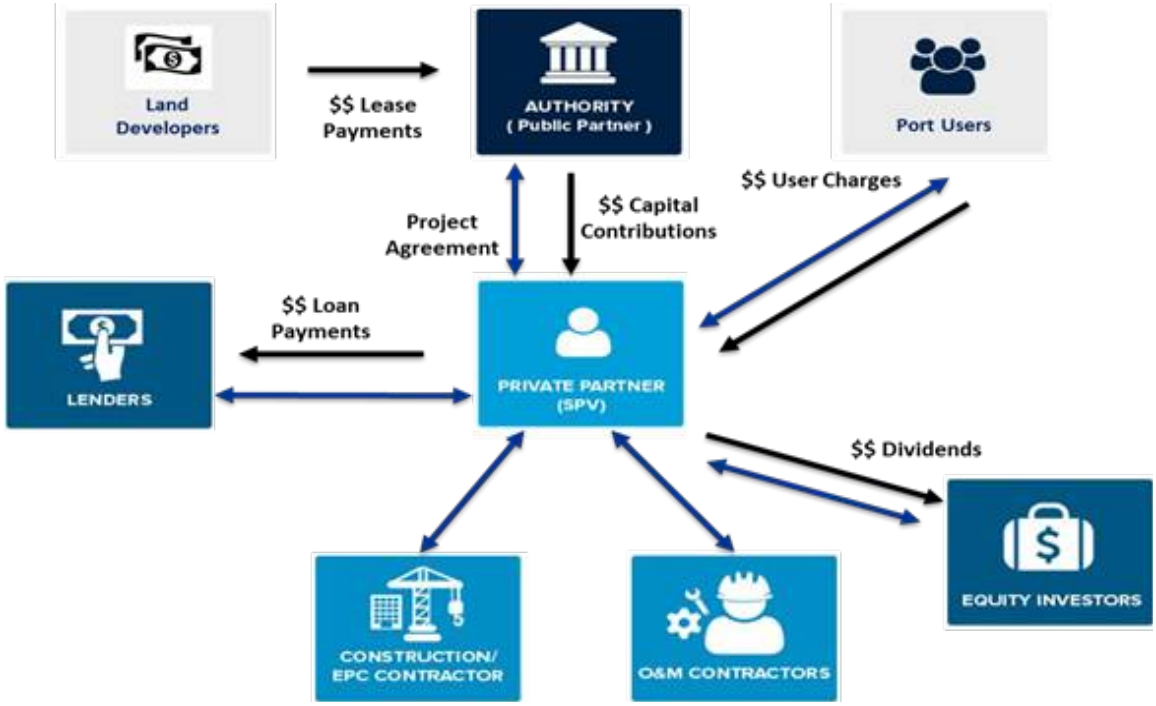
Maximizing the value from complementary developments can combine with user charges to provide a return to private operators. High-quality water ports and terminals can be developed into transport 'hubs' that not only provide transport connections, but also become destinations themselves providing a range of convenient complementary goods and services that are valuable to a range of users. PPPs could include real estate development opportunities, using inland water transport passenger hubs as a basis for commercial and residential developments, and taking advantage of land space and air-rights[145] that are currently under-utilized. All these types of development opportunities can generate additional revenue sources that can help pay for infrastructure improvements helping to attract private finance.

H.3.1 Structuring PPPs for inland water transport infrastructure

Ferry terminals and related infrastructure will be constructed where possible on a DBFOM basis illustrated in Figure H.6 Where existing structures are being upgraded, RFOM (Rehabilitate, Finance, Operate, Maintain) contracts will be used. Land development opportunities can then be converted into revenue sources through leasing out surrounding land.

145 That is, planning and leaseholder permission to build up above a transportation facility.

Figure H.6: DBFOM Structure for New Ferry Terminal



Source: Graphics adapted from APMG International 'APMG PPP Certification Guide', Section 6.1, accessible at: https://ppp-certification.com/ppp-certification-guide/61-introduction-basic-ppp-project-structure

H.3.2 Precedents of PPP in inland water transportation ports and terminals

Private sector participation has been used successfully in several countries to expand and improve the quality of inland water transport links. The approach proposed above builds on those models.

In the Netherlands, the Beatrix lock PPP reached financial close in February 2016. The US$144 million project will reduce congestion on a key inland waterway, the Lek Canal, through the renovation and expansion of existing waterway infrastructure[146]. The State of Missouri in the United States has over 200 private ports operating on over 1,000 miles of waterways along the Missouri and Mississippi Rivers. India also plans to develop 850 ports along key rivers to scale up inland waterway infrastructure in projects worth a total of US$615 million[147]. Box H.2 describes privately financed ports in North America.

146 Heijmans 'Financial Close: Project Beatrix Lock and Widening of Lek Canal', 2016, accessible at: https://www.heijmans.nl/en/news/financial-close-project-beatrix-lock-and-widening-lek-canal/

147 The Economic Times 'Investment of Rs 4,000 Crore in 850 Ports Likely', 2015, accessible at: https://www.heijmans.nl/en/news/financial-close-project-beatrix-lock-and-widening-lek-canal/

Box H.2: Privately operated and financed ports in the Mississippi-Missouri River System

The Mississippi-Missouri River System is North America's most significant inland waterway transportation route. Combining the two longest rivers in the United States, the river system has played a central role in transportation throughout the history of the United States. The system accounts for the majority of United States agricultural exports, and therefore transport infrastructure is critical to the region.

Private sector participation has a long history in water transportation, extending to the early days of steamship transportation in early 19th century. Since then, the sector expanded to include 14 publicly-owned port authorities, and over 200 private ports operating on over 1,600 km of waterways.

Although investments in highways and railroads have reduced the freight share of waterway transportation, the ports continue to play an essential role in freight movements in the United States, due to the cost-competitiveness and environmentally friendly nature of waterway transportation.

***Source:** Missouri Department of Economic Development 'The Economic Value of Investment in Freight Transportation: Missouri Ports', accessible at: https://library.modot.mo.gov/RDT/reports/Ri08040/MOportFreight.pdf*

Bangladesh has already started to use PPPs for inland transportation infrastructure. This includes the award of five Inland Container Depot projects to private developers—three of which are currently under construction. The Government now intends to build on this experience to attract increasing volumes of private finance to revitalize the role of inland waterways in Bangladesh's transport network.

H.4 Dredging and Land Reclamation

Dredging projects can revitalize waterways, improving their navigability, expanding transport capacity, and restoring ecological health. Consistent with the Delta Plan's focus on revitalizing inland water transport in Bangladesh, the country will require significant initial (capital) and ongoing 'maintenance' dredging for the foreseeable future. As the long history of PPPs for dredging indicates, these projects create a range of revenue streams which can enable them to attract finance and be undertaken as PPPs. Dredging can also enable land reclamation projects, creating new productive land for various types of development.

The following IP project has significant dredging and/or land reclamation components that are judged to have the potential to attract private finance: Protection of Rivers System around Dhaka City with Their Ecological Restoration (UA 1.1). This multi-component project (capital expenditure of US$185 million) will revitalize four rivers essential to Dhaka City, addressing problems caused by unplanned urbanization. In addition to inland water transport and solid waste and sewage management components, this project will include dredging to increase river navigability, and may include land reclamation. The dredging and land reclamation can be undertaken by a private operator, with revenues derived from the sources discussed above as well as the lease or sale of reclaimed land.

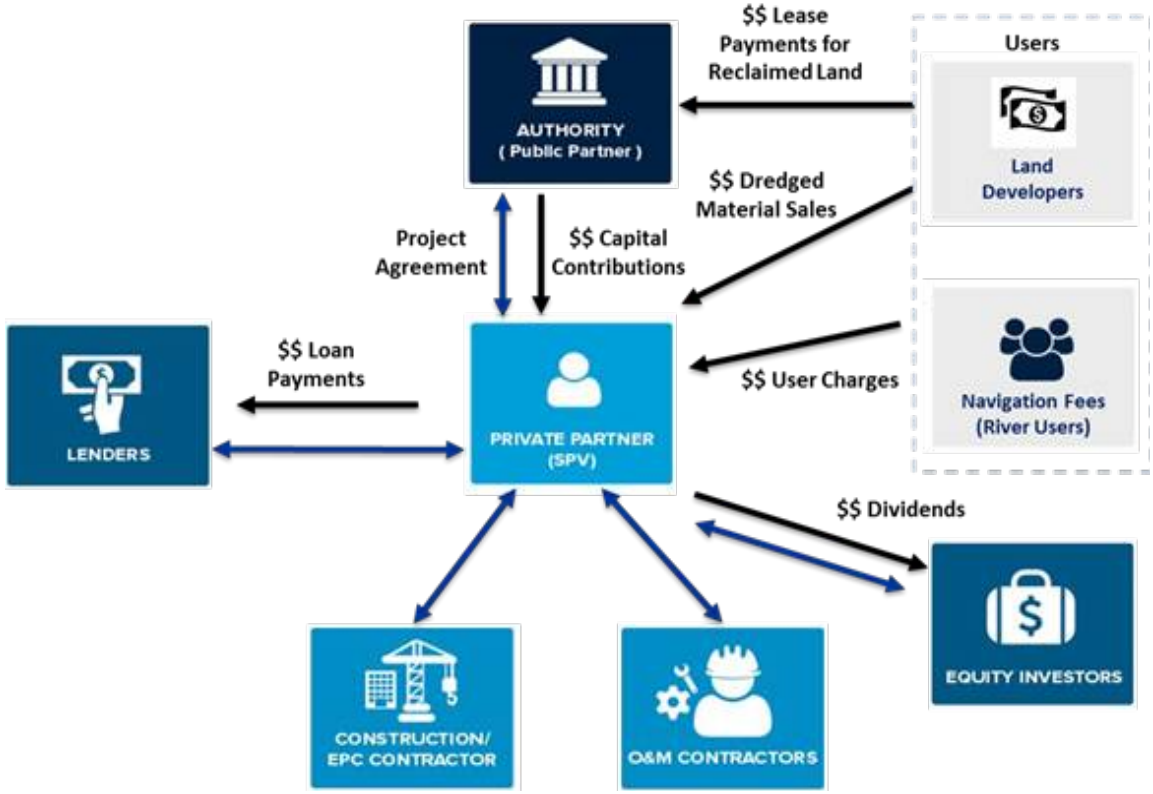
Dredging and land reclamation projects create multiple revenue streams that enable them to be undertaken as PPPs. Dredging projects can generate commercial revenue from at least three sources: sale of dredged sand as a building material; use of dredged mud for land reclamation and building up agricultural soils; and charging channel fees to commercial vessels navigating the dredged channels (like tolls on a highway). Land reclamation projects generate commercial revenues from the sale or lease of the reclaimed land. Land reclamation and dredging are often linked, in that dredging may both ensure adequate drainage of the reclaimed land, and provide fill used to build up the level of reclaimed areas.

H.4.1 Structuring dredging and land reclamation projects as PPPs

Where the focus is on channels for inland navigation, the Government will explore the use of the DBFOM model, with private firms creating or restoring the channel to navigable condition (capital dredging), and then maintaining it in that condition for a defined period, for example 10 or 20 years. This is illustrated in Figure H.7.

A portion of the capital costs would be financed by the private company, which would earn a return on its investment through revenue from channel navigation fees (from river users) and the sale of dredged material over the life of the project.

Figure H.7: DBFOM and Lease Structure for Dredging and Land Reclamation



Source: *Graphics adapted from APMG International 'APMG PPP Certification Guide', Section 6.1, accessible at: https://ppp-certification.com/ppp-certification-guide/61-introduction-basic-ppp-project-structure*

The government will also explore private sector interest in financing some or all of projects aimed primarily at land reclamation, in exchange for long term-leases on the land created. Highways and other transportation links often form a component of these projects, and tolls can provide an additional revenue source to help pay for the infrastructure.

H.4.2 Precedents of PPP in channel dredging and land reclamation

There is a history of dredging being undertaken under long-term contracts by private operators. The Fasiver Project in Belgium, described in Box H.3, provides an example.

Box H.3: Fasiver Dredging and Canal Revitalization, Belgium

In the 1990s, the canals and rivers around the City of Ghent in Belgium had suffered from environmental degradation combined with a lack of maintenance dredging operations. These problems were linked—with the dumping of hazardous material in the canals by previous industrial users creating challenges for the safe disposal or re-use of dredged material. At the same time, the City of Ghent was also suffering from a shortage of land for the expansion of a growing industrial sector.

To address these issues, the City of Ghent developed a PPP to revitalize the canals and rivers. The project involved contracting a private operator (DEC NV) to undertake substantial dredging, as well as the treatment of hazardous dredged material. In partnership with the owner of

surrounding land (DOMO Services Gent NV), the dredged material was then used to reclaim and re-design surrounding land for use as an industrial park, with the profits from the sale of the industrial land helping to pay for the costs of the environmental remediation.
Between 2001 and 2007, the private firm successfully dredged 850,000 tons of dry matter from the canals, revitalizing the canals in line with the firm's contractual obligations. Several parcels of land have since been sold off, including some purchased by the Government for further development.
Source: Johan Maes 'Fasiver: Beneficial Use of Dredged Material', accessible at: https://www.heijmans.nl/en/news/financial-close-project-beatrix-lock-and-widening-lek-canal/

Bangladesh is already developing plans for dredging PPPs that draws on these models. The World Bank report on Revival of Inland Water Transport[148] found that the private sector can contribute greatly to the dredging capacity currently provided by BIWTA and BWDB. BIWTA is currently developing a master plan for the sector that envisages 7-year performance-based contracts for dredging. There is strong private sector interest in these contracts.

H.5 Water Supply and Sanitation

Water supply projects can provide the people of Bangladesh with improved access to clean water, including through piped water systems. Sewerage systems improve both public health and water quality by better collecting industrial effluent, sewage, and fecal sludge; treating it; and disposing of it safely. Both water supply and sewerage services can be implemented as PPPs, commonly through the private sector being engaged to design, build, finance, operate, and maintain the infrastructure that provides those services.

The following Investment Plan projects have significant water supply or sewerage services-related components that are judged to have the potential to attract private finance:

- Protection of Rivers System around Dhaka City with Their Ecological Restoration (UA 1.1). This multi-component project (capital expenditure of US$185 million) will revitalize four rivers essential to Dhaka City, addressing problems caused by unplanned urbanization. In addition to inland water transport and dredging, the project includes new systems for solid waste management and sewage treatment. Private operators can be engaged to develop these systems either separately or in bundled projects, with revenues derived from user charges
- Water Supply Project for the City Corporation Areas in Bangladesh (Phase I & II) (UA 9.1). This project (capital expenditure of US$390 million) involves the construction and maintenance of eight water treatment plants with pump houses across five City Corporations, along with an additional 1,000 kilometers of pipeline infrastructure. PPP projects of varying sizes can be designed, with revenues coming from water tariffs or from a contract for bulk water with the public utility

148 World Bank 'People's Republic of Bangladesh Revival of Inland Water Transport: Options and Strategies', accessible at: http://documents.worldbank.org/curated/en/329261468003908999/Peoples-Republic-of-Bangladesh-revival-of-inland-water-transport-options-and-strategies

- Khulna Water Supply Project Phase II (UA 23.1). This project (capital expenditure of US$333 million), involves the development of a new surface water treatment plant combined with an intake structure, transmission and distribution network system, and impounding and distribution reservoir. This plant will serve about 800,000 inhabitants. This project could potentially be designed, built, operated, maintained, and financed by a private firm. Revenues could come from water tariffs or from a contract for bulk water with the public water utility

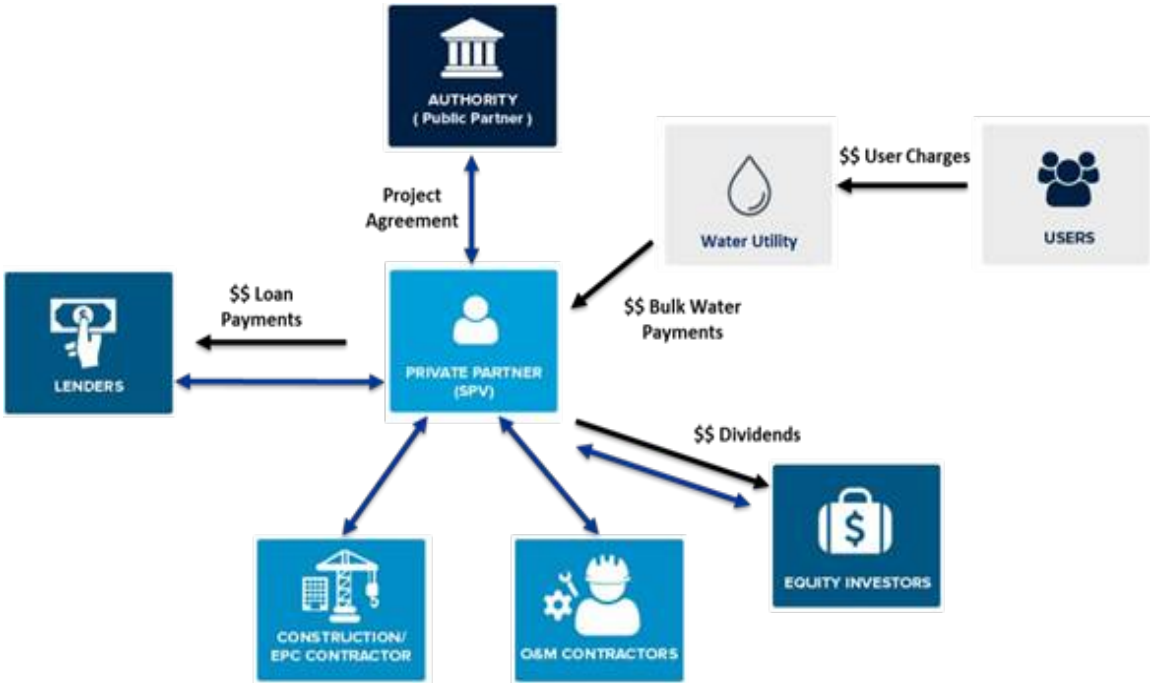
- Water Supply Project in the Urban Areas of Bangladesh (Secondary Towns) (CC 9.11). Like CC9.10, this project (capital expenditure of US$583 million) focuses on pourashavas with existing but unsatisfactory water supply systems. It includes the installation of 350 tube wells, 150 treatment plants, and 4,500 km of pipelines. The treatment plants, tube wells, and transmission systems could be developed as PPPs, with user charges contributing to costs along with public contributions.

- User-charges can provide a growing source of revenue to make private finance of water and sanitation infrastructure investment possible. Water services are valuable, and it is Government policy for water charges to increase toward cost recovery. Urban customers also need to be charged for centrally provided sanitation services, since these are essential for the health and prosperity of urban areas. Effluent-producing industries such as tanning and textiles, that have an obligation to treat their effluent prior to discharge, will often find it cost effective to pay a centralized effluent treatment plant to perform this service, rather than do it themselves.

H.5.1 Structuring water and sanitation projects as PPPs

The focus will be on DBFOM contracts in which the private firm finances, builds, and operates the treatment plant, and is paid a fee by the public utility for treating the water or effluent to the required standard. This model is illustrated in Figure H.8. In addition, the Government aims to use performance-based contracts to improve distribution system management, and is investigating the use of PPPs to operate water distribution networks, as well as water production facilities, in smaller towns in which public sector providers lack the funds or skills to operate such networks to customers' satisfaction.

Figure H.8: DBFOM Structure for Water and Wastewater Treatment Plants



Source: Graphics adapted from APMG International 'APMG PPP Certification Guide', Section 6.1, accessible at: https://ppp-certification.com/ppp-certification-guide/61-introduction-basic-ppp-project-structure

H.5.2 Khulna Water Treatment Plant: Indicative analysis of a possible PPP project

This describes how the water treatment plant ('the Water Treatment Plant') portion of the Khulna Water Supply Project Phase II ('the Project') can be developed as a PPP, including the level of private finance that could be raised. This section:

- Outlines the Project and its main components
- Describes a potential PPP structure for the Water Treatment Plant
- Provides international precedents for structuring the Water Treatment Plant as a PPP
- Presents an indicative analysis of project cash flows.

The Khulna Water Supply Project Phase II (UA 23.1) aims to improve the supply of treated water to 800,000 Khulna inhabitants.

The Project involves the development of a new surface water treatment plant combined with an intake structure, transmission and distribution network system, and impounding and distribution reservoirs.

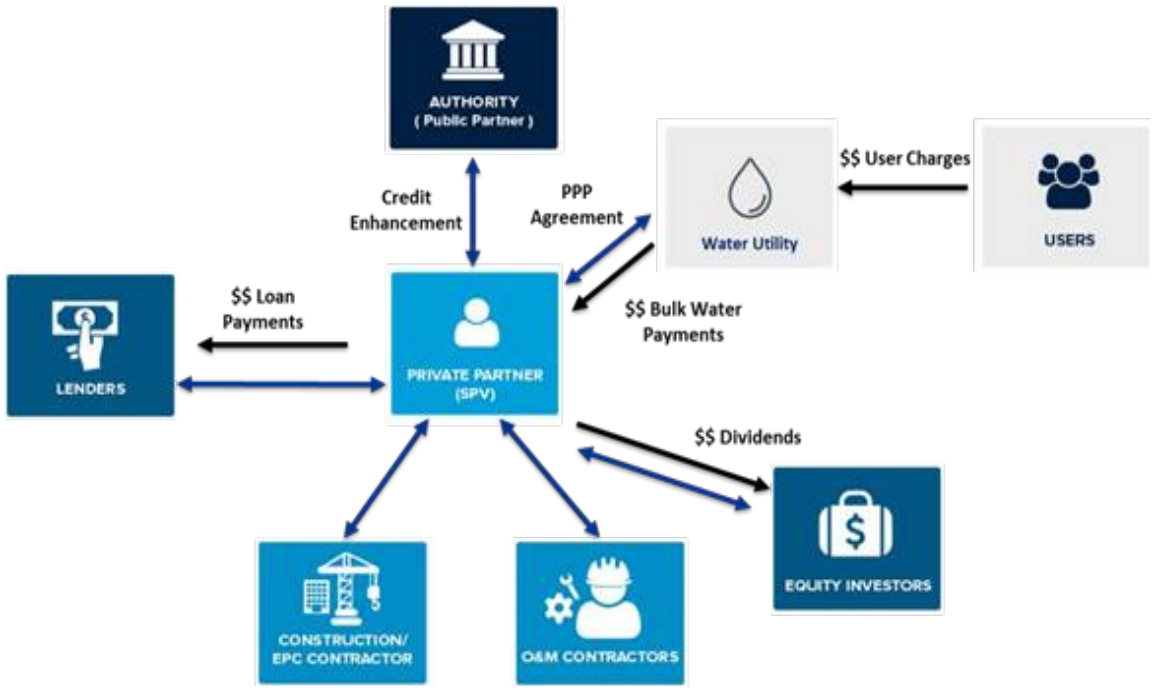
A portion of the Project that could be attractive to private investors involves the construction and operation of a water treatment plant with a capacity of 110,000m3 per day. The treated water would be purchased by the Khulna Water Supply and Sewerage Authority (KWASA), with costs recovered from KWASA's customers.

Structuring the Water Treatment Plant as a PPP

Government could transfer a significant portion of risks to the private sector by procuring the Water Treatment Plant using the design, build, finance, operate, and maintain (DBFOM) modality.

The Water Treatment Plant's revenues would come from bulk water charges paid by KWASA recovered from customers via public water tariffs. Accordingly, the private partner would enter into a PPP agreement with KWASA for a long-term concession. However, the Government would play a strong role in the procurement and negotiation of the PPP agreement, and would likely have an ongoing role in providing credit enhancement to mitigate private operator's valuation of KWASA's risk as a counterparty. Figure H.9 illustrates a structure for the project.

Figure H.9: Project Structure



Source: Graphics adapted from APMG International 'APMG PPP Certification Guide', Section 6.1, accessible at: https://ppp-certification.com/ppp-certification-guide/61-introduction-basic-ppp-project-structure

Indicative financial modelling

Analysis of indicative cash flows suggests the Khulna Water Treatment Plant can be structured and procured as a financially viable DBFOM PPP with a bulk water charge paid to the private operator of approximately US$0.82 (BDT68) per cubic meter of treated water.

In other words, with a bulk water charge of US$0.82 per cubic meter of treated water, the Water Treatment Plant could be fully privately financed. That charge would enable the private operator to recover its operating costs, as well as earn a return on capital of the level we would expect for this kind of PPP in Bangladesh.

This bulk water charge is higher than the current tariffs paid by KWASA's customers but undertaking this project does not require the public tariff to be the set at the same level as bulk water charges paid to the private operator. That is because the bulk water supplied by the private operator would only be approximately 30 percent of KWASA's total water supply the majority (70 percent) of which comes from facilities that KWASA owns and operates. Part of the bulk water charge can therefore be paid for out of the utility's surplus from its other operations, with only the balance covered through a modest increase in tariffs.

The project would increase KWASA's average costs of supply from US$0.05 per cubic meter to approximately US$0.17 per cubic meter. Fully passing on this cost would increase public tariffs from US$0.06 per cubic meter to approximately US$0.19 per cubic meter. This tariff would be above the current Dhaka Water and Sewerage Authority tariff of US$0.14 per cubic meter, but would be below that of at least four other utilities in the region, including in Cambodia (US$0.24 per cubic meter), which has a similar GDP per capita to Bangladesh. Figure H.10 presents the model.

Figure H.10: Model Calculations

	Units	Value	PV	2018	2019	2023	2024	2030	2040	2050	2051
Bulk water charge	*BDT/m3*	*67.98*		-	-	-	*67.98*	*67.98*	*67.98*	*67.98*	*67.98*
Capacity	*thousand m3/day*	*110*		-	-	-	40,150	40,150	40,150	40,150	40,150
Capacity factor	*%*	*0.9*		-	-	-	36,135	36,135	36,135	36,135	36,135
Bulk Water Revenue	*US$ millions*		**$ 99.00**	-	-	-	**$ 29.48**	**$ 29.48**	**$ 29.48**	**$ 29.48**	**$ 29.48**
	BDT millions		*8,250.38*	-	-	-	*2,456.36*	*2,456.36*	*2,456.36*	*2,456.36*	*2,456.36*
Opex	*US$ millions*		**$ 0.48**	-	-	-	**$ 0.14**	**$ 0.14**	**$ 0.14**	**$ 0.14**	**$ 0.14**
	BDT millions		*40.31*	-	-	-	*12.00*	*12.00*	*12.00*	*12.00*	*12.00*
FCF from Operations	*US$ millions*		**$ 98.52**	-	-	-	**$ 29.33**	**$ 29.33**	**$ 29.33**	**$ 29.33**	**$ 29.33**
	BDT millions		*8,210.08*	-	-	-	*2,444.36*	*2,444.36*	*2,444.36*	*2,444.36*	*2,444.36*
Capex	*US$ millions*		**$ 98.52**	**$ 25.00**	**$ 25.00**	**$ 25.00**	-	-	-	-	-
	BDT millions		*8,210.08*	*2,083.33*	*2,083.33*	*2,083.33*	-	-	-	-	-
Free Cash Flows	*US$ millions*		**$ -**	$ (25.00)	$ (25.00)	$ (25.00)	$ 29.33	$ 29.33	$ 29.33	$ 29.33	$ 29.33
	BDT millions		-	*(2,083.33)*	*(2,083.33)*	*(2,083.33)*	*2,444.36*	*2,444.36*	*2,444.36*	*2,444.36*	*2,444.36*

In addition to the level of the bulk water charge, the project analysis relies on a set of assumptions about the Water Treatment Plant:

- The capital cost is US$150 million (BDT12,500 million) and annual operating costs are US$144,000 (BDT12 million)
- The plant's capacity is 110,000m3 per day, and the plant operates at an average capacity factor of 0.9. At this capacity factor, the plant would produce 99,000m3 per day.

To assess finance ability, we take present values of cash flows, using a discount rate of 14 percent (real, US$). This is derived from a debt to equity ratio of 2.33 at a post-tax cost of debt of 10 percent, and an expected equity return of 22 percent (both in real terms). These cost of capital figures are the same as those used for other projects in this Appendix and are based on a market sounding carried out for the Dhaka-Chattogram Expressway PPP. Capital requirements are US$99 million (BDT8,210 million). Operating expenses in present value terms across the life of the project are expected to be approximately US$0.48 million (BDT40 million).

The bulk water tariff of US$0.82/m3 is calculated so the net present value (NPV) of free cash flows from operations is US$98.52 million, just equal to the present value (PV) of the capex. This gives an NPV of the project of zero, indicating that at the tariff of US$0.82/m3, the investor would be able to earn its target return of 14 percent.

H.5.3 Precedents for PPPs for water and wastewater treatment plants

Since 1990, more than 260 PPP contracts have been awarded to private operators for the management of urban water and sanitation utilities in the developing world[149]. India has implemented 13 water treatment PPPs in the past 10 years[150]. Dhaka WASA has developed two water treatment plants using the Design Build Operate Maintain (DBOM) approach. The next step is for DWASA and other utilities to ask future private partners to invest in the facilities that they will build and operate, thus moving to the DBFOM model.

PPPs have also been widely used for wastewater treatment plants globally. India, for example, developed its first Sewage Treatment Plant PPP in 2000[151]. Since then, more than 20 projects have been developed in India[152]. Jordan's experience with a PPP wastewater treatment plant is discussed in Box H.4.

149 World Bank 'Public Private Partnerships for Urban Water Utilities: A Review of Experiences in Developing Countries', 2010, accessible at: http://documents.worldbank.org/curated/en/157961468331019916/Public-private-partnerships-for-urban-water-utilities-a-review-of-experiences-in-developing-countries

150 Trends in Private Sector Participation in the Indian Water Sector: A Critical Review, 2011, accessible at: https://www.wsp.org/sites/wsp.org/files/publications/WSP-Trends-PSP-India-water-sector.pdf

151 Alandur Sewerage Project in Tamilnadu, accessible at: https://www.pppinindia.gov.in/toolkit/ports/module3-rocs-intro.php?links=rocs1

152 White Paper on Urban Wastewater PPPs, FICCI, WRG 2030

Box H.4: PPP for As Samra Wastewater Treatment Plant, Jordan

Jordan is one of the world's driest countries with water scarcity impacting all aspects of daily life. The governorates of Amman and Zarqa were facing a shortage of capacity to treat wastewater, and needed to replace aging systems which were struggling to keep up with population growth and causing environmental degradation.

In response, Jordan procured a private operator under a long-term contract to design, build, finance, operate, and maintain the As-Samra wastewater treatment plant for a period of 25 years. At the end of the project (in 2037), the facility will be transferred to the Jordanian Government. The project mobilized US$77 million of private finance, with viability gap funding provided by the Jordanian Government and USAID.

The private operator successfully completed construction in 2008. With a peak flow of 840,000 cubic meters per day, the plant is the largest wastewater treatment plant in Jordan, serving a population of 2.2 million living in the Greater Amman and Zarqa areas.

Like the projects discussed in Section H.5, the project also takes advantage of byproducts as additional sources of value to improve the financial viability of the plant. In this case, 80 percent of the plant's energy needs are provided from associated biogas and hydroelectric generation. The project has also created additional water sources for irrigation while simultaneously improving the ecological health of the Zarqa river.

The project also includes a knowledge transfer component to build the capacity of local engineers to operate the wastewater treatment plant.

Source: WaterTechnology 'As-Samra Wastewater Treatment Plant' Jordan, accessible at: http://www.water-technology.net/projects/as-samra-wastewater-treatment-plant-jordan/

Bangladesh has already developed a centralized effluent treatment plant on a PPP basis in the Savar Dhaka Economic Processing Zone, a free trade zone. The plant started operations in February 2012. The PPP is structured as a 30-year Build-Own-Operate-Transfer contract between Bangladesh Export Processing Zones Authority (BEPZA) and the private operator, Flagship Ecosystems Investment Private Ltd[153].

A preliminary market assessment for a sewage treatment plant in Dhaka indicated strong interest from the private sector[154]. Over a quarter of respondents were willing to provide at least some of the finance, provided there are sufficient guarantees to enhance offtaker credit-worthiness, and other protections. Most respondents also said that they can construct a sewage treatment plant before construction of the sewerage network is fully completed, provided there is a two-part tariff (fixed and variable) structure where the fixed component is sufficient to cover the project's capital costs.

153 https: / / www.wwdmag.com / green-technology/singaporean-company-builds-first-central-effluent-treatment-plant-bangladesh

154 Castalia, 'Preliminary Market Assessment for PPPs in Bangladesh Sewerage Treatment Plants', 2017.

H.6 Embankments with Highways

Embankments for flood mitigation can be viable as PPPs when developed with a tolled road on top of the embankment (or dike). The embankment serves a dual-purpose for projects of this type. First, it creates an elevated barrier that protects against floods. Secondly, the embankment introduces a natural barrier that makes capturing and tolling vehicles easy.

In Bangladesh, an embankment and elevated road can provide additional benefits. Together, they can limit encroachment on the road surface, which is a significant risk for at-grade road projects across the country. For projects that require land reclamation, land acquisition, and population displacement, this can be reduced because new land will be created.

The following IP projects involve constructing embankments with roads:

- UA 1.2 Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road Multipurpose Project. This project has an expected capital expenditure of at least US$400 million, and includes the design and construction of a 24-kilometer embankment and road along the Balu River in Eastern Dhaka City
- DP 1.4/1.5 Kurigram Irrigation Project.

Commercial revenue sources for embankments with roadways include:

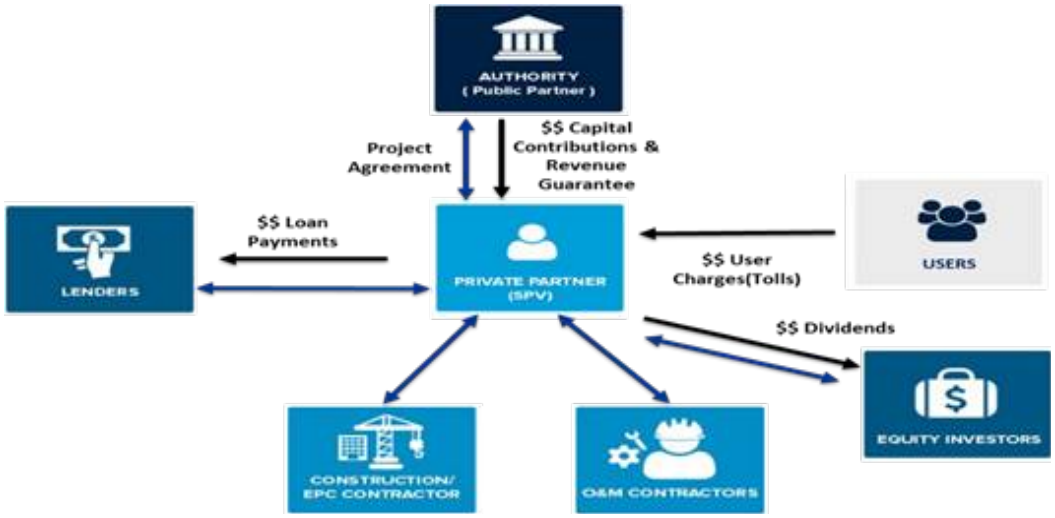
- Toll revenues to be paid by users on a kilometer traveled, fixed axle, or a combination of fixed fees and distance traveled basis
- Rights to develop the corridor, from service stations to new commuter settlements, business parks, logistics hubs, etc.

H.6.1 Structuring embankment and highway projects as PPPs

The Government will explore developing embankments with roads through the DBFOM modality. Under this model, the private partner is engaged to design, build, finance, operate, and maintain the embankment and expressway through a long-term contract. The Government provides the right of way, and may make a capital grant or viability gap payment to ensure affordability to users and to capture project benefits. The payment structure for project services and collection of user charges depends on which party takes demand risk.

Figure H.11 illustrates a project structure where the demand risk is shared by the Government and the private sector.

Figure H.11: Project Structure for Embankment and Highway PPPs



Source: Graphics adapted from APMG International 'APMG PPP Certification Guide', Section 6.1, accessible at: https://ppp-certification.com/ppp-certification-guide/61-introduction-basic-ppp-project-structure

H.6.2 Dhaka Eastern Bypass and Embankment: Indicative analysis of a possible PPP project

This describes how the Eastern Bypass Road and Embankment portion of the Dhaka Integrated Flood Control Embankment Cum Eastern Bypass Road Project ('the Project') can be developed as a PPP. The section:

- Outlines the Project and its main components
- Describes a potential PPP structure for the Eastern Bypass Road and Embankment
- Presents an indicative analysis of project cash flows
- Provides international precedents.

The Dhaka Integrated Flood Control Embankment Cum Eastern Bypass Road Project aims to protect the eastern part of Dhaka City from floods and improve the city's transportation network. The project involves the design and construction of embankments, flood walls, roadways, structures, and pumping and drainage works. Figure H.12 shows the Project.

Figure H.12: Eastern Bypass Road and Embankment Map

The portion of the Project that could be attractive to private investors involves the construction of 24-kilometer embankment along the Balu River, topped by a highway (the Eastern Bypass). Tolling this highway would generate revenue that could help cover the cost of both the highway and the embankment.

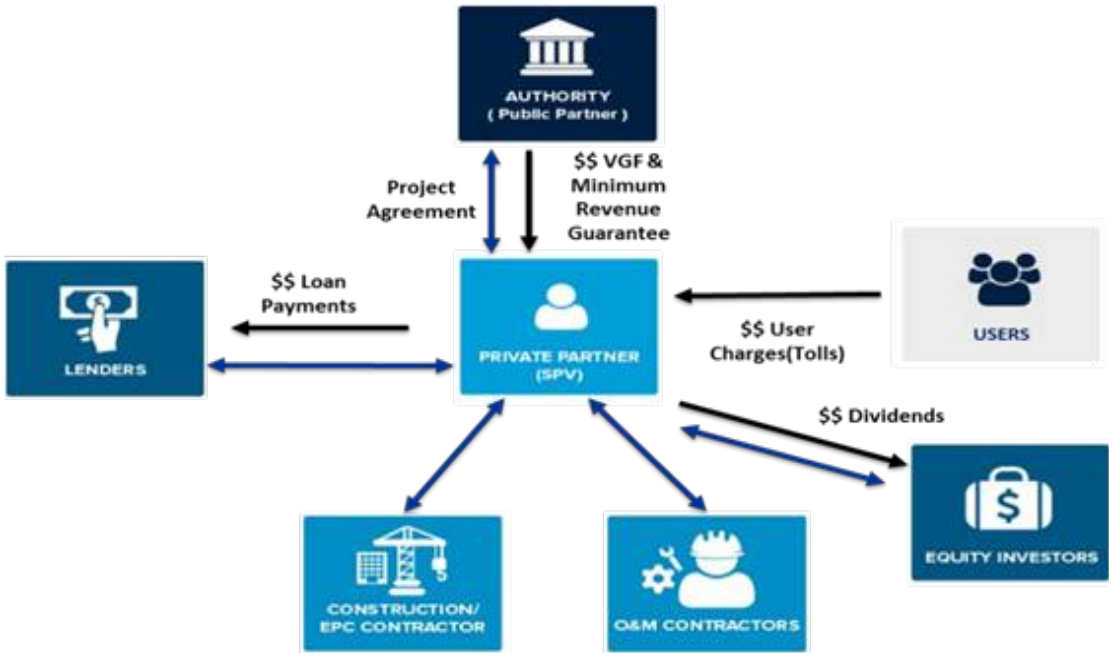
Structuring the road as a PPP

The Government could transfer a significant portion of risks to the private sector by procuring the Eastern Bypass Road and Embankment using the design, build, finance, operate, and maintain (DBFOM) modality. The private partner would enter into a PPP agreement with Government. Toll revenues from expressway users would be the primary source of revenue for the Road. Additional revenue sources could come from rights to develop the corridor, for example with service stations, business parks, and logistics hubs.

Source : GED, Detailed Concept Note on Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road Multipurpose Project, March 2016, p. 14

Figure H.13 illustrates a structure for the project in which the Government makes a capital contribution in the form of viability gap funding (VGF), and shares demand risk with the private partner by issuing a minimum revenue guarantee.

Figure H.13: Project Structure



Source: ***Graphics adapted from APMG International 'APMG PPP Certification Guide', Section 6.1, accessible at: https://ppp-certification.com/ppp-certification-guide/61-introduction-basic-ppp-project-structure***

Indicative financial modelling suggests the DBFOM structure for the Eastern Bypass Road can be financially viable with viability gap funding (VGF) in the order of US$86 million (BDT7,189 million).

In other words, US$195 million, or 70 percent of capital costs, could be privately financed. This calculation rests on an assumption of 1,093 million vehicle-kilometers travelled per year and a toll of BDT3.50 per kilometer[155]. Figure H.14 presents the model.

Figure H.14: Model Calculations

	Units	Value	PV	2018	2019	2020	2021	2022	2023	2030	2040	2050	2051
Toll rate	*BDT/km*	*2.00*		-	-	-	-	*2.00*	*2.00*	*2.00*	*2.00*	*2.00*	*2.00*
Vehicle km per year	*millions*	*1,093.25*		-	-	-	-	*1,093.25*	*1,093.25*	*1,093.25*	*1,093.25*	*1,093.25*	*1,093.25*
Toll Revenue	US$ millions		$ 200.05	-	-	-	-	$ 45.92	$ 45.92	$ 45.92	$ 45.92	$ 45.92	$ 45.92
	BDT millions		*16,670.43*	-	-	-	-	*3,826.37*	*3,826.37*	*3,826.37*	*3,826.37*	*3,826.37*	*3,826.37*
Opex	US$ millions		$ 4.61	-	-	-	-	$ 1.06	$ 1.06	$ 1.06	$ 1.06	$ 1.06	$ 1.06
	BDT millions		*384.33*	-	-	-	-	*88.22*	*88.22*	*88.22*	*88.22*	*88.22*	*88.22*
Opex as a % of Capex	*%*	*2.00%*											
FCF from Operations	US$ millions		$ 195.43	-	-	-	-	$ 44.86	$ 44.86	$ 44.86	$ 44.86	$ 44.86	$ 44.86
	BDT millions		*16,286.10*	-	-	-	-	*3,738.15*	*3,738.15*	*3,738.15*	*3,738.15*	*3,738.15*	*3,738.15*
Capex	US$ millions		$ 281.70	$ 95.72	$ 95.72	$ 95.72	$ 95.72	-	-	-	-	-	-
	BDT millions		*23,475.11*	*7,976.86*	*7,976.86*	*7,976.86*	*7,976.86*	-	-	-	-	-	-
Free Cash Flows	US$ millions		($86.27)	$ (95.72)	$ (95.72)	$ (95.72)	$ (95.72)	$ 44.86	$ 44.86	$ 44.86	$ 44.86	$ 44.86	$ 44.86
	BDT millions		*($7,189.01)*	*(7,976.86)*	*(7,976.86)*	*(7,976.86)*	*(7,976.86)*	*3,738.15*	*3,738.15*	*3,738.15*	*3,738.15*	*3,738.15*	*3,738.15*

The revenue calculations rely on a set of assumptions about demand for the road and how it will be used. These assumptions are:

- The average speed under free-flow conditions will not exceed 50 kilometers per hour. Under this speed condition, 2,000 vehicles per hour per lane would pass a given point on a highway if the road is at maximum capacity 24 hours per day
- The Road will be 4 lanes wide, meaning 8,000 vehicles per hour would pass a given point on a highway under these conditions[156]
- The calculations are based on the assumption that the highway will operate at an annual average capacity of 65 percent per year with no ramp-up period
- At 65 percent annual average capacity, 5,200 vehicles are expected to pass a set point on the Eastern Bypass Road and Embankment per hour. Across an entire year, this results in 1,093 million vehicle-kilometers traveled per year over the 24-kilometer Road. At a toll of BDT 2.00 per kilometer, this equates to annual toll revenue in the order of US$46 million (BDT3,826 million).

Table H.2 lists these assumptions.

155 The source for the toll rate assumption is a market sounding and traffic study conducted for a large expressway PPP project in Bangladesh. The study found that a toll rate of BDT5 per kilometer would be acceptable to most expressway users. We have assumed that users would be willing to pay at least 70 percent of the toll for the expressway PPP to use the Eastern Bypass Road in these forecasts.

156 The source for all traffic flow assumptions is: Homburger, Kell and Perkins, Fundamentals of Traffic Engineering, 13th Edition, Institute of Transportation Studies, UBC (Berkeley; www.its.berkeley.edu), 1992, p. 4-4.

Table H.2: Assumptions to Calculate Revenue

Input	Units	Value
Max speed under free-flow conditions*	Km/hour	49
Vehicles per hour per lane*	Number	2,000
Average annual operating capacity	%	65%
Lanes	Number	4
Length	Km	24
Vehicle kilometers per year	Millions	1,093
Toll	**BDT/km**	**3.5**

Source: ****Homburger, Kell and Perkins, Fundamentals of Traffic Engineering, 13th Edition, Institute of Transportation Studies, UBC (Berkeley; www.its.berkeley.edu), 1992, p. 4-4.***

To assess finance viability, we take present values of cash flows using a discount rate of 14 percent (real, US$). This is derived from a debt/equity ratio of 70/30, an effective tax rate of 28 percent, resulting in a post-tax cost of debt of 10 percent and expected returns on equity of 21 percent. These cost of capital figures are the same as those used for other projects in this Appendix and are based on market sounding carried out for the Dhaka-Chattogram Expressway PPP. The capex is US$383 million (BDT31,900 million), and annual operating expenditures are at least US$600,000 (BDT49 million)[157].

The toll of BDT3.5 per kilometer is set at a rate that is affordable to users while maximizing the net present value (NPV) of free cashflow from operations. This toll is 30 percent less than the rate proposed for the Dhaka- Chattogram Expressway, which was calculated based on a willingness-to-pay study for that expressway. A VGF payment of US$86 million (BDT7,189 million) would give an NPV of the project of zero, indicating that at the tariff BDT3.5 per kilometer, the investor would be able to earn its target return equal to the weighted average cost of capital (WACC) of 14 percent.

Box H.5: Note on Cost of Capital and Revenue Forecasts

All calculations in the model are made in real terms and expressed in 2016 US$. In cases where inputs are given in BDT, they are converted first to 2016 BDT, then to 2016 US$.

The cost of capital calculations are made in real terms in 2016 US$, resulting in a real WACC of 14 percent. Revenue forecasts are also made in real terms.

Source: Castalia Strategic Advisors

157 Halcrow estimated Capex and Opex for the Road in 2006. These costs have been inflated to 2016 BDT.

Using the assumptions detailed above, this means that the Eastern Bypass Road and Embankment could expect to attract US$195 million in private investment in present value terms. This expectation is reasonable because:

- The financial structure is in line with expressways of similar sizes internationally. It is expected that the private sector will finance the project with 30 percent equity and 70 percent debt
- The costs of debt and equity, in real terms, are also reasonable. The project WACC is also within expectations. Another expressway in Bangladesh generated a project WACC of slightly more than 13 percent (real, US$), suggesting that expectations for the Road are sensible.

The Government could enable the development of the Eastern Bypass Road and Embankment by making a VGF payment of 30 percent of capital costs. This contribution appears to be justified because the Eastern Bypass Road and Embankment will create economic benefits for Bangladesh by mitigating flood risks and damage, by increasing mobility, and by reducing the economic costs of traffic in Dhaka.

H.6.3 Precedents of PPP highway and embankment projects

The Road is not all that different from other highway PPPs in structure, which suggests that it could be developed as a PPP. PPPs for highways are a proven model globally. The model is successful in India, the Philippines, Malaysia, Australia, Colombia, and the United Kingdom, amongst several other countries. The projects vary in design some are built on embankments, others at grade, and other elevated and in structure, but they have demonstrated that highway PPPs can be financially and economically viable.

The Government is familiar with highway PPPs. In fact, it has at least two highway PPPs in various stages of development. Constructing a toll road on top of an embankment increases the technical difficulty of a road project, but it does so in a manner that is not unusual for highway projects in general.

Roads on embankments have been used to mitigate flood risks and increase mobility in several places, but they are new as a PPP model.

The Netherlands has built expressways on embankments for many years. The Afsluitdijk causeway is one example. The causeway stretches 32 kilometers, is 7.25 meters above sea-level, and is 90 meters across. The Government of the Netherlands is currently tendering a PPP to upgrade, operate, and maintain the flood controls and locks on the causeway. The Government will pursue a PPP for rehabilitation of the road too using a Design-Build-Finance-Maintain (DBFM) contract. The revenue source for the road will be availability payments made by the Government of the Netherlands to the private partner.

The Government of Uttar Pradesh is considering PPPs to develop embankments with roads to mitigate flood risks and improve mobility. Uttar Pradesh is in the process of reviving the Ganga expressway project, a 1050 kilometer 8-lane road to be built atop an embankment along the River Ganga as a PPP. Once completed, the project is expected to mitigate flood risks from the Ganga and increase mobility and connectivity between the eastern and western boundaries of the State.

Recently, the Government of the Philippines has explored ways that it can mitigate flood risks and improve mobility around Metro Manila. The projects face similar technical and financial challenges as embankment with roads projects would in Bangladesh, while providing similar benefits to the people of the Philippines. Box H.6 describes two projects in the Government of the Philippines project pipeline.

Box H.6: Laguna Lake Expressway Dike Project and Manila Bay Integrated Flood Control, Coastal Defense, and Expressway Projects, Philippines

The Philippines is also considering two projects that combine embankments with roadways. These projects are:

- US$2.7 billion Laguna Lake Expressway Dike Project (LLEDP)
- US$$43 billion Manila Bay Integrated Flood Control, Coastal Defense, and Expressway Project.

The LLEDP consists of a toll road atop a dike that will travel around a large, shallow lake in Metro Manila. The purpose of the project is to mitigate flooding caused by lake overflows, and to increase mobility by providing an alternate road to the southern provinces of Metro Manila. The Manila Bay project's objective is to mitigate flooding due to storm surges and to create an alternate access road to the north of Metro Manila.

Both projects include property development as well to introduce additional revenue sources to user tolls.

The Government can learn from the difficulties faced by the Philippines in developing and attracting investors to these projects. Like Bangladesh, several agencies in the Philippines were involved in the project. In the Philippines, the projects faced significant legal and regulatory issues because of the institutional structure required to implement the project one agency oversees reclamation while a second implements the toll road, while a separate agency is required for land reclamation.

The Philippines projects also show that the Government will need to consider the environmental and social impact of embankments with roads carefully. They also demonstrate that the Government will need to ensure that project risks are reasonable, that roads will interconnect to existing traffic networks, and that environmental impacts are properly accounted for and mitigated.

The Eastern Bypass Road will face many of the same risks that these other projects have. These risks, however, are no more significant of a barrier than they would be to another expressway PPP. The Government's experience with PPP expressways and international experience with similar projects should guide how to structure the Road to mitigate common risks (like demand and foreign exchange), and the technical risks associated with operation and maintenance of a flood embankment.

H.7 Building on Successful Experiences with PPPs in Bangladesh

Bangladesh has had considerable success in with PPPs and similar structures, in particular in the power sector and with special economic zones. The government aims to build on these successes.

Power sector PPP experiences

As of August 2016, the total installed capacity in Bangladesh was 12,780MW, including 600MW of imported power. Fifty-four percent of the total installed capacity comes from public sector, and the remaining 46 percent comes from privately owned companies[158].

In February 2016, the Power Development Board signed a contract for the largest independent power producer (IPP) investment in Bangladesh for building an ultra-supercritical thermal power plant with a net capacity of 1,224MW at a cost of US$2.4bn (over BDT 188.4bn)[159]. Of the total project cost of US$2.4bn, more than US$1.7bn will come from foreign investors.

Bangladesh has successfully managed to attract significant foreign capital to the power sector over the past 20 years. Table H.3 lists the drivers for success in attracting private investment in Bangladesh's power sector.

Table H.3: Drivers of Success for Private Investment in the Power Sector

Investor-Friendly Sector Policy	• Tariff based bidding capacity charge: ensures reasonable return on investment • Energy charge: fuel cost is a pass through item in the tariff • Sovereign guarantee from the Government for obligations of Government entities through an Implementation Agreement (IA) • Assistance in getting clearances from various agencies • Independent regulation to protect industry and consumers' interests
Investment Incentives	• Exemption from corporate income tax for a period of 15 years • Plant and equipment (full value) and spare parts (10% of original plant cost) without payment of customs duties, VAT, and any other surcharges • Repatriation of equity along with dividends • Tax exemption and repatriation facilities on royalties, technical know-how, and technical assistance fees
Credit Enhancement Mechanisms	• Payment of the IPPs are guaranteed by the Government and secured by a letter of credit • Payment into an escrow account assures lenders that funds will only be used for their stated purpose • Payments under the PPA continue in the event of fuel supply disruption or dispatch failure
	• Industry standard risk allocation mechanisms and PPA clauses • International arbitration

Source: Bangladesh Investment Development Authority, Castalia research

158 http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=5&Itemid=6

159 http://archive.dhakatribune.com/bangladesh/2016/feb/17/biggest-private-investment-power-sector-now-official

Ministries and agencies in the water sector can learn from the power sector and develop an approach that is customized for the water resources sector.

BEZA success story

The Bangladesh Economic Zones Authority (BEZA) was formed under the Bangladesh Economic Zones Act (2010). BEZA is attached to the Prime Minister's Office. The Authority is mandated to establish, license, operate, manage, and control economic zones in Bangladesh. BEZA develops three types of economic zones:

- Government zones, where the Government owns the land and manages the economic zone
- Private zones, where private sector developers own the land and manage the economic zone
- PPPs, where the Government leases land to the private sector, which then develops and manages the zone.

In a relatively short history of 5 years, BEZA has successfully awarded licenses for 10 privately owned, financed, and managed economic zones. Recently, it also signed a PPP for the Mongla Economic Zone with PowerPac, a local developer. The PPP has a revenue sharing mechanism between PowerPac and BEZA in the form of an upfront payment, annual fixed payments, and a percentage share of revenue. Table H.4 summarizes the reasons for BEZA's success.

Table H.4: Success Drivers for Private Investment in Economic Zones in Bangladesh

Clear Policy Guidelines	• Clear policy guidelines under the Bangladesh Economic Zones Act (2010) and supporting implementing policies (e.g. the Private Economic Zone Policy of 2015)
Investment Incentives	• Comprehensive suite of incentives and benefits for developers and investors like tax holidays, VAT exemptions, subsidies for developing effluent treatment plants, custom duty and stamp due exemptions, income tax benefits, and fully repatriable capital and dividend
Strong Team (Internal and External)	• BEZA has developed a capable team of professionals in-house and uses established advisory firms (e.g. PwC) to assess feasibility studies for new zones and for transaction advisory services
Investor-Friendly Approach	Investor-Friendly Approach

Source: ***BEZA websites, Castalia interview with BEZA Chairman on 13 June 2016***

H.8 Developing a Successful PPP Program

The legal framework and institutions needed to attract private finance to infrastructure projects have been progressively established over the last decade, and are now ready to be used for Delta Plan investments.

The PPP Law was enacted in September 2015. The PPP Authority was established in September 2010 and has since developed a pipeline of 23 projects with an estimated initial value of US$14 billion across a number of sectors. Contracts for seven PPP projects with an estimated value of US$1.3 billion have been signed. Twelve PPP projects with an estimated value of US$1 billion are in the final stages of competitive tendering. Nine projects are undergoing feasibility analysis, and are expected to attract an additional US$5 billion[160]. The PPP Authority has also issued procurement guidelines for solicited and unsolicited PPP projects in May 2016.

Promoting user- and beneficiary-pays principles will provide the revenue sources to attract private finance. The capacity of the PPP Authority will be bolstered with increased resources and training to allow it to handle the volume of transactions expected in the Investment Plan.

As the Delta Commission is established, its investment-planning guidelines will require that, as part of each project's preparation, an assessment is made as to whether private finance of the project would be possible and offer net benefits for the country. Where it is found to be desirable for a project to be privately financed (in whole or in part), the PPP Authority will coordinate with the implementation agency to prepare the transaction and attract private finance. Because many projects will require a mix of public and private finance, the Delta Fund will be structured in such a way that it can provide viability gap grants and concessional loans to PPP projects that are part of the Delta Investment Plan.

The PPP Authority will work with implementing agencies on the Investment Plan projects identified as suitable for private finance. These projects will be developed and implemented in accordance with the standard PPP process. The PPP Authority will ensure that investment-grade studies on demand and costs are prepared; that potential bidders are consulted and their views considered in project structuring; and that world-class competitive procurement processes are followed. To ensure access to best international practices, the Government will work with development partners who are willing to assist in project feasibility studies and transaction advice.

160 http://www.pppo.gov.bd/events2016_first-board-of-governors-meeting-Under-the-ppp-act.php