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Report No: 74482-BD

INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED CREDIT
IN THE AMOUNT OF SDR 248.6 MILLION (US$ 375 MILLION EQUIVALENT)
FROM IDA RESOURCES

AND

PROPOSED GRANT
IN THE AMOUNT OF US$ 25 MILLION
FROM THE PILOT PROGRAM FOR CLIMATE RESILIENCE (PPCR)

TO THE

PEOPLE'S REPUBLIC OF BANGLADESH

FOR A

COASTAL EMBANKMENT IMPROVEMENT PROJECT PHASE-I

May 29, 2013

Disaster Risk and Climate Change Unit
Sustainable Development Department
South Asia Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective May 15, 2013)

Currency Unit	=	Bangladeshi Taka (BDT)
US$ 1	=	BDT 79

Currency Unit	=	Special Drawing Rights (SDR)
US$ 1	=	SDR 0.66269

FISCAL YEAR
July 1 – June 30

Regional Vice President:	Isabel M. Guerrero
Country Director:	Johannes Zutt
Sector Director:	John Henry Stein
Sector Manager:	Bernice Van Bronkhorst
Task Team Leader:	Maria Sarraf

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
BFD	Bangladesh Forestry Department
BUET	Bangladesh University of Engineering & Technology
BWDB	Bangladesh Water Development Board
CEGIS	Center of Excellence for Geospatial Information Science
CERC	Contingent Emergency Response Component
CPTU	Central Procurement Technical Unit
DA	Designated Account
DG	Director General
DoE	Department of Environment
EA	Environmental Assessment
EIA	Environment Impact Assessment
EMF	Environment Management Framework
EMP	Environmental Management Plan
F&C	Fraud & Corruption
FM	Financial Management
FMS	Financial Management Specialist
GAAP	Governance and Accountability Action Plan
GBM	Ganges, the Brahmaputra or Jamuna, and the Meghna
GCM	Global Climate Model
GoB	Government of People's Republic of Bangladesh
GPS	Global Positioning System
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
ICB	International Competitive Bidding
IRM	Immediate Response Mechanism
IPCC	Intergovernmental Panel on Climate Change
IPOE	Independent Panel of Expert
IWM	Institute of Water Modeling
LCS	Labor Contracting Societies
MoWR	Ministry of Water Resources
M&E	Monitoring & Evaluation
NCB	National Competitive Bidding
NGO	Non-Government Organization
O&M	Operation and Maintenance
PC	Polder Committee
PD	Project Director
PDO	Project Development Objectives
PMU	Project Management Unit
PRMP	Procurement Risk Mitigation Plan
PSC	Project Steering Committee
RAP	Resettlement Action Plan
SECU	Social, Environment and Communication Unit
SLR	Sea-Level Rise
SMRPF	Social Management and Resettlement Policy Framework
ToRs	Terms of Reference
UNDB	United Nations Development Business
WMOs	Water Management Organizations
WMIP	Water Management Improvement Project

PEOPLE'S REPUBLIC OF BANGLADESH
Coastal Embankment Improvement Project Phase-I (CEIP-I)

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PAD DATA SHEET

People's Republic of Bangladesh

Coastal Embankment Improvement Project - Phase 1(CEIP-1) (P128276)

PROJECT APPRAISAL DOCUMENT

SOUTH ASIA

SASDC

Report No.: PAD432

Basic Information			
Project ID	Lending Instrument	EA Category	Team Leader
P128276	Specific Investment Loan	A - Full Assessment	Maria Sarraf
Project Implementation Start Date		Project Implementation End Date	
02-Sep-2013		02-Sep-2020	
Expected Effectiveness Date		Expected Closing Date	
02-Sep-2013		31-Dec -2020	
Joint IFC			
No			
Sector Manager	Sector Director	Country Director	Regional Vice President
Bernice K. Van Bronkhorst	John Henry Stein	Johannes Zutt	Isabel M. Guerrero

Borrower: People's Republic of Bangladesh

Responsible Agency: Bangladesh Water Development Board, Ministry of Water Resources

Contact:	Md. Sarafat Khan	Title:	Project Coordinator, CEIP-I
Telephone No.:	88001715038519	Email:	sarafat.khan@gmail.com

Project Financing Data(in USD Million)					
[ ]	Loan	[X]	Grant	[ ]	Other
[X]	Credit	[ ]	Guarantee		

Total Project Cost:	400.00	Total Bank Financing:	375.00
Total Co-financing:	25.00	Financing Gap:	0.00

Financing Source	Amount
BORROWER/RECIPIENT	0.00
International Development Association (IDA)	375.00
Climate Investment Funds	25.00
Total	400.00

IDA Expected Disbursements (in US$ Million)								
Fiscal Year	2014	2015	2016	2017	2018	2019	2020	2021
Annual	5	5	10	45	75	75	75	85
Cumulative		10	20	65	140	215	290	375
Pilot Program for Climate Resilience (PPCR) Expected Disbursements (in US$ Million)								
Fiscal Year	2014	2015	2016	2017	2018	2019	2020	2021
Annual			10	10	5			
Cumulative			10	20	25			

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Institutional Data

Sector Board

Water

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Sectors / Climate Change

Sector (Maximum 5 and total % must equal 100)

Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Water, sanitation and flood protection	General water, sanitation and flood protection sector	80	50	
Agriculture, fishing, and forestry	General agriculture, fishing and forestry sector	20		
Total		100		

☐ I certify that there is no Adaptation and Mitigation Climate Change Co-benefits information applicable to this project.

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Themes

Theme (Maximum 5 and total % must equal 100)

Major theme	Theme	%
Social protection and risk management	Natural disaster management	40
Environment and natural resources management	Climate change	20
Environment and natural resources management	Water resource management	40
Total		100

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Project Development Objective(s)

Proposed Development Objective(s)

The project development objectives are to (a) increase the area protected in selected polders from tidal flooding and frequent storm surges, which are expected to worsen due to climate change; (b) improve agricultural production by reducing saline water intrusion in selected polders; and (c) improve the Government of Bangladesh's capacity to respond promptly and effectively to an eligible crisis or emergency.

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Components

Component Name	Cost (USD Millions)
Rehabilitation and Improvement of Polders	291.00
Implementation of Social and Environmental Management Frameworks and Plans	56.00
Construction Supervision, Project Monitoring and Evaluation, and Coastal Zone Monitoring	32.00
Project Management, Technical Assistance, Training, Strategic Studies	21.00
Contingent Emergency Response	0.00

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Compliance

Policy

Does the project depart from the CAS in content or in other significant respects?	Yes [ ]	No [X]

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Does the project require any waivers of Bank policies?	Yes []	No [X]
Have these been approved by Bank management?	Yes [ ]	No [ ]
Is approval for any policy waiver sought from the Board?	Yes [ ]	No [X]
Does the project meet the Regional criteria for readiness for implementation?	Yes [X]	No [ ]

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Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	X	
Natural Habitats OP/BP 4.04	X	
Forests OP/BP 4.36	X	
Pest Management OP 4.09		X
Physical Cultural Resources OP/BP 4.11	X	
Indigenous Peoples OP/BP 4.10		X
Involuntary Resettlement OP/BP 4.12	X	
Safety of Dams OP/BP 4.37		X
Projects on International Waterways OP/BP 7.50	X	
Projects in Disputed Areas OP/BP 7.60		X

Legal Covenants

Name	Recurrent	Due Date	Frequency
Implementation	X		Yearly

Description of Covenant

BWDB will ensure that (i) a Project Steering Committee (PSC); a Project Management Unit (PMU); and a Procurement Panel (PP), all with composition, functions and resources satisfactory to IDA are maintained throughout the duration of the project.

Name	Recurrent	Due Date	Frequency
Audit	X	Within 6 months after the end of each fiscal year	Yearly

Description of Covenant

BWDB will ensure that audited financial statements are submitted to IDA within six months after the end of each fiscal year

Name	Recurrent	Due Date	Frequency
Quarterly Progress Reports	X	Within 45 days after each quarter	Quarterly

Description of Covenant			
BWDB will (i) monitor the physical and financial progress of the Project, (ii) analyze the data on key performance indicators; and (iii) prepare and submit quarterly financial and progress reports within 45 days following the end of each quarter.			
Name	**Recurrent**	**Due Date**	**Frequency**
Environment and Social Safeguards	**X**		Continuously
Description of Covenant			
The Borrower will implement the Project in accordance with the SMRPF and EMF			
Name	**Recurrent**	**Due Date**	**Frequency**
Governance	**X**		Continuously
Description of Covenant			
The Government and BWDB shall carry out the Governance and Accountability Action Plan (GAAP) in accordance with its terms.			
Name	**Recurrent**	**Due Date**	**Frequency**
Contingent Emergency Response		Condition of disbursement	
The Borrower adopt a Contingent Emergency Response Implementation Plan satisfactory to IDA prior to disbursement of funds under the contingent emergency response component, and will carry out such component in accordance with the provisions of the Financing Agreement and the Contingent Emergency Response Implementation Plan			

Team Composition

Bank Staff

Name	Title	Specialization	Unit
Maria Sarraf	Sr. Environmental Economist	Task Team Leader	SASDC
Masood Ahmad	Lead Water Resources Specialist	Advisor/ overall guidance	SASDA
Abedalrazq F. Khalil	Water Specialist and co-TTL	Water Specialist	SASDI
Md. Rafiqul Islam	Water Resource Consultant	Water Resources & Structural Eng	SASDA
Anna C. O'Donnell	Social Development Specialist	Social Mobilization for WMOs	SASDS
Md. Akhtaruzzaman	Sr. Social Development Specialist	Social and Resettlement	SASDS
Nadia Sharmin	Environment Specialist	Environment Safeguard	SASDC
Tanvir Hossain	Sr. Procurement Specialist	Procurement	SARPS
Mohammad Reaz Chowdhury	Financial Management Specialist	Financial Management	SARFM
Sayeeda Salim Tauhid	Sr. Monitoring & Evaluation Specialist	Forestry/climate change/ PPCR	SASDC
Lelia Croitoru	Environmental Economist Consultant	Economic Analysis	SASDC
Manush Hristov	Sr. Legal Counsel	Legal	LEGES
Junxue Chu	Sr. Finance Office	Disbursements	CTRLN
Chaohua Zhang	Lead Social Development Specialist	Social and Resettlement	SASDS
Susmita Dasgupta	Lead Environment Economist	Climate Change	DECEE
Angie Harney	Program Assistant	Program Assistant	SASDO
Rachel S. Palmer	Program Assistant	Program Assistant	SASDO

Non-Bank Staff

Name	Title	Office Phone
Jim Carle	Sr. Forestry Specialist	+64-21-2054024

I. STRATEGIC CONTEXT

A. Country Context

1. **Bangladesh is a hydraulic civilization** situated at the confluence of three great trans-Himalayan rivers — the Ganges, the Brahmaputra or Jamuna, and the Meghna (GBM). The GBM river system marks both the physiography of the nation, as well as the culture and livelihood of the people of Bangladesh. While over 90 percent of the GBM catchment lies outside of Bangladesh, approximately 200 rivers and tributaries of the GBM drain through the country via a constantly changing network of estuaries, tidal inlets, and tidal creeks, before emptying out into the Bay of Bengal[1]. Thus, the coastal zone of Bangladesh, the lowest landmass of the country, is continually influenced by these Himalayan drainage ecosystems that join to form one of the largest, youngest, and most active deltas in the world.

2. Bangladesh has made remarkable progress toward achieving the poverty reduction targets set by the Millennium Development Goals for 2015. Sustaining annual growth rates of around 6% in the past decade, the country has witnessed a profound social transformation with an influx of girls into the education system and women into the labor force. Economic growth has pulled 16 million people out of poverty in the last 10 years. Despite these successes Bangladesh faces considerable development challenges posed by its low and flat topography and vulnerability to floods, torrential rains, erosion, and sever cyclonic storms and tidal surges especially in the coastal zones.

3. The coastal zone[2] spans over 580 km of coastline and is prone to multiple threats. Sixty-two percent of the coastal land has an elevation of up to 3 meters and eighty-three percent up to 5 meters above mean sea level[3]. The coastal zone constitutes 32 percent of the land area and hosts nearly 28 percent of the population[4] (i.e., nearly 42 million[5]). The coastal population is projected to grow to 61 million by 2050[6]. Coastal districts are characterized by a high pace of **population growth**[7]. This trend continues to push millions of people to live in the low lying coastal areas, which are highly vulnerable to natural hazards. **Poverty indicators** in the coastal area show a higher percentage of population living below the absolute poverty line compared to the rest of the country[8].

4. The achievement of **food self-sufficiency remains a key development goal** for the country. The poor spend a large majority of their income on food (those under the poverty line spend almost 65-70% of their income on food), while many farmers derive much of their income from producing food. The inter-connected nature of the livelihoods of the poor and food production suggests that an increase in the vulnerability of farmers in the coastal areas will have large negative consequences on the welfare of both farmers and poorer consumers across the country.

5. **Women in the coastal areas are the most vulnerable to climatic changes.** In the coastal area, women's daily activities are closely related to natural resources and therefore are highly at risk from climate variability. Changes in precipitation and temperature patterns and increased risk of

[1] Yu W. et al., 2010. Climate Change Risks and Food Security in Bangladesh, World Bank.
[2] The delineation of the Coastal Zone, approved by the Ministry of Water Resources in 2003, comprises 19 districts, 147 upazillas and the exclusive economic zone.
[3] Bangladesh Water Development Board. Coastal Embankment Improvement Project, Draft Final Report, Sept 2012.
[4] Islam, M.R., 2004. Where land meets the sea: a profile of the coastal zone of Bangladesh. Dhaka, the University Press Limited. 317 pp.
[5] Based on a total population of 148.7 million in 2010; as per World Bank Open Data.
[6] Ahmad, M. 2005. Living in the coast: urbanization. Dhaka, Program Development Office for Integrated Coastal Zone Management Plan Project, Water Resources Planning Organization.
[7] In 1990s, population growth is estimated to be 2.25% according to Mcgranahan G., D. Balk, and Bridget, A., 2000. The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. Environment and Urbanization April 2007 vol. 19 no. 1 17-37, doi: 10.1177/0956247807076960.
[8] Islam, M. R., 2010. Pre and post tsunami coastal planning and land use policies and issues in Bangladesh.

storm surge and tidal flooding disproportionally affect the livelihood of women and their families. Poor people largely depending on subsistence agriculture for their livelihoods are the least able to cope with such changes. These and other pressures force large numbers of people (mostly men) to move out of their rural communities and towards large cities or abroad seeking better income. [In 2012 nearly US$12.8 billion came from remittances[9]; this represented about 12% of GDP and is projected to reach 16% by 2014-15[10]]. This additional challenge posed by out-migration leaves women with the extra burden of managing their households, the elderly, the sick, and the young while continuing the farming operations needed to sustain the family.

6. The years 2007 and 2009 were indicative of the **vulnerability** of coastal population and the development challenges faced by the Government. Severe flooding from July to September 2007 along the Ganges and Brahmaputra rivers affected the lives and livelihoods of over 13 million people and caused extensive damage to agricultural production and physical infrastructure. This catastrophic flood event was shadowed by cyclone **Sidr,** which made landfall across the southern coast on November 15, 2007, further causing over 3,400 deaths. The cyclone destroyed over a million tons of rice and incurred over US$1.6 billion[11] in damages and losses. The concurrent increase in international prices of oil and food placed further strains on both Government budgets and household livelihoods. In May 2009, cyclone **Aila** caused 3-6 meters storm surge in western Bangladesh and the Sundarbans, 179 fatalities, flooding that affected 400,000 people, widespread diseases impacting over 10,000 people and over US$0.5billion in damages.

B. Sectoral and Institutional Context

Sectoral Context

7. **The Government has always sought to buffer the socioeconomic activities and assets of the coastal population** from natural hazard risks. Their commitment to develop a safe and inhabitable coastal zone dates back to the 1960s. Compelled by the call for intensive rice cultivation during the green revolution, the Government constructed a series of embankments and polders[12] in order to provide tidal flood protection for coastal population. This enabled intense crop production and agricultural growth. The Bank became involved in coastal area protection through the *Coastal Area Rehabilitation Project (Cr 339-BD)* following the devastating cyclone of November 1970. The Government requested further Bank assistance that resulted in the *Coastal Embankment Rehabilitation Project* in 1995[13]. Coastal embankment projects put in place regulators and other structures to control water intake and drainage of polder areas with the primary principle of improving agriculture productivity. Overall, the Government invested about US$10 billion towards the development of structural (i.e. cyclone shelters, cyclone-resistant housing) and non-structural (i.e. early warning and awareness raising systems) **disaster mitigation and preparedness** systems.

8. **Continuous investment since 1960s** has resulted in the establishment of 2,130 cyclone shelters, 139 polders, 2,900 water control structures for drainage[14], and improved early warning systems. These investments have mitigated the exposure to natural catastrophes and significantly

[9] The World Bank: Bangladesh Economic Update 2012
[10] Bangladesh Economic Update GDP, Capital Investment and Remittance, November, 2010.
[11] Government of Bangladesh. 2008. Cyclone Sidr in Bangladesh: Damage, Loss and Needs Assessment for Disaster Recovery and Reconstruction.
[12] The Dutch term "polder" is used to designate areas that are enclosed on all sides by dykes or embankments, separating them hydrologically from the main river system and offering protection against tidal floods, salinity intrusion and sedimentation. Polders are equipped by in- and outlets to control the water inside the embanked area.
[13] World Bank, 2005. Project Performance Assessment Report, Coastal Embankment Rehabilitation Project (Credit 2783-BD).
[14] Data provided by BWDB on March 20, 2012.

saved lives and property during extreme events[15]. In addition, rural households have adapted their farming systems to the occurrence of floods by switching from low-yielding, deep-water rice to high-yielding rice crops. As a result, the scale of the agricultural production in Bangladesh has seen an increase of up to 200 to 300 percent in certain areas[16]. The construction of polders along the entire coastal belt provided protection to the people and their agricultural land. Today, **1.2 million hectares of land is utilized for agricultural purposes** within the coastal embankment system. This represents almost 15% percent of Bangladesh's total arable land. Overall, polderization has altered the landscape of the Bangladesh coastal zone in ways that contributed to enhanced livelihood and food security for the growing population (see Annex 7 for Polder Map).

9. Notwithstanding the security and enhanced resilience brought by polders, the vulnerability of the coastal population is on the rise due to **climate change**. Climate variability will accentuate the intrinsic risks facing coastal Bangladesh. These risks span: (i) cyclones and storm surges (ii) river bank erosion and vulnerability of islands and chars, (iii) sea-level rise (SLR), (iv) saline intrusion, and (v) coastal erosion. A lack of investment to retrofit and upgrade the polders scheme will weaken their capacity to mitigate against natural hazards and protect livelihoods and assets. A recent study on the cost of adapting to extreme weather events in a changing climate[17] indicated that if a 10 year return period cyclone hit the coastal area today, about 8 million people will be affected by inundation depths greater than 3 meters. With population growth, that figure is projected to increase to 13.5 million by 2050. However, given the potential impact of climate change, an **additional 9 million coastal inhabitants** will be exposed to inundation depths greater than 3 meters. The study identifies which polders will likely be overtopped by intensified storm surges under the climate change scenarios. The study further makes the case that investing in adaptation measures today will provide huge savings in the future by minimizing the damages associated with extreme weather events.

10. Primarily, the coastal embankment system brought immense benefits to the people living along low lying areas. The system was designed originally to protect against the highest tides, without much attention to storm surges. However, recent **cyclones** brought substantial damage to the embankments and threatened the integrity of the coastal polders. In addition embankment breaches due to cyclones, siltation of peripheral rivers surrounding the embankment caused the coastal polders to suffer from **water logging,** leading to important environmental, social and economic degradation. **Poor maintenance** and inadequate management of the polders have also contributed to internal drainage congestion and heavy external siltation. As a result, in some areas, soil fertility and good agriculture production are declining due to water logging and salinity increases inside the polders.

11. All the above reasons have led the Government to **re-focus its strategy** on the coastal area from one that only protects against high tides to one that provide protection against frequent storm surges. The Government has recognized the need for a **systematic approach** to upgrade the coastal embankment system to protect against an appropriate return period and be based on robust local risk and vulnerability assessments. Moreover, the embankment program needs to be integrated with an **afforestation** program, particularly on the foreshore, as greenbelts of mangrove and other species

[15] Even though cyclone Sidr (which hit Bangladesh in 2007) was similar to Cyclone Nargis (which hit Burma in 2008), the death toll in Bangladesh was 3,000 people as opposed to 100,000 in Burma. Effective early warning systems, the embankment structure and forests played an important role in lowering its impact in Bangladesh.

[16] Nishat, A. 1988. Review of present activities and state of art of the coastal areas of Bangladesh. Coastal area resource development and management Part II, pp. 23–35. Dhaka, Coastal Area Resource Development and Management Association (CARDMA).

[17] World Bank, 2011. The Cost of Adapting to Extreme Weather Events in a Changing Climate, Bangladesh Development Series, Paper No 28.

have proven to significantly reduce storm surge damage[18] [19] [20]. Restoration of the embankment system is a much needed catalyst to provide resilience to vulnerable communities and to revitalize the coastal zone's ailing socio-economic engine[21].

Institutional Context

12. The Government has created a highly supportive policy environment for mainstreaming coastal development, water resources management, disaster risk management, and climate change adaptation agendas in its major development strategies.

13. **Coastal Zone Development**. The Government of Bangladesh, like in many other countries, is highly departmentalized, with innumerable agencies under different Ministries having their own focused mandate. However, development problems do not occur departmentally; they appear in a complex web of interrelationships that can only be addressed through concerted efforts by more than one agency. This complexity is very apparent in the management of the coastal zone area. As such, since 1999 the Government has developed the concept of an *Integrated Coastal Zone Management* (ICZM) as a response to the administrative fragmentation. The concept is to create a common vision for the development of the coastal area and to translate this vision into actions and operations. As part of the effort under ICZM, the Government has promulgated the *Land Use Policy* (2001), *Tsunami Vulnerability Map* (2005), the *Coastal Zone Policy* (2005) and the *Coastal Development Strategy* (2006)[22]. The *Coastal Zone Policy* was the first sectoral policy to explicitly include climate change impacts and actions.

14. **Water Resources Management.** The Ministry of Water Resources (MoWR) is the apex body of the Government responsible for the development and management of all of Bangladesh's water resources. It prepares and implements development projects relating to flood control drainage and irrigation, river bank erosion and control, delta development and land reclamation. It is also responsible for constructing barrages, regulators, sluices, canals, embankments and sea-dykes along the banks of the rivers and coasts. The Bangladesh Water Development Board (BWDB), in operation since 1959, is the implementing arm of the MoWR in the execution of flood, drainage and irrigation plans. BWDB is also responsible for the collection and dissemination of hydrologic and hydraulic data and the management of the *Flood Forecasting and Warning Center*. The Water Resources Planning Organization (WARPO) is the strategic and macro planning arm of MoWR. In collaboration with other Government sectors, BWDB and WARPO coordinated and prepared the *National Water Policy* (1999), the *Coastal Zone Policy* (2005), and the *National Water Management Plan* (2004).

15. **Food security and poverty levels are highly sensitivity to climate change induced risks.** With its particularly sensitive and extensive coastline, the country faces the urgent challenge of building the resilience of coastal communities to cope with climate impacts. These communities are often also the poorest. The expected rise in the sea level is likely to worsen the situation. Climate

[18] Saenger, P. and Siddiqi, N. A., 1993. Land from the Sea; The Mangrove Afforestation Program of Bangladesh, Ocean and Coastal Management Vol 20, No.1, pp23-39. http://dx.doi.org/10.1016/0964-5691(93)90011-M

[19] McIvor, A. L., Moller, I., Spencer, T. and Spalding, M. 2012. Reduction of Wind and Swell Waves by Mangroves. Natural Coastal Protection Series: Report 1. Cambridge Coastal Research Unit Working Paper 40. Published by The Nature Conservancy and Wetlands International. 27 pages. ISSN 2050-7941. http://www.naturalcoastalprotection.org/documents/reduction-of-wind-and-swell-waves-by-mangroves

[20] FAO, 2007. The Role of Coastal Forests in the Mitigation of Tsunami Impacts. RAP Publication 2007/1, FAO of the United Nations, Regional Office for Asia and the Pacific, Bangkok, 2007 http://www.fao.org/forestry/14561-09bf06569b748c827dddf4003076c480c.pdf

[21] Rahman , M. S. and Chowdhury , F., 2005. Investment and Financing Strategy for Coastal Zone Development in Bangladesh. Retrieved from http://www.warpo.gov.bd/rep/wp037/37.pdf on March 24, 2012.

[22] The Coastal Development Strategy is also built on existing national sectoral strategies and plans and on the document on National Strategy for Accelerated Poverty Reduction.

change is anticipated to lead to more intense and frequent cyclones, floods, and SLR and associated salinity intrusion in the coastal areas leading to growing pressure on ensuring adequate food security and nutrition. This pressure on nutrition and health will be particularly acute for women and children, who face difficulties in the aftermath of a natural disaster event. Not only cyclones cause significant crop damage in coastal areas but they also severally hamper agriculture activities in the following years because saline sea water from storm surges is often deposited on agricultural lands, resulting in food stock shortages for at least two years. The recurrence period for a major cyclone and widespread flooding in Bangladesh is approximately three years, necessitating improved protection of the assets that provide livelihoods for the population of the coastal areas.

16. **Disaster Risk Management**. After the 1991 cyclones that claimed nearly 140,000 lives, Bangladesh's ability to manage disaster risks, in particular floods and cyclones, has substantially improved. This has been the result of a **gradual shift from a response-based approach to a strategy that incorporates elements of greater emergency preparedness, early warning, and risk mitigation.** Bangladesh's *Second Poverty Reduction Strategy Paper* provides for strengthening disaster management and risk reduction, mainstreaming disaster management into national policies and enhancing community capacity for disaster preparedness and risk reduction. The *National Plan for Disaster Management (NPDM)* (2010-2015)[23] is centered on the following strategic pillars: (i) risk identification and assessment; (ii) strengthening and enhancing emergency preparedness; (iii) institutional capacity building; (iv) risk mitigation investments; and (v) introducing catastrophe risk financing in the longer term. The underlying principles of the NPDM are that both the loss of life and the economic impact of disasters can be reduced through advance planning and investment. Further, these actions should be both affordable and efficient in their delivery mechanisms. The proposed upgrading of the embankment system is recognized as a key pro-active investment to build the resilience of coastal populations. The Ministry of Disaster Management and Relief is the apex institution responsible for coordinating national disaster management interventions across all agencies.

17. **Coastal embankments are an integral part of the disaster risk reduction program for Bangladesh.** There is clear evidence that embankments provided an effective buffer during the tidal surge resulting from Cyclone Sidr. Damages and losses are much lower and lives were saved in areas where effective embankments were present. After Cyclone Sidr, extensive consultations occurred between Government agencies, development partners and the World Bank to prepare a *Long Term Disaster Risk Reduction Program*[24] which included the construction of multi-purpose cyclone shelters and the rehabilitation and upgrading of the embankment system as key risk mitigating investments.

18. **Climate Change Policies and Pilot Program for Climate Resilience (PPCR)**. The Government launched the *National Adaptation Program of Action* (NAPA) back in 2005. The NAPA highlights the main adverse effects of climate change and variability on various economic sectors and identifies a list of adaptation needs. In 2009, Bangladesh was one of the first countries to prepare its *Climate Change Strategy and Action Plan* (BCCSAP).The BCCSAP is a 10 year program to build the capacity and resilience of the country to meet the challenges associated with climate change. The rehabilitation and upgrading of coastal embankments is a prime objective of the strategy. Bangladesh is also one of nine countries selected to participate in the *Pilot Program for Climate Resilience* (PPCR) established under the multi donor Climate Investment Fund (CIF).

[23] Government of Bangladesh. 2010 National Plan for Disaster Management (2010-2015). Disaster Management Bureau, Ministry of Food and Disaster Management.

[24] Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP)- PAD- Report 4288-BD. The World Bank

Bangladesh uses PPCR resources to implement a broad strategy for achieving climate resilience at the national level. The development of a *Strategic Program for Climate Resilience* (SPCR) provides a medium and long-term vision for enhancing the country's resilience to climate challenges. The SPCR, approved in November 2010, identifies 5 priority activities -for a total envelop of US$ 110 million- designed to support the implementation of the SPCR[25]. The proposed CEIP-I, is one of these 5 priority activities and is intended to increase the resilience of coastal infrastructure. In order to ensure proper coordination of all PPCR financed activities in Bangladesh, a *Quarterly Status Report* is prepared with input from the World Bank, the IFC and the Asian Development Bank (ADB). The most recent quarterly report includes a section on *emerging lessons* designed to capture and exchange lessons and knowledge between activities. In addition, the two PPCR focal points in Bangladesh (from ERD and MOEF) hold regular review meetings with all implementing agencies to ensure proper coordination and knowledge exchange.

C. Higher Level Objectives to which the Project Contributes

a) Relationship to Bangladesh Sixth Five Year Plan (SFYP) (2011-2015)

19. The Government SFYP acknowledges that supporting communities and people in rural areas to strengthen their resilience and adapt to climate change is of paramount importance in the coming decades in order to accelerate growth and reduce poverty. The SFYP states that the direct annual cost to the national economy of natural disasters over the last 10 years is estimated to be between 0.5% and 1% of GDP. These costs are likely to increase as the economy grows, especially if climate change is not factored into long-term economic planning. The SFYP emphasizes the need to continue investing in flood management schemes to raise the agricultural productivity of many thousands of kilometers of low-lying rural areas and to protect them from extremely damaging flood events. In that spirit, the SFYP **identifies polders as a priority target** for investment and calls for immediate action to repair and maintain existing coastal polders to protect and enhance agricultural productivity and mobilize communities against tidal flooding and intrusion of saline water.

b) Relationship to the Pilot Program for Climate Resilience (PPCR)

20. The PPCR recognizes that climate change has implications for many economic sectors. The PPCR is keen to integrate climate issues into other aspects of development work under a coherent framework that: a) mainstreams climate change into strategies for long term growth and poverty reduction; b) defines a common agenda for action through investments in research and knowledge generation; and c) strengthens institutions and financing to undertake these initiatives. The proposed operation recognizes that knowledge gaps are a key impediment to integrating climate risks into development initiatives and major high-value infrastructure investments. The Bangladesh *Strategic Program for Climate Resilience* (SPCR), endorsed by PPCR, acknowledges that building and rehabilitating coastal water management infrastructure, such as embankments, is environmentally beneficial because they protect people, vegetation and animals against high tidal waves and cyclone surges in coastal areas. The proposed operation is aligned with the PPCR and can contribute to the key indicators of the Bangladesh SPCR by increasing the resilience of coastal infrastructure (e.g., connectivity, flood control and improved drainage systems within polders) to withstand the effects of

[25] The five activities are: *Climate Resilient Agriculture and Food Security Project* (implemented by IFC); *Coastal Embankment Improvement Project* (implemented by the WB); and *Coastal Climate Resilient Infrastructure Project* (implemented by ADB); and *Climate Change Capacity Building and Knowledge Management TA* (implemented by ADB) and *Feasibility Study on Climate Resilient Housing TA* (implemented by IFC)

climate induced seasonal variability and natural disasters, in addition to reducing water and soil salinity and improving agricultural production.

c) Relationship to CAS

21. The proposed operation is fully aligned with the Country Assistance Strategy (CAS) for FY11-14 (Report 54615-BD). The overarching objective of the CAS is to help Bangladesh achieve its ambitious target of reaching middle-income status and reducing poverty from 32 percent to 15 percent of the population by 2021. The proposed operation directly supports the implementation of the second pillar of the CAS, which is to *Reduce Environmental Degradation and Vulnerability to Climate Change and Natural Disasters.* By enhancing the performance of coastal embankments, the project will protect people's assets, enhance their livelihoods and reduce their vulnerability to severe cyclones and storm surges.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

22. The PDO are to: (a) increase the area protected in selected polders from tidal flooding and frequent storm surges, which are expected to worsen due to climate change; (b) improve agricultural production by reducing saline water intrusion in selected polders; and (c) improve the Government of Bangladesh's capacity to respond promptly and effectively to an eligible[26] crisis or emergency. These objectives will be achieved by strengthening and upgrading embankments as part of an **integrated approach to improve** the polder system in the coastal area.

B. Key Results

23. Progress towards increasing the resilience of the coastal population to climate-related hazards by improving and rehabilitating the embankment structures of the polders will be demonstrated by the following key indicators:

- Gross areas protected against tidal flooding and storm surge in selected polders;
- Coastal population with increased resilience against storm surges, which are expected to worsen due to climate change;
- Increased cropping intensity inside the polder area; and
- Quick availability of funds to execute emergency response operations (only to be triggered in the case of a major emergency).

C. Project Beneficiaries

24. The project would provide benefits for diverse sectors of the economy in Bangladesh. Improvement of polders under the CEIP-I is expected to enhance resilience of the coastal area to cyclones, tidal and flood inundations, and salinity intrusion. The enhanced resilience to such natural calamities will result in improved livelihoods of the population living along the coastal zone through increased agricultural production during normal weather and reduced loss of life, assets, crops and

[26] An eligible crisis or emergency, for which the Immediate Response Mechanism (IRM) could be triggered, is defined as an event that has caused, or is likely to imminently cause, a major adverse economic and/or social impact to the Recipient, associated with a natural or man-made crisis or disaster. For further information, please refer to: *Bangladesh Immediate Response Mechanism: Operational Manual*

livestock in the event of a disaster. The Project will help reduce poverty and stimulate economic development by facilitating the growth of farm and non-farm activities, particularly in exposed areas along the southwestern coast[27], including six coastal districts (Bagerhat, Khulna, Satkhira, Barguna, Patuakhali and Pirojpur). The Project will provide direct protection to the 0.76 million people living within the polder boundaries, and it is expected to benefit the 8.5 million people living in these 6 coastal districts through agriculture development, employment and food security. It is expected that the Project will develop confidence among the populations in the exposed coast by securing agriculture, fishery, forestry and local industries, and by generating employment for the poor, disadvantaged women and other vulnerable groups.

III. PROJECT DESCRIPTION

25. **A multi-phased approach.** The long term objective is to increase the resilience of the entire coastal population to tidal flooding and natural disasters by upgrading the whole embankment system. With an existing 6,000 km of embankments with 139 polders, the magnitude of such a project is enormous. Hence, a multi-phased approach will be adopted over a period of 15 to 20 years. The proposed CEIP-I[28] is the first phase of this long term program. To achieve the development objectives of the project in a complex and changing environment and to pilot innovative concepts in design and implementation, it was decided that a single investment loan would be most appropriate. Based on the success of the project, a series of projects that capture the lessons learned from CEIP-I can potentially be designed for other exposed areas along the coastal region of Bangladesh.

26. **Strategic assessment of polders.** As indicated previously, the embankment system was originally designed to keep out the highest tides without any consideration of possible storm surges. Recent cyclone storm damage and the anticipation of a greater incidence and impact of future extreme weather events due to climate change have led the Government to shift its strategy towards providing protection against future storm surges, instead of only tidal protection. BWDB, with the assistance of the major modeling institutes in Bangladesh, is engaged in a strategic assessment of the overall polder system. This involves updating the environmental baseline and using extensive modeling to determine present and future storm surge levels affecting embankment stability while accounting for the impact of climate change.

27. **Polder selection.** As part of the strategic polder assessment, a multi criteria analysis was developed to guide the prioritization process to select specific polders for improvement. The analysis relies on the following key criteria: physical condition of the embankment and the drainage system, economic activities in the polders (agriculture, fishery or forestry), population and socio-economic conditions, environmental conditions and economic efficiency considerations (e.g., the geographic proximity of polders can facilitate efficient execution of works). Based on this assessment, a priority group of 17 polders has been considered in six contiguous Districts (Khulna, Satkhira, Begerhat, Pirojpur, Barguna and Patuakhali). The works will be carried out in packages of 3 to 6 polders in each package. Feasibility study has been completed for all 17 polders. Detail design has been completed for the first package of 4 polders. The polder selection may vary based on

[27] The Coastal Zone includes 3 divisions (Khulna, Barisal and Chittagong) and 19 districts. The southwestern exposed coast (areas facing the sea and estuaries) includes 7 coastal districts of which 6 are project districts (Bhola, Bagerhat, Khulna, Satkhira, Barguna, Patuakhali and Pirojpur districts) and have a population of 10 million. (Ref. *Abu M. Kamal Uddin and Rob Kaudstaal, Delineation of the Coastal Zone, Program Development Office for Integrated Coastal Zone Management Plan, Dhaka, Dec. 2003).*

[28] Studies for the preparation of the CEIP-I project were funded by the IDA credit for the Emergency Cyclone Recovery and Restoration Project 2007 (Cr 45070).

emerging conditions on the ground during project implementation. Flexibility in the selection of polder is necessary to accommodate the dynamic and complex nature of the coastal zone.

28. **Level of protection.** As clearly defined in the strategic assessment, the level of protection should be beyond the highest tides and should provide protection against frequent storm surges. A protection against a 25 year return period maximum surge height, with an additional buffer for climate change impacts, is adopted in this project. In order to cope with climate change, the design takes into account the likelihood that adverse trends in cyclones intensities, precipitation amounts, and SLR would persist. Therefore, the rehabilitated polder scheme is design to withstand storm surges with frequency up to 25 years return period for the entire lifetime of the project (i.e., up to year 2050). When the construction is completed, the protection level will be close to 1 in 50 years. Comprehensive models and simulations of storm surge and drainage routing were created to inform the selection of the design parameters. The simulations were stress tested to make sure that the design is conservative and would provide the desired protection levels (e.g., the observed storms were simulated to occur during peak tide to test the resilience of the proposed embankment height). An afforestation program and mobilization of Water Management Organizations (WMOs) are envisaged in this program to provide added protection and to contribute to an effective management of the water system within the polder schemes, respectively. Such activities lend themselves to maintain the durability polder scheme as a source of economic, social, and environmental benefits.

29. **Reliable data are critical for effective coastal planning**. Knowledge gaps and lack of reliable data are key impediments to integrating climate risks into development initiatives and major high-value infrastructure investments. Precise information on the local trends of SLR, sedimentation and erosion patterns, land subsidence in coastal Bangladesh, as well as salinity and precipitation patterns are essential to aid effective management and operation of the polder scheme. Partnerships between Bangladeshi research institutes and other global institutes are also crucial to identify the key challenges and scientific information required to put in place sustainable management of the coastal area of Bangladesh. This operation will put in place long term monitoring programs to build the data base on the fast paced changes induced by climate change, river morphology, and human interventions. Such data systems will enable the development of better options to enhance resilience to climate change and increase awareness of decision makers to help mainstream climate change in development policy and planning.

A. Project Components

30. The Project has **five components**: four components are related to polder improvement and a fifth component (with a provisional zero amount) has been included to allow for rapid reallocation of loan proceeds during an emergency, under streamlined procurement and disbursement procedures. A detailed description of the Project is found in **Annex 2**:

A. Rehabilitation and Improvement of Polders;
B. Implementation of Social and Environmental Management Frameworks and Plans;
C. Construction Supervision, Project Monitoring and Evaluation, and Coastal Zone Monitoring;
D. Project Management, Technical Assistance, Training and Strategic Studies;
E. Contingent Emergency Response.

Component A – Rehabilitation and Improvement of Polders (US$291 million).

31. **Component A1: Rehabilitation and Improvement of Polders (US$ 286 million)**. (US$ 266 million from IDA Credit; 20 million Grant from PPCR). This component will finance activities that aim to increase community resilience to tidal flooding and storm surges. Investments include: (i) rehabilitation of critical portions of polder embankments including slope protection work, (ii) increasing embankment height in some stretches to improve resilience, (iii) repairing and upgrading drainage and flushing systems within polders, and (v) improving operations and maintenance (O&M). The reconstruction and rehabilitation works will be designed with improved standards so that protection is for both tidal flooding and frequent storm surges. It is expected that about 17 polders will be rehabilitated under this component. Polders have been selected based on technical, environmental, social, economic and geographic criteria. A list of the polders considered for rehabilitation is presented in the table below[29].

32. Stakeholders and beneficiaries consultations and participation are central to carrying out the improvement works to the polder system. Beneficiaries will be consulted and work with BWDB on the operation and management of water infrastructure, through Polder Committees (PCs) that either already exist or will be established through the project. In addition, participatory WMOs will be piloted in 4 to 6 polders. WMOs will be involved in all stages of project implementation from identification of works, prioritization, design, construction as well as operation and minor maintenance (see Component B1 for more detail).

33. Improving the embankment system will provide stronger protection to people living inside polders from storm surges; hence reducing the recovery time after a natural disaster such as a cyclone. Improving the internal drainage system will enhance agriculture production, which is the primary source of livelihood for coastal population. Protecting assets and enhancing agricultural production will bring in much needed economic growth to the coastal population.

34. **Component A2: Afforestation (US$5 million).** Afforestation is important to the security of embankments and the livelihoods of communities as it provides protection from tidal flooding and storm surge. Planting selected mangrove and other salt tolerant species are planned on BWDB's land to demonstrate the important role of a protective belt on the tidal inundation zone on the riverside of the embankment. Planting a range of commercial wood, fruit and other shallow rooting social forestry tree species is proposed on the foreshore lower slopes of embankments. Plantings would commence after resolving land ownership and competing land-use (fish and shrimp ponds, rice paddies, livestock grazing, settlement, etc.) issues and the completion of needed earthworks on the embankments. The afforestation component will engage local communities to ensure benefit sharing and achieve social, environmental and economic sustainability. The component will finance effort to increase community awareness of the protective and productive functions of trees. It will also build the capacity of local institutions and communities in secondary maintenance schemes, foreshore and embankment afforestation, social forestry and protection of embankment toe against erosion. Key lessons from past embankment afforestation will be taken into account in the implementation of this component. They include lessons in participatory planning, selection of forest types and species, selection of beneficiaries, post-planting O&M, plantation protection, harvesting of wood and non-wood forest products and benefit sharing.

[29] A report detailing the description of each polder is available in the project file "GoB- BWDB "Technical Feasibility Studies and Detailed Design for Coastal Embankment Improvement Project" Draft Final Report: Volume IV Polder Reports, September 2012.

Table 1: Characteristics of polders considered for rehabilitation and improvement under CEIP-I

Sl No.	Polder No./ Polder Name	Location Thana	District	Gross Protected Area (HA)	Cultivable area (ha)	Existing Project Feature				Av. Existing level of Embankment (m PWD)	Polder Population
						Embkt. (km)	Regulator (No)	Flushing Inlet (No)	Drainage Channel (km)		
1	14/1	Koyara	Khulna	2,933	2,350	30.50	4	-	30	3.75	20,578
2	15	Shymnagar	Satkhira	3,441	2,925	30.78	5	-	40	4.00	31,788
3	16	Paikgacha, Tala, Dumuria	Satkhira, Khulna	10,445	8,102	45.00	12	31	21	3.00	118,616
4	17/1	Dumuria	Khulna	5,020	4,000	38.50	11	0	43	3.50	23,919
5	17/2	Dumuria	Khulna	3,400	2,700	11.00	6	0	21	3.50	34,070
6	23	Paikgacha	Khulna	5,910	4,872	37.00	11	39	36	3.30	23,888
7	32	Dacope	Khulna	8,097	6,500	49.50	16	35	45	3.75	38,397
8	33	Dacope	Khulna	8,600	7,600	52.50	13	19	100	3.80	62,305
9	34/3	Bagerhat	Bagerhat	3,656	2,930	16.75	3	6	35	2.80	65,399
10	35/1	Sharankhola, Morelgonj	Bagerhat	13,058	10,700	62.50	14	25	56	4.35	99,182
11	35/3	Bagerhat Sadar, Rampal	Bagerhat	6,790	5,090	40.05	4	11	75	2.70	31,075
12	39/2C	Matbaria, Bhandaria	Pirojpur	10,748	8,500	59.25	-	4	57	2.50	84,853
13	40/2	Pathargatha	Barguna	4,453	3,300	35.58	12	21	50	4.30	41,317
14	41/1	Barguna Sadar	Barguna	4,048	3,440	33.81	6	28	84	4.00	41,051
15	43/2C	Galachipa	Patuakhali	2,753	2,000	25.70	6	16	26	4.00	14,851
16	47/2	Kalapara	Patuakhali	2,065	1,850	17.55	3	6	30	4.25	5,411
17	48	Kalapara	Patuakhali	5,400	3,715	37.88	8	3	45	5.30	26,260
				100,817	**80,574**	**623.85**	**134**	**244**	**794**		**762,960**

Component B–Implementation of Social and Environmental Management Frameworks and Plans (US$56 million).

35. **Component B1: Implementation of Social Action Plans (US$3 million).** This component will support consultation with and strengthening of polder stakeholders and beneficiaries. PCs will be strengthen or established in all Polders to determine the competing needs and uses for water resources, and to decide on the operation of hydraulic infrastructure. Intensive social mobilization will be piloted in 4-6 polders to establish participatory WMOs that will be responsible for the operation and minor maintenance works of the polders. The establishment of WMOs will follow an eight step process, as identified in the *Guidelines for Integrated Planning for Sustainable Water Resources Management,* published by BWDB in 2008. Social mobilization is expected to last around two years, during which time the WMOs will be established and trained in participatory planning, as well as in operation and minor maintenance activities. It is expected that where WMOs are piloted, the detailed design of polders will be discussed in a participatory manner with BWDB to ensure their full participation at early stage. Small works, including minor periodic maintenance and operation of minor hydraulic infrastructure would be undertaken by the WMOs under a memorandum of understanding with BWDB. Should the participatory approach prove to be successful, it would be scaled up under the next phase of investments. It is envisaged that this component, along with the social afforestation (Component A2) will be implemented through a well-established Non-Government Organization (NGO).

36. **Component B2: Implementation of Social Management and Resettlement Policy Framework (SMRPF) and Resettlement Action Plans (RAPs) (US$49 million).** Polder scheme rehabilitation is a complex project that involves a variety of issues ranging from land acquisition, physical and economic displacement of people and other unanticipated impacts. Generally there are informal settlers on the embankments as they are safe structures. A *SMRPF* has been prepared and will be disclosed in accordance with Bank guidelines. A draft *RAP* for the first package of investment has been prepared and disclosed in the info shop on February 15, 2013. This component will finance the implementation of the RAP, embankment monitoring and public consultation plans. The component will finance land acquisition and the resettlement and rehabilitation of persons adversely affected by the project. It will also support the development of a system to computerize land acquisition and resettlement data with Global Positioning System (GPS) reference and independent institute to undertake surveys and verify field data in order to guard against improper targeting of beneficiaries and/or false delivery of benefits in case of RAP.

37. **Component B3. Implementation of EMF and EMPs (US$4 million).** An overall environmental assessment (EA) of the polder system; a draft *Environmental Management Framework* (EMF) for the project; and *Environmental Impact Assessment* (EIA) for polders targeted under the first package of investment have already been prepared and disclosed in the infoshop on February 15, 2013. This component will finance: (i) the preparation of EIAs for all remaining polders; (ii) the implementation of the *Environment Management Plan* (EMP) and environmental mitigation and enhancement measures; and (iii) the establishment of an environmental monitoring system in BWDB to enable it to track continuous improvement in environmental performance of the polder system. Some of the items under EMP will be integrated with the civil works and included in the budget of Component A1.

Component C- Construction Supervision, Monitoring and Evaluation of Project and Coastal Zone Monitoring (US$32 million)

38. **Component C1: Detailed Design and Construction Supervision (US$16 million).** This component will cover consulting services for (i) surveys, designs of remaining polders to be included in the project (other than the 5 for which detailed designs have already been completed) and (ii) construction supervision of rehabilitation and improvement of coastal embankments. This will include facilitating consultations with local communities in identifying needs and suitable design of the embankment as well as with other stakeholders such as local government, *upazilla* and union level governments. The component will finance surveys required prior to construction work.

39. **Component C2: Third Party Monitoring and Evaluation of Project (US$4 million).** This component will cover consulting services for continuously monitoring project activities and providing feedback to the government and the implementing agency on the project's performance. This includes supervising the implementation of the Governance and Accountability Action Plan (GAAP), EMP and RAP. This will be provided through third party assessment and monitoring of key aspects of project implementation.

40. **Component C3: Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone (US$12 million).** (US$7 million from IDA credit; US$5 million Grant from PPCR).
The coastal zone is a crucial region for Bangladesh, and it is subject to a multitude of complex natural phenomena that are currently not fully understood. The region is experiencing fast paced changes due to changes in river morphology, fluvial processes, human intervention, and climate change. To tackle this knowledge gap and enhance people's understanding of this complex

environment, the project will support a comprehensive monitoring and morphological assessment of the Bangladesh Delta. A program to extend the current monitoring systems in Coastal Bangladesh is also essential to generate data, information, and new knowledge for assessments of effects of multiple drivers on the environment of coastal zone and guide future design, rehabilitation and improvement requirements. The monitoring will cover sediment rates and composition; erosion rates; SLR; subsidence rates; tidal dynamics changes; river cross section changes and meander migration; shoreline changes; and any relevant geomorphological attributes.

41. This work will be carried out by key institutions in Bangladesh, such as Institute of Water Modeling (IWM), Center of Excellence for Geospatial Information Science (CEGIS), Dhaka University, Bangladesh University of Engineering and Technology (BUET), and BWDB, in cooperation and twining arrangements with international institutions and experts in the topic of estuarine and coastal morphology and geomorphology. This twining arrangement is needed to build in-house capacity and guide local institutions and experts to improve their understanding of the physical processes of such a complex delta system. The project will support the installation and operation of needed equipment and systems on the ground, technical expertise, provision of advanced technology and equipment, high resolution specialized remote sensing images, and the capability to analyze these images. The project will support procurement of goods, services, and incremental operation costs in carrying out this research and analysis, and the development of databases and information systems that will be made available widely both within and outside of Bangladesh. This component will also support sharing of lessons learned from this analysis and dissemination to maximize synergies and results as part of PPCR and Bangladesh's longer term climate resilience goals.

Component D – Project Management, Technical Assistance, Training and Strategic Studies (US$21 million).

42. This component will support BWDB in implementing the project through **Component D1: Project management support and audits;** whereby a fully functioning Project Management Unit (PMU) will be established and maintained and all necessary audit reports financed; **Component D2: Technical assistance and training;** whereby institutional capacity building, technical assistance and training for BWDB will be provide. In addition, this component will support the coordination and management of the PPCR at program level; and **Component D3: Strategic studies and future project preparation**: whereby resources will be provided for needed strategic studies (including the continuous updating of the strategic polder assessment as well as all necessary preparatory studies for following phases of the CEIP.

Component E – Contingent Emergency Response (US$0 million)

43. In case of a major natural disaster, the Government may request the Bank to re-allocate project funds to this component (which presently carries a zero allocation) to support response and reconstruction[30].

44. Disbursements under an Contingent Emergency Response Component (CERC) will be contingent upon the fulfillment of the following conditions: (i) the Government of Bangladesh has determined that an eligible crisis or emergency has occurred and the Bank has agreed and notified the Government; (ii) the Ministry of Finance has prepared and adopted the Contingent Emergency

[30] Such a reallocation would not constitute a formal Project Restructuring.

Response (CER) Implementation Plan that is agreed with the Bank; (iii) Bangladesh Water Development Board has prepared, adopted, and disclosed safeguards instruments required as per Bank guidelines for all activities from the CER Implementation Plan for eligible financing under the CERC.

45. Disbursements would be made either against a positive list of critical goods and/or against the procurement of works, and consultant services required to support the immediate response and recovery needs of the Government of People's Republic of Bangladesh (GoB). All expenditures under this component, should it be triggered, will be in accordance with BP/OP 8.0 and will be appraised, reviewed and found to be acceptable to the Bank before any disbursement is made.

B. Project Financing

Lending Instrument

46. The proposed lending instrument is a Specific Investment Loan (SIL).

Project Cost and Financing

47. **Project Costs**. Total project costs are estimated at US$400 million. The project would be financed through a mix of IDA Credit (US$375 million) and a Grant (US$25 million). The Grant is provided by the Pilot Program for Climate Resilience (PPCR), one of the targeted programs of the Strategic Climate Fund (SCF) under the Climate Investment Funds (CIF). Detailed costs estimates are provided below.

48. **Project Financing**. The PPCR Grant will be provided as parallel co-financing to some activities. As indicated in the table below, US$20 million of the PPCR Grant will be used to finance a proportion of a selected embankments rehabilitation contract as indicated in the Procurement Plan under Component A1. The PPCR Grant will also be used to finance US$5 million in selected consultancy services and training specified in the Procurement Plan under Component C3 for the long term monitoring of the coastal zone.

49. **Retroactive Financing:** Retroactive financing of up to SDR 2 million for payments made against eligible expenditures from April 1st, 2013 to the Credit signing date shall be allowed provided that the procurement procedures are acceptable to the Bank

Table 2: Estimated Project Cost by Component (US$ million)

Project Component	Total Base cost	Total Cost Incl. Contingencies	IDA Amount	PPCR Amount
A. Rehabilitation and Improvement of Polders				
A1. Rehabilitation and Improvemet of Polders	231	286	266	20
A2. Afforestation	4	**5**	5	
Sub-total A	**235**	**291**		
B. Implementation of Social and Environmental Mangement Frameworks and Plans				
B1. Implementation of Social Action Plan	2	3	3	
B2. Implementation of SMRPF and RAP	36	49	49	
B3. Implementation of EMF and EMPs	3	4	4	
Sub-Total B	**41**	**56**		
C. Construction Supervision, M&E, Coastal Zone Monitoring				
C1 Construction supervision, detail design, EIA	14	16	16	
C2 Third Party M&E of Project, GAAP, RAP and EMP	4	4	4	
C3 Long term coastal zone monitoring, reseach and anlysis	11	12	7	5
Sub-total C	**29**	**32**		
D. Project Management, TA, Training, Strategic Studies				
D1 Project management support and audits	10	13	13	
D2 BWDB strengthening, TA, Training	2	2	2	
D3 Strategic studies, future project preparation	5	6	6	
Sub-total D	**18**	**21**		
E. Contingent Emergency Response	0	0		
Base Cost	**322**	**400**		
Physical Contingencies (10% ~25%)*	45	-		
Price Contingencies (10%)	32	-		
Total	**400**	**400**	**375**	**25**

C. Program Objective and Phases

50. Not Applicable.

D. Lessons Learned and Reflected in the Project Design

51. The Implementation Completion Report (ICR) of the Coastal Embankment Rehabilitation Project prepared in 2003 provides very useful lessons and guidance that are being considered under the proposed operation.

52. **Embankment design must combine engineering solutions with appropriate plantation interventions.** The ICR strongly recommend the proper integration of vegetation on the embankment slopes as well as forehore afforestation when feasible in order to reduce tidal flooding and storm surge damages and embankment maintenance costs. The proposed CEIP-I endorses this view and includes proper provision of social afforestation to provide protection to the embankment while also generating livelihoods for local communities.

53. **Need a comprehensive approach in integrated coastal zone management**. The coastal area of Bangladesh faces an array of challenges. Land subsidence, coastal erosion, saltwater intrusion, seal level rise, trapping of upriver waters and sediments, and other forces combine to create complex scenarios for the management of the coastal area. Therefore, coastal projects require multi-disciplinary and comprehensive approaches for the long-term sustainable economic,

environmental and social development of the area. The proposed CEIP-I will attempt to lay the ground for improved evidence based planning in the future. Under Component C3, twinning arrangements between Bangladesh and international institutes will be put in place to bring together a multidisciplinary group of experts, including scientists, engineers, planners, and government officials to study the long term sustainability of the polder scheme. Integrated management strategies that address the intertwined goals of economic growth, environmental sustainability, resilience to climate change, and inform timely O&M are not possible without reliable information and monitoring systems. As envisaged in CEIP-I, the long term monitoring of the coastal zone (which will include surveys/data collection/monitoring/analysis of flow, tide, sediment, subsidence, SLR, river cross section, and estuary bathymetry of the coastal zone) will provide a more comprehensive understanding of the development of the coastal area.

54. **Sustainability should not be an afterthought.** Sustainability of the coastal polders requires regular monitoring of the social and environmental impacts and timely maintenance of the physical facilities, as well as efficient management that is in line with the purpose of the polder scheme. Engagement with local communities on the project is considered integral to the successful implementation of the project's components. Bangladesh's *National Water Policy* (1999) and *Guidelines for Participatory Water Management* (GPWM), 2001 recognize the role of all stakeholders in the management of water, and mandate their participation in any schemes to promote sustainability and to ensure the long term integration of social and environmental considerations. In line with this mandate, the BWDB will pilot principles of participatory water management in 4-6 polders under the CEIP-I (Component B1) to enhance the local water resources management schemes. To ensure this, an appropriate plan for participatory O&M of these polder systems shall be institutionally integrated into the project implementation. WMOs will be trained in participatory planning as well as in operation and minor maintenance activities under a Memorandum of Understanding with BWDB. Experience from similar projects in Bangladesh, such as Integrated Planning for Sustainable Water Management (IPSWAM), have proven to substantially reduce O&M costs for BWDB.

55. **The need for fast maintenance**. Lessons learnt from the *Water Management Improvement Project* (WMIP) shows that lack of timely maintenance increases the chance of embankment failure. With the establishment of WMOs, the project will pilot an approach that engages local communities in minor maintenance works, thereby responding to maintenance issues in a faster manner.

56. **Responding to Disasters:** The scope of the coastal embankment rehabilitation work that took place in 1996-2002 under IDA-27830 and IDA-27831 had to be revised to finance emergency works undertaken after the 1997 cyclones. Similarly, the *Emergency 2007 Cyclone Recovery and Restoration Project* (ECRRP) had to be revised to facilitate recovery efforts after Cyclone Aila in 2009. Given the high vulnerability of the coastal area to natural disasters, the proposed project includes a CERC (Component E). The CERC will enable the Government to reallocate funds between project components (without the need for formal restructuring and by following simplified emergency procedures) in order to quickly make funds available for post-disaster financing needs.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements (Annex 3)

57. The Government would have overall responsibility for project management and coordination through MoWR. A *Project Steering Committee* would provide the forum for overall guidance, policy advice and coordination of the project activities and addressing the inter-agency issues. The proposed project is to be implemented by BWDB, which will act as the *Project Implementing Agency*. BWDB will be responsible for the implementation of the Project through a PMU.

58. **Project Steering Committee (PSC).** The PSC will be chaired by the Secretary of the MoWR and comprise representatives of the MoWR, BWDB as well as ministries and agencies responsible for finance, planning, implementation monitoring, agriculture, environment, local government and forestry, representatives of districts where the embankments rehabilitated under the Project are located, and representatives of civil society and academia. The PSC will oversee the project; provide policy-level guidance and inter-agency coordination for the project. The Project Director (PD) of the PMU will act as the secretary of the PSC.

59. **Project Management Unit (PMU).** BWDB will set up a PMU to oversee the development and management of the project. The PMU, will be led by a PD appointed by BWDB. It will have a central project office located at the headquarters of BWDB in Dhaka. The PD will have preferably the rank of Chief or Additional Chief Engineer, and will report directly to the Director General (DG). The PMU will have 3 subordinate units: (i) Engineering Unit; (ii) Procurement and Finance Unit; and (iii) Social, Environment and Communication Unit (SECU). The SECU will be established to supervise, among other things, the environmental screening, the EA, the EMPs, RAP and social mobilization and afforestation activities. The PMU will have one senior environment specialist, one senior social specialist, one senior forestry specialist, one senior revenue staff and a communication officer (see Figure 1) at headquarters and one environment specialist, two social specialists and two revenue staff at the field level. In addition to the central unit in Dhaka, 3 *Field Level Offices* (FO) will be set up, each headed by an Executive Engineer, recruited by the project. The FOs will be located in each of the three main project districts, namely Khulna, Patuakhali/Barguna, and Bagerhat. The central and field offices will also have all needed support staff (assistants, drivers, etc.) and logistics. The need for professional staff will be reviewed jointly with IDA during the course of project implementation. The role of the PMU is, therefore, largely to contract competent organizations, to carefully supervise their performance, to enable them to perform efficiently, and to ensure transparent and regular reporting to MoWR and BWDB.

60. A **PD** for the project has already been named from BWDB, and given appropriate authority to begin project management. Given the size of the contracting packages, as well as the scope of overall management, designated staff will be recruited under the project to fill key positions. Positions can be filled either from BWDB's existing personnel, through external recruitment procedures, or through deputation from other government agencies. The project will have designated procurement and financial management staff, as well as staff for the technical/engineering unit and the social, environment and forestry unit that will report directly to the PD. To the extent possible, all staff will be expected to serve for the duration of the project in order to ensure consistent implementation of the project.

61. **Collaboration with Bangladesh Forestry Department**. The implementation of the afforestation activities (Component A2) will be undertaken by the BWDB in close collaboration with the Bangladesh Forestry Department (BFD) and social and environmental NGOs. To ensure the integration of afforestation activities into the project, a Senior Forestry Specialist will be part of the PMU. The Forestry Specialist will either be deputed from BFD or externally recruited.

B. Results Monitoring and Evaluation

62. Monitoring the results and impacts of the project will consist of the following:

63. **Quarterly Report**. The PD will submit quarterly reports in an appropriate format to the PSC and the Bank no later than 45 days after the end of each quarter. The quarterly report will cover: (a) progress towards achieving the results framework (Annex 1) and all project key indicators; (b) for each component the progress and expected completion dates for civil works, equipment supply contracts and consultancy contracts; (c) progress on implementation of RAP and EMP; and (d) progress in institutional strengthening, capacity building, training and studies.

64. **Semi Annual PSC meetings**. The PSC will be called twice a year to hold a review of the project progress and to raise / resolve any pending issues. Ad hoc meetings can also be called upon to discuss urgent issues.

65. The PD and PMU will be supported by a specialized Monitoring & Evaluation (M&E) firm recruited under Component C2 of the project that will be responsible for monitoring project impacts as well the implementation of the EMP, and the RAP. The M&E studies will evaluate the success in project implementation in terms of meeting the project's objectives, and assess its physical, hydrological, environmental, social, and economic impacts. The M&E activities will provide continuous feedback to the GoB the PSC and Development Partners on the project's performance, and on mitigation of negative impact under various components, so that corrective actions can be undertaken in a timely manner if necessary.

C. Governance and Accountability Action Plan (GAAP) (Annex 5)

66. Bangladesh is rated as a high risk environment from a governance, procurement and financial management viewpoint. Therefore, the project would have a fully developed GAAP in order to ensure proper implementation of the project and the use of IDA funds. The **key elements** of the GAAP are: (a) information and public disclosure of all project documents to ensure full transparency of project activities; (b) social accountability measures including third party monitoring; and (c) measures to safeguard procurement and financial management. These measures have been discussed and agreed upon with BWDB.

67. **Information and Public Disclosure:** In line with the World Bank's Disclosure Policy and Bangladesh's Right To Information (RTI), access to all information in the project shall be made public. This includes: (i) public disclosure of all project documentation, including project information, description and location information; (ii) disclosure of procurement and other related information; and (iii) a centralized information system in Dhaka that will allow for the public to access information on the project. In accordance with the RTI, public disclosure shall include the dissemination of all information via local notice boards, public information meetings, as well as on a designated website. As mentioned in the implementation arrangements, a communication/ information officer will also be appointed to ensure proper implementation of the RTI.

68. **Social Accountability and Third Party Monitoring**: The project will make use of social accountability and transparency measures to improve project performance through third party monitoring, project level grievance redress mechanisms (GRMs), and project level monitoring to ensure the integration of social accountability measures and the transparency of procurement and

implementation. Specific measures will be designed on (i) consultation, feedback and grievance-redress mechanisms to alert project staff to problems identified by beneficiaries, affected people, and other stakeholders; (ii) participatory planning to ensure the project meets the needs of beneficiaries; and (iii) participatory monitoring to identify problems. As indicated above, the project will establish PC(s) with a primary function of operating hydraulic structures. PCs will also serve as a platform for third party monitoring, to track progress in implementing civil works construction, afforestation and social forestry programs, the RAP and EMP. Issues identified can be reported via the field level, district level or project level GRMs. In addition, PCs and water management organizations will engage in participatory planning together with the BWDB to provide feedback on engineering designs and the progress of construction.

69. **Procurement and Financial Management.** Procurement under the project would be grouped into large International Competitive Bidding (ICB) contracts that would be done with high level of scrutiny by the Bank and the Government, and under which construction supervision would be undertaken by international consultants, who would be the "engineer" for works contracts. In addition, bidding documents would require all contractors to disclose their agents and relationships with the implementing entity as well as in Bangladesh. Finally, under the project, a **Procurement Panel** will be established, made up of two international/expatriate and one national consultants. Procurement Panel will act as the bid evaluation for large contracts as specified in the procurement plan. This would also ensure that the bidding process is followed with full integrity and thoroughness, following appropriate guidelines. BWDB has already finalized the terms of reference (ToR) of the procurement panel and will start identifying members of the panel as soon as possible so that the Panel can be put in place prior to starting major procurement under the project. Also appropriate clauses would be added giving Bank the right to audit the contractors. Finally, **Financial Management** would be undertaken by a Financial Management Specialist, to be recruited by the project, and to be based in Dhaka. All financial management activities will be undertaken centrally in the PMU office in Dhaka, to ensure full accountability

D. Sustainability

70. **Social Afforestation**. Lessons learnt from prior projects highlighted that foreshore afforestation was important in providing protection of the embankment to stabilize the environmental condition of the coastal belt, reduce the need for O&M on the embankment and providing employment and livelihoods benefits for coastal communities. In instances where Nipa palm (Golpata) were grown, these provided not only protection from tidal flooding and storm surge, but also income and livelihood benefits to beneficiaries from the harvesting of forest products. Harvesting of mangrove species will not be permitted because of their critical protection role. Due to vulnerability to windthrow, strip planting on the shoulders of the embankment will also not be permitted. However, there will be options for planting social forestry species behind mangrove belts, mound at the foreshore base and slopes of the embankment. These will provide shelter, shade, and livelihoods options from harvesting timber, fuel wood, fruits etc. Technically sound projects that also combine best social and environmental practices are likely to be more sustainable in the long run.

71. **Operation and Maintenance**. A new approach to planning, construction, operations and maintenance and management of polder schemes is required to ensure sustainability of the PDO. Past experience has shown that preventive maintenance of polder schemes through community participation becomes successful when coupled closely with BWDB mechanisms of O&M. The establishment of community-based maintenance groups with "locked-in incentive" has been

successful and should be replicated where feasible. In order to ensure that the community organizations do not wither away, it is important to explore performance based contracts to communities and maintain regular monitoring and assessment. Participation of all stakeholders from the outset has been shown to promote sustainability and to ensure the long-term integration of social and environmental considerations during project construction and post construction. Reform initiatives of the Government over the last decade (e.g., the *National Water Management Plan* approved by the Government in 2004 and through the World Bank funded WMIP have created an enabling environment to introduce participatory approaches for improved water management. The proposed CEIP-I will pilot this approach through WMO in 4-6 polders (see Component B1 for more details). In addition, the Government will ensure the sustainability of the polders by providing sufficient budget for the O&M of the polders after completion of the project.

V. KEY RISKS AND MITIGATION MEASURES

A. Risk Ratings Summary Table

Risk	Rating
Project Risk	
- Design	M
- Social and Environmental	S
- Delivery Monitoring and Sustainability	S
Implementing Agency Risk	
- Capacity	S
- Governance	S
Stakeholder Risk	S
Overall Implementation Risk	S

B. Overall Risk Rating Explanation

72. The overall risk rating for the project is Substantial. This is based on governance risks primarily due to the operating environment and large contracts involved. The **governance risks** within BWDB relating to procurement and contract management will be mitigated through: (i) a Procurement Panel, made up of two international and one national consultants, which will be responsible for key procurement actions for large value contracts as specified in the procurement plan. (iii) the supervision consultant will act as the "Engineer"; (iv) the Bank will appoint an individual consultant to continuously monitor the progress of the contract implementation; and (v) the Bank will hold monthly coordination meetings with BWDB to monitor the progress of the procurement and resolve critical issues.

73. While the project is expected to positively impact the coastal population, additional risks around potentially unforeseen and negative environmental impacts have also been identified. These risks will be mitigated through the preparation of polder specific EIAs and EMPs that will carefully assess the environmental impacts and their proposed management measures. Delays in land acquisition, resettlement and compensation payments also pose a risk to the project's timely implementation. These risks will be mitigated through specific actions developed in the RAP. In addition, BWDB will contract a reputable NGO to identify target beneficiaries, manage compensation issues and implement the RAP. A third party monitor will also oversee the implementation of both the EMP and RAP.

74. The third risk is associated with the potential lack of financing for O&M for infrastructure and the protective afforestation belt. The mitigation measures will include seeking assurances of government for the full provision of such funds. In addition, the project will pilot the use of WMOs and to actively engage these in the operation and minor maintenance of infrastructure. Experience with this approach in Bangladesh has shown that, if implemented well, WMOs can actually reduce the maintenance costs to BWDB of the polder systems.

VI. APPRAISAL SUMMARY

A. Economic Analyses

75. The economic analysis of the project covers 17 polders and is based on the Cost-Benefit Analysis (CBA) approach. The results show a **Net Present Value (NPV) of BDT 27.6 billion** and an economic Internal Rate of Return (IRR) of **20 percent**[31]. To account for the project's long-term benefits related to climate change, the analysis covers a 33-year time horizon. It captures a wide range of benefits, such as avoided damages due to storm surges and river flooding (e.g. crop production, fisheries, livestock, roads, property, and other sectors), improved crop production due to better drainage and benefits from afforestation. The analysis includes costs related to civil works, afforestation, resettlement, supervision and monitoring. As several benefits[32] have not been estimated in monetary terms, the overall result underestimates the real magnitude of the project benefit.

76. Overall, the project has a **benefit/cost ratio of 2.4**. The most important benefit (39 percent of total benefit) is improved crop production due to better drainage. This is a cumulated result of increased productivity and cropped area thanks to reduced salinity and water-logging provided by the upgraded embankments. Avoided damages to roads (30 percent of total benefit) and property (17 percent) are other significant benefits, as a result of a substantial increase in road network and number of houses by the end of the project lifetime.

77. The analysis deals with several uncertainties related to climate change, such as frequency and strength of storms. The only assessment of storm damages available in Bangladesh relates to Sidr cyclone (2007). Thus, the avoided damages due to storm surge and river flooding are based on sector-specific damage and loss functions derived from Sidr damage assessment. To account for the uncertainties related to future storms, a sensitivity analysis in relation to different scenarios of damage incidence shows the project's economic viability. In addition, a sensitivity analysis to increases in project costs reveals that the project is economically attractive even at cost increase of 50 percent.

B. Technical

78. **Design Level/Storm Surge**. There have been 19 well documented major cyclones that have occurred from 1960 to 2009. These events were used and simulated under different tidal conditions. Specifically, these storms were simulated under the maximum tide level in order to have conservative simulation of storm surge to compute the design parameters of the embankment scheme. A spatio-temporal hydrodynamic cyclone and storm surge model of the Bay of Bengal was

[31] This CBA considers Components A, B and C, which account for 95 percent of the total project's base cost.
[32] E.g. lives saved by the embankments, improved delta monitoring in the future.

used to compute maximum surge heights for different return periods (i.e., 10, 25, 50 and 100 years[33]) at different locations of the embankment. The model used was stressed using different monsoon characteristics. The model also took into account 50 cm of SLR, 10% increase of tropical cyclone intensities for a rise in sea surface temperature of two degree Celsius and 20% increase in extreme precipitation by 2050. Generally, for the normal flood protection works, the frequency of occurrence of floods that needs to be selected for the design of a particular embankment depends on the acceptable extent of damage by inundation in the locality. Considering likely agricultural damage to important installations and loss of human lives, a 20 year return period flood is acceptable for use in Bangladesh in agricultural dominated areas. Considering the result of the analysis and project purpose, it was decided that the design return period should be 25 years. This time frame was used in the model to inform the design of sea, interior, and marginal dykes and used to test hydraulic, seepage, and structural failure modes. The design of slope protection work, and scour depths, launching apron, and filter material were also informed by the hydrodynamic simulations.

79. **Drainage Model**. The main function of the drainage canals is to safely drain out the design discharge or the drainage basin runoff volume generated during intense rainfall events and storms. The rate of drainage from the field as generally expressed in liter /sec/ ha and depends on the type of soils, crops, rainfall intensity and duration of storm. The discharging capacity of a drainage canal depends on canal characteristics, such as flow area, roughness of the canal profile, and the hydraulic gradient. CEIP-I used a validated drainage model for the existing system to assess the existing drainage performance of the present drainage networks and future drainage performance with the changed morphological condition of the peripheral rivers. One of the design criteria was to ensure that a rainfall storm of 5 day duration and 10-year frequency could be effectively drained with no major water logging (i.e., no submergence of more than 5% of the incremental area in addition to the area that cannot be drained by gravity to a greater depth than 0.3 m for a period of 3 days). The drainage system was designed to account for the aforementioned assumptions for climate change and was tested against a 100 cm rise in sea level by 2050. Under such a scenario, the drainage system will need a pumping scheme installed to maintain the same level of drainage effectiveness. Such modeling was essential for the design of drainage sluices and regulators and flushing inlets, and the sectional design of drainage canals.

80. **Subsidence and SLR (Annex 2.1)**. While there is widespread agreement among scientists that SLR will continue due to climate change, estimates vary. Furthermore, regional estimates of SLR are scarce at present. The Intergovernmental Panel on Climate Change (IPCC AR4) report projected increased global SLR between 0.18m and 0.59m across various emission scenarios over the next 100 years[34]. CEIP-I adopted 0.5 m SLR by 2050 assuming a liner progression over time for the 1m SLR by 2100 predicted[35]. In addition to SLR, land subsidence in coastal Bangladesh is common and mainly caused by tectonic subsidence and isostatic adjustments, sediment loading, compaction of Holocene sediments, compaction of peat layers, withdrawal of water and surface water drainage and management. A literature review was conducted to compile available estimates of land subsidence of coastal Bangladesh. Estimates vary widely from a fraction of a millimeter to a few centimeters per year. In light of such widely varying estimates of land subsidence, CEIP-I took into account a potential subsidence of land by 9.55 mm per year as per the measurement of the Dhaka University Earth Observatory at Khulna.

[33] Government of the People's Republic of Bangladesh, Ministry of Water Resources. Consultancy Services for "Technical Feasibility Studies and Detailed Design for Coastal Embankment Improvement Project for Flood Embankments, Drainage Canals, Protection works and Hydraulic Structures, Phase-I (CEIP-I) Volume III: Modeling and Survey Reports: Bathymetric and Topographical Survey; Storm Surge Modeling, Polder Drainage Modeling" May 2012.

[34] IPCC AR3 suggested a SLR of 0.09 to 0.88 m by the year 2100 unless greenhouse gas emissions are reduced substantially (IPCC, 2001).

[35] Climate Change: Global Risks, Challenges and Decisions; Copenhagen 2009.

C. Financial Management (Annex 3)

81. **Financial Management Capacity Assessment**. The Financial Management system of BWDB is adequate to meet the requirement of GoB, BWDB and its regional accounting centers as well as IDA's fiduciary requirement as per OP/BP 10.02. The financial management framework envisages that the project financial management system for BWDB will be a subset of its mainstream financial management system that has been evaluated to be adequate by IDA. The PMU and all concerned units and offices will follow the BWDBs financial, accounting and internal control procedures and manual, along with the project specific financial management arrangements as reflected in the project documents. The project will follow the fixed assets recording arrangements that have been separately identified as important for the project.

82. **Financial management arrangements.** BWDB has prior experience in implementing Bank financed programs and has reasonable internal controls and accounting system in place for accounting and reporting of expenditures. The following arrangements will govern the project financial arrangements: (i) an Financial Management Specialist (FMS), with ToRs agreed with the Bank, will be recruited as soon as the project becomes effective and will maintained for the project duration (ii) two separate bank accounts will be opened for implementing this project; (iii) all payments would be made directly by the PD from the PMU; no payments are anticipated to be handled through the three divisional offices; (iv) the accounting system of the BWDB will be used for accounting and reporting of the project expenditures; (v) an annual external audit of this project will be carried out by Comptroller & Auditor General (C&AG) of Bangladesh, through its Foreign Aided Project Directorate (FAPAD) and submitted to the World Bank; and (vi) one performance audit will be carried out two years before the closing of the project. The performance audit will be carried out by an independent private auditor on the basis of ToR and selection process acceptable to the Bank. Overall the financial management risk rating for the project is **substantial (S).**

D. Procurement

83. **Procurement Plan**. Detailed procurement packaging including methods of procurement will be finalized in consultation with BWDB.

84. **Procurement Capacity Assessment**. A capacity assessment of BWDB has been conducted. BWDB will require adequate procurement staff to manage procurements under this project. The assessment shows that BWDB has limited procurement knowledge of ICB, and weakness in bid evaluation. In BWDB, contract administration is a significant issue; most the high value contracts are not completed within the original contract period. BWDB is also not immune to systemic issues affecting procurement efficiency and performance. In addition to adequate staffing for procurement needs, emphasis needs to be laid on areas of internal control, documentation, information dissemination, administration of contract including delivery follow up, payments, handling complaints, etc. The project is rated as "High-Risk" from a procurement operation and contract administration viewpoint. Several measures are introduced to minimize risk during the implementation of the project, including: (i) a Procurement Panel will be established made up of two international and one national consultants. This panel would be responsible for key procurement actions for large value contracts as specified in the procurement plan. These would include short listing of consultants, pre-qualification of contractors and suppliers, review and issuance of bidding documents, evaluation of bids / proposals and recommendation of award. This would ensure that the bidding process is followed with full integrity and thoroughness, following appropriate guidelines.

The Panel will also oversee contract management issues including the quality and scope of work, changes in the contracts and variation orders and payments; (ii) procurement training, especially in ICB procurement, for key project staff; (iii) awareness training on fraud & corruption (F&C) issues both for project officials and prospective bidders. These assessments and agreed action plans are captured in the web based Procurement Risk Assessment Management System (P-RAMS).

E. Social (including Safeguards)

85. Polders provide protection to the communities in the coastal region from flooding, tidal inundations and salinity intrusion. The polder embankments also provide emergency shelter to victims of riverbank erosion and flood inundations. As the embankments are safe structures and serve also as roads, the slopes are often used by the poor and landless peoples and sometimes socially influential persons for residential, commercial and community purposes without any functional restrictions. Bank investment for improvement of these polders will involve acquisition of land to accommodate improved design and displacement of people, largely the informal embankment settlers. The World Bank policy on **involuntary resettlement (OP/BP 4.12) has therefore been triggered** for this project. As none of the residents or likely affected persons within the polders selected by CEIP-I is from the tribal communities (indigenous peoples), **OP/BP 4.10 on Indigenous Peoples has not been triggered** for CEIP-I.

86. Civil works under CEIP-I have been organized into four packages, each including works in 3 to 6 polders. Social impacts will be identified when specific investments are designed for each package. A SMRPF has therefore been developed for the CEIP and a RAP has been prepared for the first package of CEIP-I in compliance with the Bank policy on social safeguards and the national law on land acquisition. The SMRPF will guide the preparation of RAPs for all remaining packages. The SMRPF includes a resettlement policy framework and a social inclusion/gender framework. Social screenings, social impact assessments and RAP will be carried out for future investments in line with the SMRPF.

87. Land acquisition in this project is required for the first component (a) rehabilitation and improvement of polders. The upgrading of embankments will require increasing their heights and widening theirs slopes almost in all and retirement of embankment in very limited locations. The footprint of the upgraded embankment will require land on each side of embankment. Some of the land is already owned by BWDB, the rest will need to be acquired from private land owners. Upgrading existing embankments to more climate resilient design will cause displacement of squatters and encroachers on the existing embankments. The project interventions will, therefore cause physical and economic displacement of some affected people.

88. The project includes 17 polders comprising 623 km of embankments including sea-dyke (sea facing), marginal dyke (on estuaries) and interior dykes (on rivers). Adverse social impacts associated with implementation of the first procurement package are related to land acquisition and population displacement due to embankment upgrading and construction of water control structures. Detail design has been completed for 4 polders (which represent the first package of investment) for which a RAP has been prepared with provisions for compensation, and relocation and livelihoods restoration assistance for the project affected persons. The RAP cost for the four polders is estimated at BDT 928 million (US$ 11.6 million) including cost of land acquisition. The remaining polders will follow the project SMRPF in preparation of the required RAPs. It is estimated that the

land acquisition and resettlement cost of the remaining polders will be around BDT 2,613 million (US$ 32.6 million).

89. **Use of IDA credit for land acquisition and involuntary resettlement costs**. The Government of Bangladesh intends to use part of proceeds from IDA credit requested for the Project towards the costs of land acquisition and involuntary resettlement pursuant to OP 4.12. In accordance with the BP 6.00 Annex A and OPCS guidelines on expenditure eligibility, a memorandum has been prepared to seek approval from the Regional Vice Presidency (RVP) for the use of the proceeds of the IDA Credit to reimburse the land acquisition and involuntary resettlement costs to be incurred for implementation of the project.

90. BWDB will adopt a gender inclusive approach in the overall implementation of the project and in particular when it comes to resettlement and livelihood restoration of project affected peoples. Women will be consulted at each stage of project process and their representation will be ensured in project management and resettlement. BWDB will encourage the employment of poor women in earth work through Labor Contracting Societies (LCS) and will ensure that women represent at least 30% in the WMOs for participatory scheme cycle management and O&M of the improved polders.

91. BWDB has already designed a **GRM** for the project. The BWDB field offices will be the local focal points of GRM for receiving and settling complaints from local communities related to procurement, contract management, social, environmental, and health safety. Grievance Redress Committees (GRCs) will be set up at each union within a polder to ensure easy accessibility by the affected persons for resolving land acquisition and resettlement related grievances. Women will be involved in the GRCs. The PMU will remain to address any unresolved cases from local GRCs and involve the MoWR in only critical circumstances. A full description of the GRM is provided in the SMRPF.

92. The SMRPF was reviewed and cleared by the Bank in May 2012. With the developments in project design and implementation arrangement, it was revised and re-submitted to the Bank for further review and clearance. The SMRPF was disclosed on April 15, 2013. The draft RAP for the first package was reviewed by the Bank in February 2013 and disclosed in the Bank Infoshop on **February 15, 2013**. The updated RAP was been disclosed locally on the BWDB website on February 18, 2013 for comments. BWDB conducted a national workshop on the draft RAP on February 28, 2013.

F. Environment (including Safeguards)

93. Overall, the project bears significant positive environmental aspects. It will increase the resilience of vulnerable committees living in natural disaster prone coastal areas and it will develop the capacity of BWDB in environmental management. The project's physical intervention is expected to reduce loss of crops and assets by withstanding storm surges, taking into account the impact of climate change, and to decrease salinity intrusion which, in turn, will increase agricultural production in the long run. Component A of the project (about 75% of total funding) will involve infrastructure development with extensive earth work. Component B will support the implementation of the Environmental Management Plans (EMPs) and the establishment of an environmental monitoring system in BWDB to enable it to track improvements in environmental performance of the polder system during implementation and after project completion. Component C2 will support an independent supervision (possibly through third party monitoring) of the EMP implementation.

94. Environmental impacts will be triggered from the following activities: upgrading embankments (height increased and base widening), limited realignment, embankment slope and river bank protection work by concrete block and vegetation, disposal of drainage substrate obtained from drainage channels re-excavation and construction/repair and operation of hydraulic structures. These activities are expected to affect agricultural land, fish habitat, flora and fauna, physical and cultural structure and livelihood of the people. Considering the sensitivity, extent and duration of the impact, CEIP is a Category 'A' project according to the Bank's safeguard classification. The project will trigger environmental safeguard policies for EA (OP/BP 4.01), Natural Habitats (OP/BP 4.04) and Forests (OP/BP 4.36). Although no direct impacts on physical cultural resources is identified for polder 35/1, 35/3, 32 and 33, screening mechanism incorporated into the EA process for the rest of the thirteen polders may identify subprojects with archeological, paleontological, historical, religious, or unique natural values. Physical cultural resources (OP/BP 4.11) are also triggered for the project

95. BWDB has already developed an EMF for the Project. The EMF provides the guidelines to comply with national legislation and World Bank safeguards policies, and defines all environmental requirements and management plans needed for the reconstruction/rehabilitation of all polders as well as for the afforestation program. In addition, BWDB has also conducted polder specific EIAs for polder numbers 32, 33, 35/1 and 35/3 (polder selected for rehabilitation in the first package) and recommended polder specific EMPs. An independent consultant with international experience reviewed the four EIAs. Thirty six polder specific consultations with community and stakeholders were carried out in 2012/2013 during the preparation of the EMF and various EIAs. The views of the community have already been incorporated in the EMP and project design. The implementing agency disclosed the EIAs and EMF on the website on **February 18, 2013** and conducted national level consultation to finalize the documents. Upon request from BWDB, the documents were disclosed at World Bank's Infoshop on **February 15, 2013** (i.e., at least 120 days prior to Board approval, scheduled for June 26, 2013).

96. Considering the substantial and possibly long term impacts of the project, the PMU will be staffed with a senior environment specialist in the Dhaka office and one or more environment specialists at the field office. At least one environment specialist is expected to be on board before project effectiveness. The contractor will ensure proper environmental management during project implementation, and the environment specialist and project supervision consultant will supervise the implementation of EMP during project period. WMOs will be trained to ensure environmental management during project operation. The Environmental, Social and Communication Unit of BWDB will oversee the environmental management during project implementation and operation. As part of the Quarterly Progress Report, BWDB will provide progress on environmental management.

Annex 1: Results Framework and Monitoring

BANGLADESH: COASTAL EMBANKMENT IMPROVEMENT PROJECT PHASE-I (CEIP-I)

Project Development Objectives. The project development objectives are to (a) increase the area protected, in selected polder, from tidal flooding and frequent storm surges, which are expected to worsen due to climate change; (b) improve agricultural production by reducing saline water intrusion; and (c) improve the Government of Bangladesh's capacity to respond promptly and effectively to an eligible crisis or emergency

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values								Frequency	Data Source/ Meth.	Respons. for data collection
				YR1	YR2	YR3	YR4	YR5	YR6	YR7	End Target			
Gross area protected		1000 x ha	-	-	-	-	36.5	67.7	77.9	100.8	100.8	Annual	BWDB	M&E
Direct project beneficiaries from increased resilience to climate change (number), of which female (percentage)[36]	✓	1000 x person	0	-	-	-	230	480	530	760	760 (50%)	Annual	BWDB	M&E
Increase cropping intensity		(%)	140	-	-	-	158	167	171	180	180	Annual	BWDB	M&E
Contingent Emergency Appropriation		Triggered if requested	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BWDB	NA

Intermediate Results Indicators

Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values								Frequency	Data Source/ Meth.	Respons. for Data Collection
				YR1	YR2	YR3	YR4	YR5	YR6	YR7	End Target			
Length of upgraded embankment		km	0	-	20	121	309	452	551	623	623	Annual	BWDB	M&E
Drainage structures replaced and upgraded		No.	0	-	3	23	59	89	113	129	129	Annual	BWDB	M&E
Regulators upgraded		No.	0	-	4	28	73	106	123	134	134	Annual	BWDB	M&E
Flushing inlets upgraded		No.	0	-	9	52	127	178	214	244	244	Annual	BWDB	M&E
Length of Drainage Channels upgraded		Km	0	-	27	157	381	540	681	794	794	Annual	BWDB	M&E
Area Afforested	✓	ha	0	-	-	-	-	100	200	300	300	Annual	BWDB	M&E
Water Management Organization (WMO)		Nb.	0	-	-	-	1	2	3	4	4	Annual	BWDB	NGO
Improved coastal monitoring [37]		Studies	Limited data					1		2	2	Annual	BWDB	M&E
BWDB day of training provided	✓	No.	0	20	40	60	80	100	120	140	160	Annual	BWDB	
Grievance Redress Committee (GRC)		No.	0		4		10	13	17			Annual	BWDB	M&E/NGO

[36] As related to PPCR core indicator A1.3.
[37] As related to PPCR core indicator B3 on the use of climate information in decision making.

Annex 2: Detailed Project Description

BANGLADESH: COASTAL EMBANKMENT IMPROVEMENT PROJECT PHASE-I (CEIP-I)

97. The project consists of five major components. Component A is designed to upgrade and improve polders, embankments and drainage systems, while Component B is aimed at implementing social action and environmental management plans. Component C is to design future polder packages, supervise construction and monitor project impact and implementation of social and environmental activities. Component D is related to supporting project management, technical assistance, and training. Component E is a contingent emergency window to equip the GoB to respond to disaster events by shifting, mobilizing and requesting funds for immediate actions. The project components are described below.

Component A – Rehabilitation and Improvement of Polders (US$291 million).

Component A 1– Rehabilitation and Improvement of Polders (US$ 286 million)

98. Each polder is typically enclosed by an embankment and includes various water controlling structures for draining and flushing the polder area. Embankments were originally constructed to prevent salinity intrusion and tidal flooding; they now need to be strengthened (by raising their height and protecting their slopes) to be able to protect against storm surges. In addition, as most embankments were constructed in the 1960s, many water controlling structures are not functioning fully and some of the internal drainage channels (or *khals*) have been severely silted. This component will finance the following works: (i) upgrading embankments; (ii) embankment slope and river bank protection work; and (iii) construction and repair of hydraulic structures and re-excavation of drainage channels.

99. **Upgrading Embankments.** The crest height of most existing embankments was determined as the "maximum normal high tide" (reordered in 1960s) plus a freeboard of 5 feet. With poor maintenance and repeated cyclones the embankments conditions have deteriorated and breaches are common. Therefore, the crest level of almost all embankments needs to be raised and the breaching point must consider the present and future scenarios of tidal/ storm surge levels. This intervention will include mainly *earthworks*. It may need to re-align the existing embankments, usually to provide additional setback to avoid bank erosion. The following *guidelines* were adopted in the design of the upgraded embankments:

- Alignment of upgraded embankments to be kept, to the extent possible, within the existing alignment to avoid land acquisition and relocation of existing infrastructure and settlements that have taken place after the construction of the coastal polders.
- Retirement of existing embankments will be avoided as much as possible in order to minimize land acquisition requirements; and will be limited to cases where there is a strong and persistent bank erosion threatening the existing embankment.
- Upgrading of the embankments will be accompanied by the provision of social forestry and vegetation planting for slope protection and foreshore afforestation where sites are available and suitable.
- Mechanical compaction is proposed in the embankment upgrading.
- The embankment height is raised to protect against most storm surges[38].

[38] The design storm surge levels were obtained from 38 cyclones simulations based on 19 actual events and 19 additional events of the same magnitude and identical tracks but landfalls occurring in the opposite tidal phase. The climate computations are based on IPCC predications for 2050 of 0.5 m sea level rise and 10 per cent increase in wind speed for cyclonic events. On this basis, surge levels were computed for 10, 25, 50 and 100 return periods. A full detail analysis is found in the *Technical Feasibility Studies and Detailed Design for Coastal Embankment Improvement Program* – Draft Final Report Volume III Modeling and Survey, Sept 2012.

- Strong design with high quality construction material, while ensuring reasonable economic costs, is to be used for all construction works.
- Local residents and stakeholders are consulted every step of the way.

100. **Embankment and slope river bank protection work**. Protection work can be divided into two main parts, protection of the river bank itself and protection of the embankment slope. The purpose of protection work is to stabilize the slope against erosion and scour. Generally, embankment slope erosion occurs due to wave action and scour takes place due to flow velocity. Slope protection consists of a layer of hard *cover* (and some vegetative cover) and a *filter* layer. The cover layer must be able to resist hydraulic impacts (current and waves) while the filter layer (in between core materials and the cover layer) is responsible for preventing migration of soil particles out of the bank slope and simultaneously allowing for the movement of water through the designed filter.

101. **Construction and repair of drainage structures.** The main functions of the drainage channels (also referred to as *khals* or canals) is to safely drain out the drainage basin runoff[39] and drain out the surplus water from cropping lands, which is important for the satisfactory growth of crops. In most polders, drainage channels have been silted up. The major activity under CEIP-1 is to re-excavate drainage channels to improve the drainage conditions. This will involve dredging and disposal of soil.

102. Drainage structures were designed **originally to drain out** excess water from the polder area and into the river through a drainage sluice. Later on, agricultural practices developed among the farmers to cultivate winter boro crops inside the polder. For this winter agriculture, farmers started to take sweet **water into the polder** during the monsoon/post monsoon and store it for later use. As such, sluices that were originally constructed only for drainage purposes started being used for drainage and flushing. However, the use of a one way sluice to allow reverse flows has damaged some of the structures. In addition, many structures are not functioning properly due to natural sedimentation and poor maintenance. The CEIP-I project will repair damaged structures and construct new **two way regulators** to allow both drainage and flushing. Depending on the need in each polder, the CEIP-I will fund:

- Construction/repair drainage sluices (to drain out the excess water from the polder area to the river).
- Construction/repair flushing inlet (to allow river water to enter inside the polder for various agricultural purposes).
- Construction/repair of drainage–cum–flushing sluices (to drain out excess water from the polder to the river and also to allow the river water to enter into the polder area).

103. In very limited channels, closure regulators may be installed to protect from tidal/storm surges. Closure Regulator construction will mainly include earthworks and a discharge structure to accommodate the drainage blocked by the dam.

104. Stakeholder and beneficiary consultations and participation will be central to carrying out the improvement works to the polder system. The beneficiaries, through their formal and informal WMOs, would be involved in all stages of project implementation from identification of works, prioritization, design, and construction. These consultations will be carried out by the consultants and NGOs with support from the BWDB under Component B1.

105. An illustration of the work being undertaken under Component A is provided in Box 1 below.

[39] A rainfall storm of 5 day duration and 1 in 10 year frequency is considered as design rainfall runoff for investigating the effectiveness of the drainage system and considered for the design of drainage channels.

Box 1: POLDER 35/1

Background: With an area of 13,100 ha and a population of 99,200 people, polder 35/1 is the largest of the 17 polders covered by this project. It is bounded by the mighty Baleswar River to the south east, Sannashir Khal to the north and Bhola River to the west. The existing embankment is home for about 17 percent of the polder's population. The polder is vulnerable to storm surges, which affect lives and cause significant losses of assets and agricultural production. For example, the SIDR cyclone caused about 600 deaths and totally damaged 25 percent of the road network.

This polder was conceived in the year of 1960 under Coastal Embankment Project (CEP). The original concept of construction of this polder was only to protect the agricultural lands from salinity intrusion caused by tidal inundation from the sea and river and to drain out rainfall run off. The polder embankment continues to be under threat of cyclone surge, wave attack and increasing risks brought about by climate change. Many segments of the embankment were damaged in different places by SIDR and, to a lesser extent, by AILA mostly by overtopping of embankment, severe wave action and river erosion.

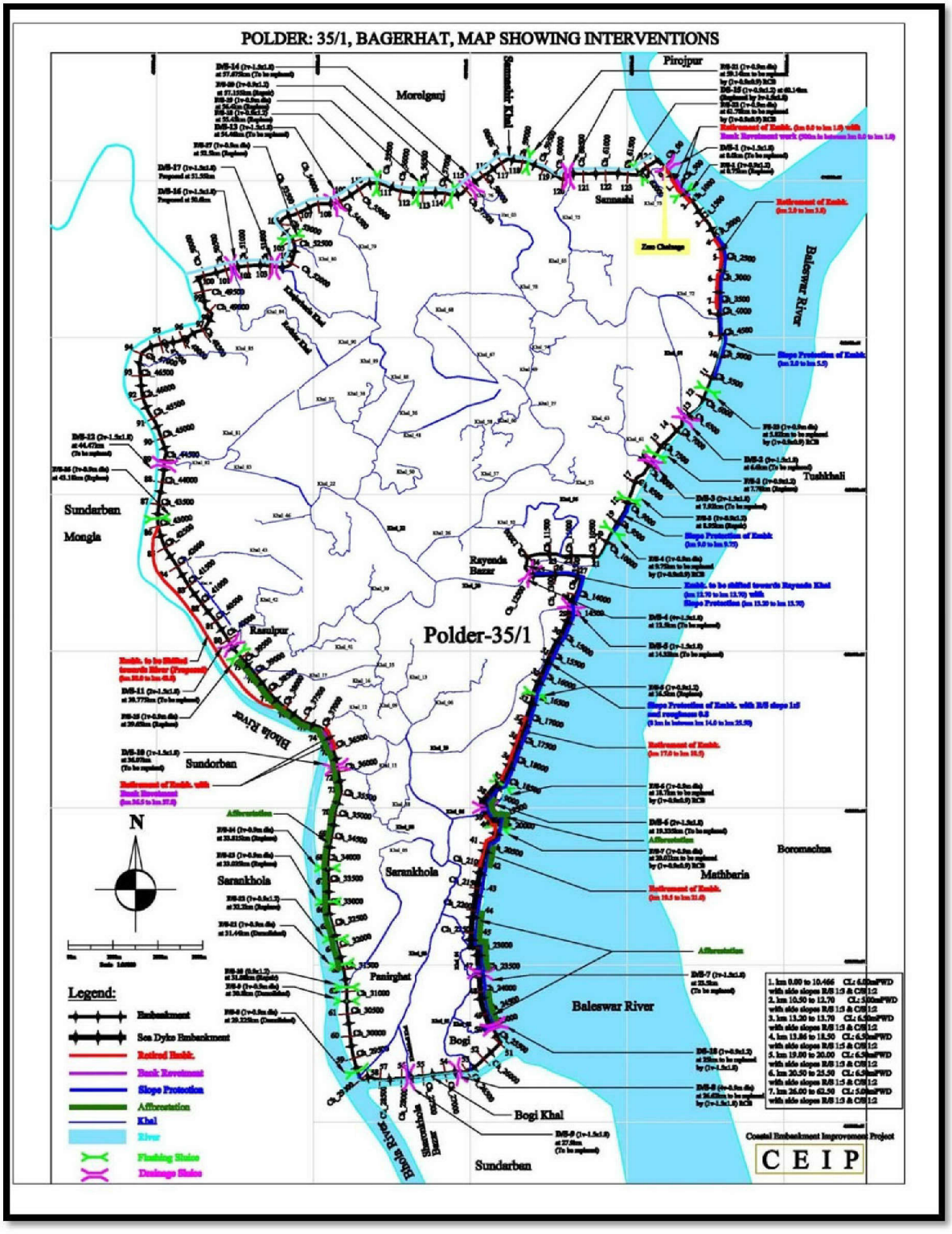
Most of the existing drainage sluices are in a very bad condition and have become almost non-functional. The upstream and downstream aprons of the sluices have been damaged. The internal drainage channels have become silted up and need to be re-excavated for improved drainage. An index map showing the alignment of the embankment and existing structures is shown below. This is one of the four polders selected for rehabilitation under Batch 1.

Description of the Polder: The entire embankment was classified as an "Interior dyke" having side slopes C/S 1:2 and R/S: 1:3. After the CEIP storm surge and wave analysis, sections of the Baleswar facing embankment (km.13.50 to km.26.0) was upgraded to a "Sea Dyke" with R/S slope 1:5. The summary of the existing infrastructure is given below:

- Total length of Embankment : 62.50 km
- Design crest level : 4.88 mPwd
- Total number of Drainage sluice: 14 nos.
- Total number of Flushing Inlets: 25 nos.
- Total length of Drainage Channel : 56 km
- Gross protected area: 13,058 ha.
- Cultivable area: 10,700 ha.

Rehabilitation work: The embankment from on the Baleswar River has been washed away km 0.0 to km 1.0, due to continued river erosion and the existing drainage sluice has been damaged. Therefore, the embankment retirement and replacement of sluice gates of this place is considered to keep sufficient set back. Similarly, the embankment will be retired from km19.5 to km21.0. Bank revetment with afforestation work will also be implemented in selected places to further strengthen the embankment against erosion forces. This will be specifically implemented on the stretches from km 0.3 to 0.8 and km 36.5 to 37.0. Slop protection work will need to be strengthened for the stretch from km2.0 to 10.5, possibly with concrete blocks. The design slope is revised in other stretches and work will be implemented to achieve the desired slopes. The remaining length of embankment has to be re-sectioned up to the CEIP-I design level with mechanical compaction. In addition, there are 14 existing drainage sluices and 25 flushing inlets in Polder-35/1. Out of 14 drainage sluices, 11 will be replaced, 2 will be repaired, 1 is functioning well and 2 additional sluices will be constructed new.

Box 1 cont.


POLDER: 35/1, BAGERHAT, MAP SHOWING INTERVENTIONS
Polder-35/1
Morolganj
Sannasir Khal
Pirojpur
Sannasi
Baleswar River
Tushkhali
Rayenda Bazar
Rasulpur
Sundarban
Mongla
Bhola River
Sarankhola
Panighat
Bogi
Bogi Khal
Mathbaria
Boromachua
Zero Chainage
N
Legend:
Embankment
Sea Dyke Embankment
Retired Embk.
Bank Revetment
Slope Protection
Afforestation
Khal
River
Flushing Sluice
Drainage Sluice
Coastal Embankment Improvement Project
C E I P

Component A2: Afforestation (US$5 million)

106. The afforestation sub-component is to provide protection from erosion and stabilize the embankments by countering floods, tidal surges, wave attacks and strong winds whilst supporting the livelihoods of local communities, directly and indirectly. The design builds upon the lessons in Bangladesh since the 1960s, evolving increasingly to improve the socio-economic and environmental conditions of vulnerable coastal communities, particularly the poorest. Selected mangrove and other salt tolerant species will be planted as a protective greenbelt on the tidal inundation zone to the foreshore of the embankment. Planting of foreshore slopes of embankments with a range of commercial wood, fuel wood, fruit, and other tree, palm and grass species utilizing participatory social forestry practices will support the livelihoods needs of landless, marginalized and poor villagers, including women.

107. Afforestation will commence after mapping and demarcation of BWDB land ownership and land acquisition, competing land-uses (shrimp and fish ponds, rice paddies, livestock grazing, settlements) and completion of earthworks in restored and new embankments. The afforestation component will adopt pro-poor, community participation approaches to encourage ownership and benefit sharing to achieve social, environmental and economic sustainability. A time bound afforestation implementation plan and associated maps will detail: i) a schedule of gross and net afforestation areas (accounting for competing land-uses and other constraints) by afforestation types (mangrove, Golpata, enrichment, mound and slope plantings in social forestry mechanisms), suitable species and purpose (protective or productive); ii) the logistical, technical, social and environmental issues related to the afforestation; and iii) the physical inputs, productivities, costs, yields, revenues and benefit sharing (where appropriate). The afforestation implementation plan and maps will facilitate planning for the selection of beneficiaries and the targeting of community awareness programs, beneficiary training programs and the mobilizing of operational activities for seed collection, nursery location and seedling production, commencing up to a year in advance of planting. Additionally, the site preparation, planting, tending, maintenance, protection and harvesting operations will be scheduled for the most appropriate seasonal conditions.

108. The afforestation will include Golpata, Enrichment, Keora and Baen and Mound plantation types on the foreshore and Social Forestry on the embankment slope.

Afforestation Type	Purpose	Species
Nypa (Golpata) on foreshore	Embankment protection belt, Frond harvest Yr 5+	*Nypa fruticans* (Golpata)
Enrichment Plantation on foreshore	Foreshore embankment protection, no harvest allowed	*Excoecaria agallocha* (Gewa), *Aegiceras corniculatum* (Kholshi), *Avicennia alba* (Shada Baen), *Avicennia marina* (Moricha Baen), *Avicennia officinalis* (Baen), *Bruguiera cylindrical* (Kakra), *Bruguiera parviflora* (Kakra), *Bruguiera gymnorrhiza* (Kakra), *Bruguiera sexangula* (Kakra), *Ceriops decandra* (Goran), *Cynometra ramiflora* (Shingra), *Heritiera fomes* (Sundri), *Nypa fruticans* (Golpata), *Hibiscus tiliceus* (Bolla), *Rhizophora mucronata* (Jhana), *Xylocarpus moluccensis* (Pasur), *Xylocarpus granatum(*Dhundul),
Keora and Baen Mangrove Plantation on foreshore	Foreshore embankment protection, no harvest allowed	*Sonneratia apetala (*Keora*)* and *Avicennia alba*, *Avicennia marina, Avicennia officinalis (*Baen)
Mound Plantation on foreshore	Foreshore embankment protection, no harvest allowed	*Acacia sinegal and Acacia nilotica (*Babla), *Casuarina* spp. (Jhaw), *Cynometra ramiflora (*Shingra), *Eugenia* spp. (Puti Jam) *Phyllanthus emblica (*Amloki), *Pongamia pinnata (*Koroj), *Tamarindus indica (*Tatul), *Terminalia arjuna (*Arjun), *Terminalia catappa (*Katbadam)
Social Forestry Plantation on Embankment Slope	Embankment protection, harvest non wood forest products (fruits, etc.)	Lower Slope: *Tamarindus indica* (Tatul) and *Acacia nilotica* (Babla), Upper Slope: *Borasus flabellifer* (Tal), *Phoenix sylvestris* (Khajur) & *Cocos nucifera* (Narikal).

109. The afforestation footprint from evaluation of the 4 polders that will constitute the first patch of rehabilitation and 39/2C included: Slope, 83.1 hectares and Foreshore, 52.0 hectares, Total, 135 hectares, scattered in fragmented, small areas along the foreshore and embankment slopes. Based upon survey of the 5 polders the Foreshore afforestation area was extrapolated for the other 12 polders assuming: the same foreshore area/kilometer ratio (0.19564). The estimations for Embankment Slope afforestation were extrapolated from the BWDB polder maps by the preparatory team. The afforestation estimates for the 17 polders include: Embankment Slope, 207 hectares, Foreshore, 122 hectares, Total, 329 hectares.

Polder No	Polder Length (km)[40]	Embankment Slope Afforestation (ha)[41]	Foreshore Afforestation (ha)[42]	Total Afforestation Slope + Foreshore (ha)
Survey				
32	49.5	16.4	19.0	35.4
33	52.5	19.0	22.7	41.7
35/1	62.5	22.0	3.8	25.8
35/3	40.0	14.4	6.5	20.9
39/2C	61.5	11.3	0	11.3
Sub-total	**266.0**	**83.1**	**52.0**	**135.1**
Extrapolation				
14/1	30.5	11.4	6.0	17.4
15	30.8	0	6.0	6.0
16	45.0	15.2	8.8	24.0
17/1	38.5	22.0	7.5	29.5
17/2	11.0	6.3	2.2	8.5
23	37.0	11.8	7.2	19.0
34/3	16.8	9.2	3.3	12.5
40/2	35.6	10.1	7.0	17.1
41/1	33.8	13.2	6.6	19.8
43/2C	25.7	8.4	5.0	13.4
47/2	17.6	6.3	3.4	9.7
48	37.9	9.5	7.4	16.9
Sub-total	**360.2**	**123.4**	**70.4**	**193.8**
TOTAL	**626.2**	**206.5**	**122.4**[43]	**328.9**

Source: Preparatory Team and BWDB

110. The afforestation types for the 17 polders were estimated on the same afforestation type ratios calculated for the 5 surveyed polders (32, 33, 35/1, 35/3 and 39/2C) i.e. Golpata, 43.6%; Enrichment, 25.2%, Mangrove (Keora and Baen), 13.3% and Mound, 17.9%). The estimation of Foreshore afforestation types as detailed in the table below include: Golpata 53.4 hectares, Enrichment, 30.8 hectares, Mangrove (Keora and Baen), 16.3 hectares, Mound 21.9 hectares and Total, 122.4 hectares.

Afforestation Type	5 Surveyed Polders (ha)	Ratio %	Extrapolated 17 Polders (ha)
Golpata	22.7	43.6	53.4
Enrichment	13.1	25.2	30.8
Mangrove (Keora, Baen)	6.9	13.3	16.3
Mound	9.3	17.9	21.9
Total	**52.0**	**100.0**	**122.4**

Source: Extrapolated by Preparatory Team and BWDB

[40] Based upon BWDB maps
[41] Based upon Preparatory Consultant's calculations from maps
[42] Based on survey of 5 polders (32, 33, 35/1, 35/3 and 39/2C) to extrapolate for remaining polders using same ha/km ratio = 0.19564
[43] Foreshore afforestation types in same % ratio as the 5 surveyed polders (32, 33, 35/1, 35/3 and 39/2C)

111. The project will establish temporary **nurseries** in close proximity of foreshore afforestation sites for mangrove species *Keora (Sonneratia apetala), Baen (Avicennia officinalis), Chaila/Ora (Sonneratia caseolaris), Kankra (Bruguiera gymnorhiza), Gewa (Excoecaria agallocha), Bhola (Hibiscus tiliaceous) and Golpata (Nypa fruticans)*. The foreshore will be surveyed, demarcated and mapped to match mangrove species with preferred tidal inundation throughout the year, regular silt deposition and natural drainage. An indicative foreshore operational implementation plan will schedule seed collection and seed extraction (August-September), nursery management and seedling production (8-12 months depending upon species), planting (June-August) and subsequent silviculture and protection. As the principle aim of the mangrove greenbelt is protection, except for *Golpata*, which gives an annual return after 4-5 years, harvesting of forest products from mangrove species will be restricted. Local communities will be engaged in all stages of planning and implementation of the foreshore activities. There will be direct benefits from employment in seed collection, nursery management, planting, silviculture and protection, and additional indirect benefits will result from the protection that the greenbelts provide to the embankments, aquaculture, agriculture, social forestry and communities.

112. The seed collection and seed treatments are time bound and specific to species as illustrated below:

Species Name	Seed Collection	Special seed treatment
Sonneratia apitala (Keora)	After spring tide, 1st 2weeks of September	Rot the fruit and clean seeds
Sonneratia alba (Keora)	As above	As above
Sonneratia cassiolaris (Ora)	As above	As above
Avicennia officinalis (Baen)	June-July	Hang in running saline creeks and streams
Avicennia marina (Moricha Baen)	As above	As above
Avicennia alba (Shada Baen)	As above	As above
Rhizophora mucronata (Jhana)	August-September	Heap for 2-3 days
Bruguiera cylindrical (Kakra)	June-July	Heap under shade 2-5 days
Bruguiera parviflora (Kakra)	As above	As above
Bruguiera gymnorrhiza (Kakra)	As above	As above
Bruguiera sexangula (Kakra)	As above	As above
Xylocarpus granatum (Dhundul)	As above	Plant immediately seeds from fruits
Xylocarpus moluccensis (Passur)	As above	As above
Aegiceras comiculatum (Kholshi)	July-August	
Excoecaria agallocha (Gewa)	June	
Heritiera fomes (Sundri)	July-August	
Ceriops decandra (Goran)	June-July	
Nypa fruticans (Golpata)	January - April	
Cynometra ramiflora (Shewri)	June-July	
Hibiscus tilliceus (Bolla)	By cuttings in April	
Acacia Senegal (Babla)	March-May	Seeds from fruits immediately and dried
Casuarina spp. (Jhaw)	May-June	Mix seeds with wood ash & kerosene to avoid ants
Eugenia spp. (Putijam)	June-July	
Phyllanthus emblica (Amloki)	November-December	
Pongamia pinnata (Koroj)	By cuttings in April	
Tamarindus indica (Teatool)	February-March	
Terminalia arjuna (Arjun)	December-March	Keep in cow dung:urine (1:16) for 5-12 days
Terminalia catappa (Kat-badam)	June-July	

113. The project will finance greater flexibility and support for **livelihoods** options for the poor and for women in social forestry plantings. A range of indigenous and exotic timber and fruit tree species can be mound at the embankment toe and social forestry and other vegetation (shrubs and grasses) can be planted on the foreshore slopes of embankments. Due to the longer rotation duration for growing trees, plantings will

need to be complemented by alternative income from other land-uses and other livelihood activities. This is particularly important because of the population pressure and competing land-uses, which can be intense, and vary within and between polders. The piloting of Vetiver Grass (*Vetiveria zizanoides)* should be tested as an important species for embankment stabilization and its multiple uses for supporting livelihoods (aromatic oil extraction, weaving, textiles etc). **Social forestry** has already been embraced in many parts of the Khulna, Patuakhali, Barguna and Bagerhat landscapes, but only to a limited extent on the proposed project polders, which are dominated by fishermen and farmers. The project will engage NGOs to adopt participatory planning approaches with local communities, identify beneficiaries, assist in supporting alternative livelihoods options, raise public awareness, facilitate resolution of land-use conflicts and plan and implement nurseries, planting sites and tending of trees. Benefits will be shared in accordance with formulae detailed in the Social Forestry Regulations (2004, updated 2011). Harvesting, trade and transport in timber and non-timber forest products to markets are robust in the region, with good prices being paid for timber, fuel wood and non-timber forest products by larger industrial companies.

114. Success of the afforestation component will depend on the effectiveness of involving **community participation**. The component will finance the transfer of knowledge and technology in all aspects of planning and implementation of afforestation to local government institutions, WMOs, NGOs and community based organizations and village participants. Demonstrations and training in the techniques of scheduling seed collection, nursery management and seedling production, site preparation, planting, silviculture and protection of foreshore and embankment plantings will be provided through extension services undertaken by forestry specialists and NGOs.

115. **Studies** will research fields such as: i) impacts of improved seeds, alternative nursery techniques, seedling handling and the importance of silvicultural tending to increase survival, growth and yields for greenbelt protection and financial benefits to participants in social forestry; ii) impacts of trees (and their roots) on embankment slopes; iii) impacts of protection greenbelts on embankment O&M; iv) afforestation models to include commercial benefits from protection belts of mangrove species; v) siltation dynamics in mangrove greenbelts over time, and implications for mangrove species succession and embankment protection; vi) impacts of social forestry on direct and indirect benefits to participants; vii) resilience of mangrove and social forestry species to adapt to climate change; and viii) propagation and piloting of the management and multiple uses of Vetiver Grass (*Vetiveria zizanoides*) as a species to protect the foreshore slope of embankments.

116. **Scope of the Afforestation component**. Due to the limited landholding of BWDB and the difficulty in implementing such types of projects, this subcomponent will be limited for multiple reasons: (i) Limited availability of land: Afforestation can only be undertaken on BWDB owned land that is available and not subject to encroachment and competing land-uses. In the course of project preparation, surveys have been done and land ownership maps collected for the first four polders and on this basis the land available for afforestation was identified (less than 130ha accounting for both foreshore and slope afforestation); (ii) Difficulty in implementation: The CEIP-I incorporates lessons learnt from the previously Bank-funded CERP[44] project, whereby original objectives were too optimistic and difficulties in implementation limited their achievements. Implementation on the ground was challenged by competing activities (cattle grazing), encroachment and the absence of routine and proper maintenance. While learning from previous lessons, be it the CERP's recommendations or successful social forestry in adjoining communities, the CEIP-1 proposes **a piloting approach** to the forestry component.

[44] Implementation Completion Report (IDA 27830- IDA 27831) on the Coastal Embankment Rehabilitation Project, 2003. Report no 26149. The World Bank.

Component B–Implementation of Social and Environmental Management Frameworks and Plans (US$56 million).

117. **Component B1: Implementation of Social Action Plans (US$3 million).** This component will support consultation with and strengthening of polder stakeholders and beneficiaries. PCs will be strengthen or established in all Polders to determine the competing needs and uses for water resources, and to decide on the operation of hydraulic infrastructure. However, a more intensive and participatory process will be piloted in 4-6 polders to establish WMOs that will be responsible for the operation and minor/routine maintenance works of the polders. The establishment of WMOs will follow a six step process, as identified in the *Guidelines for Integrated Planning for Sustainable Water Resources Management,* published by BWDB in 2008. This process has been piloted effectively under BWDB for three phases, and the steps tested through intensive mobilization in nine polders and through capacity building and technical strengthening of BWDB.

118. Under the CEIP, a six step process will be followed that builds on the experience of the IPSWAM project and will be piloted in between four and six polders. These pilot polders will be selected prior to the development of detailed designs, in order to ensure that the design process remain fully participatory. The period of identification and social mobilization are expected to last about six months to one year, and to be undertaken together with Local Government Institutions and line ministries at the Upazilla level to inform them that the infrastructure in the polder will be rehabilitated and that a pilot program for participatory management will be introduced in these areas. The participatory process will also begin a process of identification of key community organizations, and social mobilization, under which interest groups at the community level will be organized under Water Management Organizations. Once WMOs are fully formed and established, participatory planning will be undertaken to develop (i) an infrastructure rehabilitation plan; (ii) a Sustainable EMP; and (iii) an O&M agreement between the WMA and BWDB. Once the rehabilitation is undertaken, together with the WMO wherever possible, O&M responsibilities will be transferred to the WMO. Major maintenance and emergency rehabilitation will continue to remain the mandate of BWDB. It is envisaged that this component, along with the social afforestation (Component A2) will be implemented through a well-established NGO.

119. **Component B2: Implementation of SMRPF and RAPs (US$49 million).** Polder scheme rehabilitation is a complex process that involves a variety of issues ranging from land acquisition, physical and economic displacement of people and other unanticipated impacts. Generally, there are informal settlers on the embankments as they are safe structures. A SMRPF and a RAP for the first package of investment have been prepared and the RAP has already been disclosed in accordance with Bank guidelines. This component will finance the implementation of RAP, embankment monitoring and public consultation plans. The component will also finance resettlement and rehabilitation of persons adversely affected by the project. It will also support the development of a system to computerize land acquisition and resettlement data with GPS reference and independent institutes will be commissioned to undertake surveys and verify field data in order to guard against improper targeting of beneficiaries and/or false delivery of benefits.

120. **Component B3: Implementation of EMF and EMPs (US$4 million).** An overall EA of the polder system will be undertaken. An EMF for the project has been drafted and EIAs for polders targeted under the first package of investment have already been prepared. This component will finance: (i) the preparation of EIAs for all remaining polders; (ii) the implementation of the EMP and environmental mitigation and enhancement measures; and (iii) the establishment of an environmental monitoring system in BWDB to enable it to track continuous improvement in environmental performance of the polder system. Some of the items under EMP will be integrated with the civil works and included in the budget of Component A1.

Component C- Construction Supervision, M&E of Project and Coastal Zone Monitoring (US$32 million)

121. **Component C1: Detailed Design and Construction Supervision (US$16 million).** About 17 polders will be selected under this project for rehabilitation. Polder upgrading will take place in batches of 3 to 6 polders in each batch. Detail design has been completed for the first batch, while feasibility level analysis has been completed for the remaining batches. This component will finance consulting services for: (i) construction supervision - initially for the first batch and eventually for all packages; (ii) surveys and detail design for all remaining batches including preparation of bid documents; and (iii) surveys prior to construction work.

122. In both the design and supervision stages, community engagement is crucial and this component will encourage community participation. This will include facilitating consultations with local communities in identifying needs and suitable designs of the embankment, as well as with other stakeholders such as local government entities, *upazilla* and union level Government.

123. **Component C2: M&E of Project Impact and Supervision of EMP and RAP (US$4 million).** Setting up effective monitoring and supervision systems is imperative for achieving the intended project outcomes. Traditional M&E mechanisms mostly rely on quantitative indicators measured at periodic intervals and may not fully take into account the perspective of project beneficiaries. Monitoring of the implementation processes in Bank supported projects by non-state actors can fill the gap of information not provided by traditional M&E mechanisms and provide BWDB, beneficiaries and service providers with better understanding of CEIP's effectiveness especially when it comes to resettlement issues and the beneficiaries receiving their entitlements. The objective of the Third Party Monitoring will focus on improving the resource use through utilization of community knowledge and presence. Community feedback can be effective in addressing failures in service delivery, spotting contractor irregularities or in identifying procurement problems. This component will finance consulting services to recruit a Third Party Monitoring firm to continuously monitor project activities and providing feedback to the government and the implementing agency on the project's performance. This includes supervising the implementation of the GAAP, EMP and RAP.

124. **Component C3: Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone (US$12 million).** The Bangladesh Delta and its coastal zone is a crucial region for Bangladesh, and it is subject to a multitude of complex natural phenomena that are not fully understood as of now. The region is experiencing fast paced changes due to changes in river morphology, fluvial processes, human intervention, and climate change. To tackle this knowledge gap and enhance people's understanding of this complex environment, the project will support a comprehensive monitoring and morphological assessment of the Bangladesh Delta. A program to extend the current monitoring systems in Coastal Bangladesh is also essential to generate data, information, and new knowledge for assessments of the effects of multiple drivers on the environment of the coastal zone and guide future design, rehabilitation and improvement requirements. The monitoring will cover sediment rates and composition; erosion rates; SLR; subsidence rates; tidal dynamics changes; river cross section changes and meander migration; shoreline changes; and any relevant geomorphological attributes.

125. This work will be carried out by key institutions in Bangladesh, such as IWM, CEGIS, Dhaka University, BUET, and BWDB, in cooperation and twining arrangements with international institutions and experts in the topic of estuarine and coastal morphology and geomorphology. This twining arrangement is needed to build in house capacity and guide local institutions and experts to improve their understanding of the physical processes of such a complex delta system. The project will support the installation and operation of needed equipment and systems on the ground, technical expertise, provision of advanced technology and equipment, high resolution specialized remote sensing images, and the capability to analyze these images. The project will support procurement of goods, services, and incremental operation costs in carrying out this research and analysis, and the development of databases and information systems that will be made available

widely both within and outside of Bangladesh. In order to institutionalize the knowledge generated under this component, a technical committee will be convened by the planning wing of BWDB and will include senior representation form Planning and Design to review and incorporate findings in policy formulation.

Component D – Project Management, Technical Assistance, Training and Strategic Studies (US$21 million).

126. **Component D1: Project management support and audits**. This component will support BWDB in implementing the project through the establishment of a fully staffed and functioning PMU. As detailed in the Implementation Arrangement (Annex 3), the PMU will be headed by a PD and include: (i) a SECU staffed with a Sr. Environment Specialist, a Sr. Social Specialist, a Sr. Forestry Specialist, a Sr. Review Staff and a Communication Expert; (ii) an Engineering Unit staffed with a Deputy PD, two Executive Engineers and two Assistant Engineers; and (iii) a Procurement and Finance Unit staffed with a Financial Management Specialist, a Procurement Specialist, two accountants and support staff as needed. In addition, the PMU will recruit field office staff in its Khulna, Bagerhat and Patuakhali divisional offices to ensure on the ground day to day implementation of the project.

127. The PMU will be supported by an Independent Panel of Experts (IPOE) consisting of five renowned experts including: i) morphology/river engineering specialist; ii) tidal river management/sediment specialist; iii) geotechnical specialist, iv) social specialist, v) and environment/polderization specialist. The role of the Panel is to provide quality control over the design and implementation of the project. The PMU will also be supported by a Procurement Panel as well as by various consultants. The PMU will also provide secretarial support to the PSC. Funding under this component will cover the costs of consultants, travel, office equipment, meeting costs, audits and any operating costs necessary for project implementation and reporting.

128. **Component D2: Technical Assistance and Training**. This component will fund institutional capacity building, technical assistance and training of BWDB. This will include strengthening the capacity of BWDB's in procurement, financial, contract and project management; environmental and social compliance, water resource management and polder O&M. For example, BWDB's environment unit has posts of four Assistant Chiefs and two Deputy Chiefs to oversee the overall environmental compliance of BWDB implemented projects. In reality, this unit does not have the capacity nor the staff to perform its function. Under this component, the SECU unit established under the PMU will provide training to the BWDB officers responsible for monitoring of environmental compliance. Thus, a smooth transition to BWDB will occur, ensuring environmental compliance during the O&M after project completion. These staff members will be responsible for managing the environmental aspects of the O&M of the polders, its water control structures, and other relevant issues such as protection of key environmental resources of the polders and fish migration.

129. **Component D3: Strategic studies and future project preparation**. In addition, this component will provide resources for strategic studies such as: i) feasibility studies and preparation of designs for the following phases of CEIP; ii) the continuous updating of the strategic polder assessment; iii) a master plan for tidal river management; iv) the development of land policy; and v) cadastral maps for the entire coastal area. This will involve the digitization of cadastral maps and ownership details.

Component E – Contingent Emergency Response (US$0 million).

130. In case of a major natural disaster, the Government may request the Bank to re-allocate project funds to this component (which presently carries a zero allocation) to support response and reconstruction[45]. This

[45] Such a reallocation would not constitute a formal Project Restructuring.

component would allow the Government to request the Bank to cancel project funds from Immediate Response Mechanism (IRM) portfolio projects and designate them as IRM funds to be engaged to partially cover emergency response and recovery costs. This component would be implemented following the rapid response procedures under OP/BP8.00 in combination with the IDA IRM guidelines dated November 3, 2011. In addition to reallocation of funds from other project components, the contingent component may also serve as a conduit for additional funds to be channeled to the project in the event of an emergency. A specified amount could also be earmarked for liquidity support through reimbursement of a pre-identified positive list of good purchased by the state. The resources would be executed through the existing PMU greatly accelerating immediate response and recovery needs

131. Disbursements under a CERC will be contingent upon the fulfillment of the following conditions: (i) the Government of Bangladesh has determined that an eligible crisis or emergency has occurred and the Bank has agreed and notified the Government; (ii) the Ministry of Finance has prepared and adopted the Contingent Emergency Response (CER) Implementation Plan that is agreed with the Bank; (iii) Bangladesh Water Development Board has prepared, adopted, and disclosed safeguards instruments required as per Bank guidelines for all activities from the CER Implementation Plan for eligible financing under the CERC.

132. **Disbursements** would be made either against a positive list of critical goods and/or against the procurement of works, and consultant services required to support the immediate response and recovery needs of the GoB. All expenditures under this component, should it be triggered, will be in accordance with BP/OP 8.0 and will be appraised, reviewed and found to be acceptable to the Bank before any disbursement is made. All supporting documents for reimbursement of such expenditures will be verified by the Internal Auditors of the GoB and by the PD, certifying that the expenditures were incurred for the intended purpose and to enable a fast recovery following the damage caused by adverse natural events, before the Application is submitted to the Bank. This verification should be sent to the Bank together with the Application.

133. **Specific eligible expenditures** under the category of Goods include: (i) construction materials; water, land and air transport equipment, including supplies and spare parts; (ii) school supplies and equipment; (iii) medical supplies and equipment; (iv) petroleum and fuel products; (v) construction equipment and industrial machinery; and (vi) communications equipment. Specific eligible expenditures under the category of Works may include urgent infrastructure works (repairs, rehabilitation, construction, etc.) to mitigate the risks associated with the disaster for affected populations. Specific eligible expenditures under the category of Services may include urgent studies (either technical, social, environmental, etc.) necessary as a result of the effects of the disaster (identification of priority works, feasibility assessments, delivery of related analyses, etc.). Operating costs eligible for financing would include the incremental expenses incurred by the Government for early recovery efforts arising as a result of the impact of major natural disasters.

Project Costs

134. **Project Cost:** The total project cost is estimated at about US$400 million for all the components. Cost by components is provided in Table 2 (Main text) and cost by expenditure category is provided in Table 2.1 below. The cost estimates are based on December 2012 costs with 10% physical contingencies for polders with detail design, 15% physical contingency for polder with only feasibility study, 25% physical contingency for resettlement and about 10% price contingencies in US$ term. Taxes and duties are estimated at around US$40 million equivalent based on prevalent taxes, VAT and duties in April 2013[46].

[46] Goods & Works: Tax = 5% and VAT 5.5%
Services: Tax = 10% and VAT 15%

Project Cost by Category

Table 2.1: Total Project Cost by Category (US$ million)

Project Component	Works	Goods	Consultant Services	Incremental Operating Cost	Training	RAP Compensation	Total
A. Rehabilitation and Improvement of Polders							
A1. Rehabilitation and Improvemet of Polders	286						286
A2. Afforestation	2		2				5
Sub-Total A	**289**		**2**				**291**
B. Implementation of Social and Environmental Mangement Frameworks and Plans							
B1. Implementation of Social Action Plan	1			2			3
B2. Implementation of SMRPF and RAP						49	49
B3. Implementation of EMF and EMPs	2.5	0.4		0.4	0.4		4
Sub-Total B	**3.4**	**0.4**		**2.5**	**0.4**	**49**	**56**
C. Construction Supervision, M&E, Coastal Zone Monitoring							
C1 Construction supervision, detail design, EIA		1.6	14.4				16
C2 Third Party M&E of Project, GAAP, RAP and EMP			4.0				4
C3 Long term coastal zone monitoring, reseach and anlysis		2.4	4.8	2.4	2.4		12
Sub-total C		**4.0**	**23.2**	**2.4**	**2.4**		**32**
D. Project Management, TA, Training, Strategic Studies							
D1 Project management support and audits		3.9	2.6	6.5			13
D2 BWDB strengthening, TA, Training			0.4	0.4	1.2		2
D3 Strategic studies, future project preparation			4.8	1.2			6
Sub-total D		**3.9**	**7.8**	**8.1**	**1.2**		**21**
Total per category	**292**	**8**	**33**	**13**	**4**	**49**	**400**

Annex 2.1: Changing Climate in Coastal Bangladesh

BANGLADESH: COASTAL EMBANKMENT IMPROVEMENT PROJECT PHASE-I (CEIP-I)

Introduction

135. Integration of climate risk information is a prerequisite for planning investment in a changing climate. This annex summarizes the scientific knowledge to date of potential future climate change impacts on the coastal region of Bangladesh. Protection from inundation by riverine flooding and cyclonic surge being the prime objectives of the Coastal Embankment Improvement Project, this assessment focuses on key climatic determinants of flooding in coastal Bangladesh: change in precipitation (rainfall), potential SLR and intensification of cyclonic wind speed in a future climate.

136. The coastal zone in southern Bangladesh is a part of the evolving Ganges-Brahmaputra Delta. The impact of SLR and cyclonic storm surges in coastal Bangladesh will also depend on the process of sedimentation and subsidence of land. This annex, therefore, also addresses the issue of subsidence of land as documented in the relevant literature. This assessment is primarily based on:

- Intergovernmental Panel on Climate Change (IPCC). Climate Change 2007: The Physical Science Basis, Summary for Policymakers.
- Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Huu Ninh, 2007: Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds.,Cambridge University Press, Cambridge, UK, 469-506.
- Synthesis Report- Climate Change: Global Risks, Challenges and Decisions. Copenhagen 2009, 10-12 March. www.climatecongress.ku.dk .
- Precipitation-based derivatives from climate downscaling, as provided by the climatewizard.org website http://climateknowledgeportal.climatewizard.org/ and the World Bank Group's Climate Change Knowledge Portal http://climateknowledgeportal.worldbank.org .
- Sugiyama, M. 2008. Climate Downscaling for Dhaka. Mimeo.
- Dasgupta S., and C. Meisner 2009. Climate Change and Sea Level Rise: A Review of the Scientific Evidence. The World Bank Environment Department Working Paper No. 118.
- http://documents.worldbank.org/curated/en/2009/05/10567848/climate-change-sea-level-rise-review-scientific-evidence-climate-change-sea-level-rise-review-scientific-evidence.
- A synthesis of literature on subsidence of land in coastal Bangladesh as presented in Huq, M. 2012. Climate Change: Factors Influencing Salinity in Bangladesh- A Literature Review. Mimeo.

137. In light of the planning horizon of the CEIP, this annex considers the potential climate and land subsidence changes by 2050. Given **the substantial uncertainties** in projecting future climatic conditions, a number of emission scenarios referred to by the IPCC's Fourth Assessment Report (IPCC AR4), 2007 has been taken into account.

Future Change in Precipitation:

138. Despite significant technical advances in forecasts of global mean temperatures and changes in rainfall patterns for the next two or three decades, uncertainties about future climate variability at sub-continental, country and sub-national scales are still significant (IPCC AR4, 2007). Direct uses of Global

Climate Model (GCM)[47] outputs are not appropriate for forecasting future changes in precipitation at sub-national level due to the coarse spatial and temporal resolution of GCMs. To better understand the implications of climate change, this assessment drew on a collaborative effort between The World Bank, The Nature Conservancy, Climate Central and Santa Clara University to produce statistical downscaled GCM projections for precipitation as provided by the climatewizard.org website http://climateknowledgeportal.climatewizard.org/ and the World Bank Group's Climate Change Knowledge Portal http://climateknowledgeportal.worldbank.org.

139. Annual forecasts for *Maximum 5-day precipitation total per year* and *Total precipitation for the year* were derived on a spatial grid of 0.5° in latitude by 0.5° in longitude (approximately 50 km by 50 km) and aggregated for the *Coastal* Bangladesh for the time periods 1961-1999 and 2046-2065. To capture the uncertainty of the extent of climate change nine different GCMs[48], some with multiple runs among three different greenhouse gas emission scenarios (SRES A1B, A2, B1)[49] were considered. In statistical downscaling the daily timescale Bias-Corrected Spatial Disaggregation (BCSD) method[50] was used. The downscaling, bias correction and trend preservation used historically observed daily meteorological observation.[51] Table 2.1.1 summarizes the percentage change in the *future* (2046-2065) average of the precipitation variable from the *historic* (1961-1999 baseline) average and the level of statistical confidence for the predicted change.

[47] These numerical coupled models represent various earth systems including the atmosphere, oceans, land surface and offer considerable potential for the study of climate change and variability.

[48] CCCMA-GCM3.1: Canadian Centre for Climate Modeling and Analysis; CNRM-CM3 : Centre National de Recherches Météorologiques, Météo France, France ; ECHAM5/MPI-OM: Max Planck Institute for Meteorology, Germany; ECHO-G: Germany/Korea: Meteorological Institute of the University of Bonn (Germany), and Institute of KMA (Korea), and Model and Data Group; GFDL-CM2.0 and CM2.1: Geophysical Fluid Dynamics Laboratory, NOAA, USA; IPS-CM4L: Institut Pierre Simon Laplace, France ; MIROC-MIROC3.2: CCSR/NIES/FRCGC, Japan; MRI-CGCM2.3.2, Meteorological Research Institute, Japan.

[49] **A1B** is a scenarios characterized by rapid economic growth, a global population that reaches 9 billion in 2050 and then gradually declines, quick spread of new and efficient technologies, a convergent world - income and way of life converge between regions, extensive social and cultural interactions worldwide; and a balanced emphasis on all energy sources. **A2** scenarios are characterized by a world of independently operating, self-reliant nations, continuously increasing population, and regionally oriented economic development. **B1** scenarios are characterized by rapid economic growth as in A1, but with rapid changes towards a service and information economy, population rising to 9 billion in 2050 and then declining as in A1, **r**eduction**s** in material intensity and the introduction of clean and resource efficient technologies, an emphasis on global solutions to economic, social and environmental stability.

[50] The monthly version of this method is described by Wood et al. (2002 and 2004). A daily variant of the BCSD similar to that of Abatzoglou and Brown (2011) was used.

[51] For details, see http://climatewizardcustom.org/WorldBank/Global_Daily_Downscaled_Climate_Data_Guidance_Note.pdf

Table 2.1.1: Projected percentage change in future (2046-2065) average precipitation from historic (1961-1999) average in Coastal Bangladesh and corresponding level of statistical confidence[1]

Maximum 5-day rainfall				Total Precipitation for the year		
GCM	Emission Scenario			Emission Scenario		
	A1B	A2	B1	A1B	A2	B1
cccma_cgcm3_1.1	6.66 (0.61)	10.63 (0.75)	8.98 (0.74)	16.56* (0.99)	14.96* (0.99)	17.33* (1.00)
cccma_cgcm3_1.2	17.19* (0.96)	27.60* (1.00)	14.83* (0.93)	13.92* (0.99)	10.80* (0.98)	11.89* (1.00)
cccma_cgcm3_1.3	12.82 (0.84)	24.01* (0.99)	16.70* (0.94)	8.21* (0.99)	22.98* (1.00)	14.51* (1.00)
cnrm_cm3.1	35.71* (1.00)	25.90* (1.00)	11.85 (0.87)	15.71* (1.00)	1.54 (0.20)	4.52 (0.66)
gfdl_cm2_0.1	4.77 (0.40)	8.70 (0.64)	15.09* (0.92)	-6.05 (0.74)	-15.68* (1.00)	-1.75 (0.25)
gfdl_cm2_1.1	23.41* (0.96)	31.96* (0.98)	20.03* (0.97)	-8.37 (0.88)	-4.47 (0.50)	2.87 (0.43)
ipsl_cm4.1	10.69 (0.71)	10.69 (0.77)	10.86 (0.64)	1.41 (0.18)	-10.61* (0.90)	-6.58 (0.68)
miroc3_2_medres.1	13.31* (0.95)	11.64 (0.84)	8.37 (0.75)	24.81* (1.00)	24.71* (1.00)	11.46* (0.98)
miroc3_2_medres.2	8.56 (0.86)	2.74 (0.29)	9.64 (0.74)	23.81* (1.00)	5.57 (0.81)	16.02* (1.00)
miub_echo_g.1	18.54* (0.98)	10.69 (0.86)	15.84* (0.96)	19.28* (1.00)	1.18 (0.31)	8.14* (1.00)
miub_echo_g.2	20.99* (0.99)	14.88* (0.93)	21.74* (1.00)	17.96* (1.00)	6.54 (0.88)	15.44* (1.00)
miub_echo_g.3	18.35* (1.00)	6.84 (0.69)	5.99 (0.57)	20.07* (1.00)	7.48* (0.95)	10.13* (1.00)
mpi_echam5.1		13.58 (0.88)	18.56* (0.94)		17.93* (1.00)	20.14* (1.00)
mri_cgcm2_3_2a.1	12.74* (0.91)	7.03 (0.67)	-0.73 (0.09)	7.26 (0.85)	10.28* (0.99)	5.65* (0.90)
mri_cgcm2_3_2a.2	10.78 (0.87)	-2.79 (0.32)	10.56 (0.77)	16.12* (1.00)	3.26 (0.51)	9.29* (0.96)
mri_cgcm2_3_2a.3	3.03 (0.29)	10.75 (0.80)	10.20 (0.84)	8.58* (0.94)	8.79* (0.91)	6.20 (0.86)
mri_cgcm2_3_2a.4	-2.43 (0.30)	1.55 (0.16)	3.13 (0.35)	3.14 (0.57)	-5.61 (0.87)	0.07 (0.01)
mri_cgcm2_3_2a.5	-2.21 (0.22)	12.32 (0.84)	4.42 (0.46)	-1.16 (0.22)	11.27* (0.99)	0.06 (0.02)

140. It should be noted that all GCMs do not agree on the direction of change in future precipitation in Coastal Bangladesh, and much less on the magnitude in either direction. However, all GCMs - at 90 percent or higher statistical confidence level, agree that extreme precipitation events (as proxied by Maximum 5-day rainfall) will increase in the region in the future time period of interest.

141. Since different GCMs have very different views of future prospects even for a particular area, use of future projections from a single GCM for any emission scenario is not generally recommended (IPCC 2007). Instead, an ensemble analysis is suggested to quantify the range of possibilities. Table 2.1.2 summarizes two

alternative ensembles[52] of *Maximum 5-day rainfall* from the GCMs with 90 percent level of statistical confidence or more. Since all the GCMs agree that the Maximum 5-day rainfall will increase, the ensemble indicates magnitudes of the increment.

Table 2.1.2: Ensemble of GCM forecasts of *Maximum 5-day rainfall* for *Coastal* Bangladesh from estimates with 90 percent or higher level of statistical confidence

	Percentage change in future (2046-2065) of *Maximum 5-day rainfall* from historic (1961-1999) average		
	Emission Scenario		
	A1B	A2	B1
Simple average ensemble	20.03	24.87	17.54
Non-parametric: Quantile (Median) Ensemble	18.45	25.90	16.70

In light of the above, the preparation of the CEIP assumed a 20 percent increase in extreme precipitation by 2050.

Future Sea-level rise:

142. There is a scientific consensus that SLR will continue for centuries even if greenhouse gas concentrations were to be stabilized today. Situated in the delta of Ganges, Brahmaputra and Meghna rivers, topography of Bangladesh is extremely low and flat. Two-thirds of its land area is less than 5m above sea level. Low-lying coastal districts along the Bay of Bengal, in particular, are vulnerable to SLR.

143. While there is widespread agreement among scientists that sea levels will continue to rise due to climate change, estimates vary. Furthermore, regional estimates of SLR are scarce at present.

144. The IPCC AR4 report projected increased global SLR between 0.18m and 0.59m across various emission scenarios over the next 100 years.[53] These projections, however, are calculated from projections of SLR due to thermal expansion, melting of glaciers - with the Greenland and Antarctic ice sheets calculated as being close to mass balance; and **exclude** rapid dynamical changes in ice flow (Reference: IPCC, 2007-Working Group Report "The Physical Science Basis"). Hence, it should be noted that SLR estimates by IPCC AR4 are conservative.

145. The scientific literature since the publication of IPCC AR4 in 2007 suggests that global SLR could reach 1 meter or more during this century (for example, Hansen and Sato 2011; Nicholls et al. 2011; Grinsted, Moore and Jevrejeva 2010; Vermeer and Rahmstorf 2009; Pfeffer et al. 2008; Kerr 2008; Hansen 2007; Rahmstorf 2007; Overpeck et al. 2006; Hansen 2006) [54]. See Table 2.1.3. These results focused on the dynamic implications of ice sheet instability and produced estimates significantly beyond the upper limit of the range cited by the IPCC's Fourth Assessment Report (2007): a 90% confidence interval of 18-59 cm based principally on thermal expansion, with an additional 10-20 cm or more allowed for a potential dynamic response from the Arctic and Antarctic ice sheets.

[52] There are numerous ways of conducting ensemble analysis.
[53] IPCC AR3 suggested a SLR of 0.09 to 0.88 m by the year 2100 unless greenhouse gas emissions are reduced substantially (IPCC, 2001).
[54] For a review of scientific literature on sea-level rise, see Dasgupta and Meisner 2009.

Table 2.1.3: Illustrative examples on SLR Projections in recent literature

Source	Year	Projection of Mean SLR
Nicholls et al. (2011)	2100	0.5m -2m
Grinsted, Moore and Jevrejeva (2010)	2090-2100	0.9m – 1.3m
Vermeer and Rahmstorf (2009)	2090-2100	0.75m - 1.9cm
Jensen and Stefan (2009)	2100	1m ± 0.5m
Pfeffer, Harper and O'Neel (2008)	2100	0.8m - 2m
Horton et al. (2008)	2100	0.54m - 0.89m
Rahmstorf (2007)	2100	0.5m - 1.4m

146. The most recent evidence suggests the seasonal temperature variation in Greenland Ice Sheet[55] is causing widespread melting in the interior and through the discharge of icebergs and small ice-shelves (Jensen and Steffen 2009; Tedesco 2007). Satellite images are also showing Arctic sea ice in summer is in sharp decline in recent years, hitting the lowest record ever measured. This reduction in ice coverage has significant implications for global climate, as an ice-free ocean absorbs more heat as compared to an ice-covered ocean and creates a feedback in the climate system that increases warming (http://www.nrdc.org/globalwarming/qthinice.asp). The updated estimates of the future global SLR are now almost double the IPCC AR4 projections (Dahl-Jensen 2009, as cited in the Synthesis Report- Climate Change: Global Risks, Challenges and Decisions; Copenhagen 2009).

In the absence of a scientific SLR estimate for the Bay of Bengal near the coast of Bangladesh, the CEIP adopted 0.5m SLR by 2050 assuming a liner progression over time for the 1m SLR by 2100 predicted in the Synthesis Report- Climate Change: Global Risks, Challenges and Decisions; Copenhagen 2009 (Box 1, Page 9).

Land subsidence

147. The predicted acceleration in sea-level, as discussed in the previous section, can have more serious implications for the coastal regions of Bangladesh depending on the local land subsidence[56,57]. The Ganges-Brahmaputra Delta, where Bangladesh is located, lies at the junction of the Indian, Eurasian and Burma tectonic plates. Land subsidence in coastal Bangladesh (and the lower Bengal delta in general) is mainly caused by tectonic subsidence and isostatic adjustments, sediment loading, compaction of Holocene sediments, compaction of peat layers, withdrawal of water and surface water drainage and management. A literature review was conducted to compile available estimates of land subsidence of coastal Bangladesh. Estimates vary widely from a fraction of a millimeter to a few centimeters per year. See Table below.

[55] Greenland Ice Sheet contains enough water to raise sea level by 7m.
[56] Subsidence is defined as a relative decrease in elevation relative to a datum.
[57] For any delta, effective sea-level rise is defined by the combination of eustatic sea-level rise, the natural gross rate of fluvial sediment deposition and subsidence, accelerated subsidence due to groundwater and hydrocarbon extraction (Ericson et al. 1006).

Table 2.1.4: Estimated Land Subsidence Rates by Various Sources

Source	Area	Subsidence Rate (mm/year)
Nicholls and Goodbred (2004)	Bengal Delta	0.1 – 0.4
Brammer (1996)	Patuakhali, Gopalganj and Khulna	<1.0
CEGIS (2010)	Bangladesh excluding Sylhet	1
Dhaka University Earth Observatory *	Khulna	9.55
Dhaka University Earth Observatory (2012)*	Khulna, Patuakhali Chittagong	13.94±1.14 9.16±1.10 2.31±1.38
Syvitski et al. (2009)	GBM Delta	8 - 18
Pethick (2012)	Hiron Point Mongla and Khulna	12 26 19

* correspondence between Mr. Syed Humayun Akhter and Mr. Ranjit Galaps. Source: Huq M. 2012

In light of these widely varying estimates of land subsidence[58], the preparation of the CEIP did take into account a potential subsidence of land by 9.55 mm per year as per the measurement of Dhaka University Earth Observatory at Khulna as cited in Table 2.1.4.

Cyclone Intensification

148. Trends in sea surface temperature are indicating a significant increase over time (IPCC 2007). Furthermore, recent estimates are showing ocean warming is 50 percent greater than the reports of the IPCC AR4 (Church et al 2009; Domingues et al. 2008). A sea-surface temperature of 28^{o} C is considered an important threshold for the development of major cyclones/ hurricanes of categories 3, 4 and 5 (Michaels, Knappenberger, and Davis 2005; Knutson and Tuleya 2004).

149. Although the science is not yet conclusive on whether intensities of tropical cyclones have changed or will change with global warming (Bengtsson, Rogers, and Roeckner 2006; Landsea et al. 2006; IWTC 2006; Emanuel 2005; Pielke et al. 2005; Webster et al. 2005;), the International Workshop on Tropical Cyclones (IWTC) has recently noted that *"[it] is likely that some increase in tropical cyclone peak wind-speed and rainfall will occur if the climate continues to warm. Model studies and theory project a 3-5% increase in wind-speed per degree Celsius increase of tropical sea surface temperatures*." The IPCC (IPCC AR4, 2007) using a range of model projections, has also asserted a probability greater than 66% that continued sea-surface warming will lead to tropical cyclones that are more intense, with higher peak wind speeds and heavier precipitation (IPCC 2007; see also Woodworth and Blackman 2004; Woth, Weisse, and von Storch 2006; and Emanuel et al. 2008). The Special Report of the IPCC on extreme weather events has also reemphasized that "Average tropical cyclone maximum wind speed *is likely* to increase, although increases may not occur in all ocean basins" (IPCC, 2011).

150. For the Bay of Bengal, a study using dynamical models driven by Regional Climate Model simulations of current and future climates have shown large increases in the frequency of highest storm surges despite no significant change in the frequency of cyclones (Unnikrishnan et al, 2006). Tropical cyclone simulations with four general circulation models for the A1B emission scenario conducted by Emanuel projects increased intensity of tropical storms by 2100 for the North Indian Ocean, as measured by the percent

[58] In reality, there is a raging controversy in Bangladesh regarding estimates and projection of land subsidence in the coastal region.

change in landfall power using the Model for Interdisciplinary Research on Climate (MIROC) General Circulation Model (World Bank and United Nations 2010).[59] Hence, from a practical perspective vulnerability of Bangladesh to cyclones and storm surges may increase even more as a result of climate change.

The CEIP assumed an increase of 10 percent tropical cyclone intensities for a rise in sea surface temperature of 2° C relative to the current threshold temperature projected for South Asia as has been specified in the IPCC AR4 (Cruz et al. 2007, Page 479) following Knutson and Tuleya, 2004.

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Annex 3: Implementation Arrangements

BANGLADESH: COASTAL EMBANKMENT IMPROVEMENT PROJECT PHASE-I (CEIP-I)

A. Project Institutional and Implementation Arrangements

151. **Overall Project Management**. The proposed project implementation arrangements are shown in Figure 1. The Government of Bangladesh has the overall responsibility for project management and coordination through its MoWR. A PSC would provide the forum for overall guidance, policy advice and coordination of the project activities and addressing the inter-agency issues. BWDB will act as the *Project Implementing Agency* and will implement the project through a PMU.

152. **PSC**. The PSC will be chaired by the Secretary of the MoWR and comprise representatives of the MoWR, BWDB as well as ministries and agencies responsible for finance, planning, implementation monitoring, agriculture, environment, local government and forestry, representatives of districts where the embankments rehabilitated under the Project are located, and representatives of civil society and academia. The PSC will oversee the project; provide policy-level guidance and inter-agency coordination for the project. The PD of the PMU will act as the secretary of the PSC.

153. **PMU/PD.** BWDB will set up a PMU to oversee the development and management of the project. The PMU, will be led by a PD appointed by BWDB. The PD will have preferably the rank of Chief or Additional Chief Engineer, and will report directly to the DG. The PD must have at least a Master degree in civil/water resources and have substantial experience (10 years) both in planning and implementing water resources projects and managing donor funded projects. The PMU will have a central project office located at the headquarters of BWDB in **Dhaka**. The PMU will have 3 subordinate units: (i) Engineering Unit; (ii) Procurement and Finance Unit; and (iii) SECU. In addition to the central unit in Dhaka, 3 *Field Level Offices* will be set up, each headed by an Executive Engineer, recruited by the project. The Field Offices will be located in each of the three main project districts, namely **Khulna**, **Patuakhali/Barguna**, and **Bagerhat**. The central and field offices will also have all needed support staff (assistants, drivers, etc) and logistics. The need for professional staff will be reviewed jointly with IDA during the course of project implementation.

154. **The Procurement and Finance Unit:** The financial unit will be responsible for the entire financial management process of the project. However procurement unit will be responsible for all procurement except large value contracts as specified in the procurement plan. Procurement Panel will be responsible for these large value contracts. The procurement unit will also be responsible for monitoring project progress, to liaise with the Bank, and to prepare annual programs, implementation reporting, updating all procurement reporting documents and financial management reporting. The Procurement and Finance Unit will consist of a procurement specialist, a financial specialist, a deputy director finance/account officer, two accountants and support staff.

155. **The Engineering Unit** will oversee the work of the consultants on design and construction supervision matters. A Deputy PD will head the *Engineering Unit* and will spend about half of his/her time at the site to provide coordination between the PMU, the supervising consultant and the three Field Offices. In addition to the Deputy PD, the engineering unit will also include two Executive Engineers, two Assistant Engineers as well as all needed logistics.

156. **The SECU** will supervise compliance with the EMP and Social Action Program and together with the engineering unit implement the communication strategy. The unit will include a Sr. Environmental Specialist, a Sr. Social Specialists, a Sr. Forestry Specialist a Revenue Staff and a Communication Specialist.

157. **Each Field Office** will be staffed with one Project Manager/Executive Engineer (Xen), two Sub-Divisional Engineer (SDE) and two Assistant Engineers (AE). It will also be furnished will all needed logistics. In addition, an environmental specialist, two social specialists and a revenue staff will work across all three field offices.

158. **The PMU will be supported by** the following consultancy:

a. An *Experienced NGO* will be mobilized by the PMU to implement the social afforestation the EMP [Component A2] and the Social Action Plan including the mobilization of Water Management Organization [Component B1].
b. A *Design and Construction Supervision Consultancy* Firm [Component C1] that will assist the PMU in preparing the detail design of the remaining polders and supervise all the construction. For civil works contracts, the PD will serve as the *Employer*, and the Project Supervision Consultant will serve as the *Engineer* for construction supervision. At the site, a *Resident Engineer*, appointed by the consultant, with a team of specialists and inspectors will supervise the Contractor. The firm will also be responsible for preparing the EIAs of the remaining polders and for implementing the EMP [Component B3]. It will also be responsible for implementing the RAP [Component B2] most likely via a reputable NGO.
c. A *Monitoring and Evaluation* Consultants [Component C2] will provide support in monitoring project impacts and supervise the implementation of the EMP/RAP and will report to the PMU.
d. *A Procurement Panel* will be appointed by BWDB to help the procurement process of large value contracts as specified in the procurement plan under the project. The panel consists of two international/expatriate and one national consultants.
e. *An Independent Panel of Expert (IPOE).* BWDB will also appoint an IPOE to act as an independent "peer reviewer" and undertake quality control functions of various technical outputs. The Panel will consist of 5 renowned experts in the field of: coastal, estuarine and river morphologist; sediment/ tidal management expert; design expert in embankment and hydraulic structures; social expert and environment, water management and polder expert.

B. Financial Management, Disbursements and Procurement

Financial Management

159. BWDB has well documented financial regulations and procedures and internal control measures in financial management but strict adherence needs to be reinforced by its management. BWDB has the experience of implementing a number of Bank and other donor financed projects. Its finance wing is headed by an Additional Director General (Finance) who is supported by a Controller (Finance & Accounts) who oversees the three core financial management functions – finance, accounts and audit. Preparation of budgets, exercise of budgetary control and fund management and placement are carried out by Director (Finance). Director (Accounts) performs the disbursements and accounting functions through his headquarter units and 25 Regional accounting Centers (RACs). Director (Audit) takes care of internal audit functions through head office based audit staff.

160. BWDB Accounting System has passed through a modernization process under a CIDA-assisted project. It has been operating a computerized accounting system for the last few years in recording, processing and report generating. The chart of accounts is well designed and flexible enough to facilitate recording of all present and prospective BWDB operations and development projects and generating the reports, as required.

161. ***FM staffing.*** BWDB will identify a FMS for the project before singing the financing agreement so that signing the contract with the FMS can happen as soon as the project is declared effective. The ToR of the FMS will be sent to the bank for its review and acceptance before starting the selection process. The FMS must be a qualified chartered accountant/ cost and management accountant / chartered certified. A Deputy PD (Finance) will be appointed or deputed by BWDB in the PMU to ensure efficient performance of financial management functions of the project. S/He will report to the PD and will be assisted by two Accounts Officer and a Cashier/Sr. Accounts Assistant to be assigned by BWDB from amongst its existing staff experienced in Bank financed projects, otherwise they will be hired through competitive selection procedure acceptable to the Bank.

162. ***Special Account*** Two separate designated accounts (CONTASA) will be opened for implementing this project upon signing the financing agreement, one for the IDA credit and one for the PPCR Grant. Selection of the local bank to operate the special account shall have to be acceptable to the World Bank.

163. ***Payments*** All payments will be made directly by the PD from the PMU; no payments are anticipated to be handled through the divisional/regional offices. 100% beneficiary bank accounts will be opened for resettlement payments. In this respect no cash payment or cash cheek will be issued. Resettlement payments will be shown as an individual category of expenditure in the financial statement.

164. ***Interim Un-audited Financial Report (IUFR).*** The PMU will prepare an IUFR, in the format provided by the Bank, on a quarterly basis and submit it to the World Bank review within 45 days from the end of each quarter.

165. ***Accounting system*** the accounting system of BWDB will be used for accounting and reporting project expenditures. If BWDBs accounting software becomes unable to produce IUFRs, the PMU shall install and operationalize an off the shelf accounting software to produce timely and accurate financial reports. BWDB shall test run the existing software to see whether the IUFRs can be generated; otherwise the decision to buy off the shelf software will be taken as soon as the financing agreement is signed.

166. ***Annual audit of the financial statement.*** The Foreign Aided Project Audit Directorate (FAPAD) of the Auditor & Comptrollers Generals office (C&AG) shall carry out the annual financial statement audit of the project. Audited project financial statements will be submitted to the Bank within six months from the close of each fiscal year until the close of the credit.

167. ***Performance Audit.*** One independent performance audits, including review of the financial management system and verification of procurements will be carried out by a firm of Chartered Accountants. The performance audit will be carried out two years before the credit closing date. The process of selecting such auditors and TOR(s) for such audits will be agreed with the Bank during the selection process.

168. ***Internal audit*** will be carried out by the Internal Audit wing of BWDB and the report shall be submitted to the Bank within 15 days of receipt of such report by the project.

169. ***Project Audit Committee*** A project audit committee shall be established within the PMU to follow up the implementation of valid audit recommendation. This committee shall be chaired by an individual independent of the operation of the project and it will consist of no less than 3 people including the Chairman and the PD. The Committee shall sit within every 120 days and minute the decisions and discussion held. These minutes will be shared with the Bank within 15 days from the date of the meeting takes place.

170. ***Financial Management Procedures.*** The Project will follow the Public Works Department (PWD) Accounts Code/Manual with updating (BWDB system). Should it become necessary, the PMU will prepare a

separate FM Manual for the project. The FM manual will be aligned with the BWDBs mainstream financial management and ensure the compatibility with the agreed funds flow arrangement. The FM Manual will be reviewed by the Bank.

Disbursement

171. ***Flow of Funds and Designated Account (DA)*** Funds will be disbursed through two DAs (CONTASA) (One for IDA Credit and one for PPCR TF Grant) to be established with the PMU for the Project. In order to further simplify processes, report-based disbursements' using the Interim Unaudited Financial Reports (IUFRs) will serve as the basis for withdrawal of funds from the Loan. Quarterly IUFRs will be used as a basis for disbursement. BWDB is currently using IUFRs as the basis for disbursements in two Bank financed projects: *Water Management Improvement Project* and *Emergency Cyclone Recovery and Restoration Project.* Advances would be made to the DA based on six months projections. The Funds from the Loan will be transferred to any commercial bank as having adequate experience (in maintaining such accounts), acceptable to IDA. PMU would be managing the DA. The approved Government procedures governing the establishment of DAs shall be followed in all respects. Direct payment method would also be allowed to process large payments to the contractors/ consultants, particularly those in foreign currency to avoid exchange loss.

Table 3.1: Indicative Allocation of Credit Proceeds (US$ Million)

	Total Amount	IDA Amount	PPCR Amount	Financing Percentatge
1. Works	292	272	20	100%
2. Goods & non consulting services	8	7	1	100%
3. Consulting Services	33	29	4	100%
4. Land Acquisition, Resettlement and Compensation	49	49		100%
5. Incremental Operating Cost & Training	17	17		100%
6. Emergency expenditures	0	0		
Total	**400**	**375**	**25**	

Note: -The legal agreement will have a single disbursement category containing all of the above eligible expenditure; above is an indicative allocation of funds from the credit and PPCR
- Taxes and duties will also be financed from the Credit and PPCR.
- In case of an emergency the Government may request to Bank to re-allocate project funds to the "emergency expenditures" category to support response and reconstruction in accordance with the IRM Guidelines.

Procurement

172. Procurement for the proposed project would be carried out in accordance with the World Bank's "Guidelines: Procurement Under IBRD Loans and IDA Credits" dated January 2011 (Procurement Guidelines); and "Guidelines: Selection and Employment of Consultants by World Bank Borrowers" dated January 2011 (Consultant Guidelines)) and the provisions stipulated in the Financing Agreement.

173. All expected major procurement of works and consultants' services will be announced in the General Procurement Notice (GPN), published in the Bank external website and United Nations Development Business (UNDB).

174. *Procurement Responsibility*: The overall responsibility of project implementation would be with the BWDB.

175. *Particular Methods of Procurement of Goods and Works:* Except as otherwise agreed in the procurement plan, works and goods may be procured on the basis of ICB. Procurement of Goods and Works having estimated value less than the ceiling stipulated in the Procurement Plan may follow National Competitive Bidding (NCB) and Shopping. Direct Contracting (Goods/Works) and Single Source Selection (Consultants) may be allowed under special circumstances with prior approval of the Bank. NCB would be carried out under Bank Procurement Guidelines following procedures for Open Tendering Method (OTM) of the People's Republic of Bangladesh (Public Procurement Act 2006 - PPA, 1st amendment to PPA (2009) and The Public Procurement Rules 2008, as amended in August 2009) using standard bidding documents satisfactory to the Bank. The "Request for Quotation" document based on PPA is acceptable to IDA for shopping. For the purpose of NCB the following shall apply:

- Post bidding negotiations shall not be allowed with the lowest evaluated or any other bidder;
- Bids should be submitted and opened in public in one location immediately after the deadline for submission;
- Rebidding shall not be carried out, except with the Association's prior agreement;
- Lottery in award of contracts shall not be allowed;
- Bidders' qualification/experience requirement shall be mandatory;
- Bids shall not be invited on the basis of percentage above or below the estimated cost and contract award shall be based on the lowest evaluated bid price of compliant bid from eligible and qualified bidder; and
- Single-stage two-envelope procurement system shall not be allowed.

176. *Procurement of non-consulting services:* Except as otherwise agreed in the procurement plan, non-consulting services may be procured on the basis of ICB. Procurement of non-consulting services having estimated value less than the ceiling stipulated in the Procurement Plan may follow NCB. The agencies will carry out such procurement using Bank Guidelines.

177. *Methods of Procurement of Consultants' Services:* Selection of Consultants will follow the Bank Consultant Guidelines. The following methods will apply for selection of consultants: Quality- and Cost-Based Selection (QCBS), Quality-based selection (QBS), Fixed Budget Selection (FBS), Consultants' Qualification (CQ), Least-Cost Selection (LCS), and Single-Source Selection (SSS). Shortlist of consultants for services estimated to cost less than US$300,000 equivalent per contract may be composed entirely of national consultants. The Procurement Plan will specify the circumstances and threshold under which specific methods will be applicable.

178. *Operating Costs*: These costs will include incremental operating costs for office utilities, office supplies and stationeries, O&M of equipment and vehicles, hiring of vehicles, fuel, office rent, souvenirs, events, bank charges, advertising costs, and salaries and contractual allowances of contracted staff, but excluding salaries of Government officials.

Assessment of the Agency's Capacity to Implement Procurement

179. Bangladesh has a nodal procurement policy agency and a Public Procurement Act (PPA) 2006 with associated Public Procurement Rules 2008 (PPR) and bidding documents. It created a critical mass of about 25 procurement professionals and, as of now, provided training to over 4800 staff of about 350 organizations. To sustain the reform, with Bank's assistance, the Government has been implementing a second procurement reform project since late 2007, focusing largely on the implementation and monitoring of PPA including introduction of e-government procurement at key sectoral agencies.

180. Notwithstanding the above progress over the past years, recently the new Government made a few amendments to the PPA part of which were found not consistent with the Bank's Guidelines, and as such the Bank for its projects allowed for local procurement the use of PPA/PPR with those exceptions.

181. A capacity assessment of BWDB has been conducted. BWDB will require adequate procurement staff to manage procurements under this project. The assessment shows that BWDB has lack of procurement knowledge especially in ICB and weakness in bid evaluation. Furthermore, the BWDB will need more training and experience in ICB following Bank guidelines. In BWDB contract administration is a significant issue; most of the high value contracts are not completed within the original contract period. BWDB is also not immune to systemic issues affecting procurement efficiency and performance. In addition to adequate staffing for procurement needs, emphasis also needs to be laid on areas of internal control, documentation, information dissemination, administration of contract including delivery follow-up, payments, handling complaints etc. The project is rated as "High-Risk" from procurement operation and contract administration viewpoint. Several measures need to be introduced to minimize the risk during the implementation of the project. These assessments and agreed action has captured in the web based Procurement Risk Assessment Management System (P-RAMS).

182. In order to minimize procurement associated risks, the following measures have been agreed upon with the Government:

i. *Identify procurement focal points (PFP) in BWDB:* BWDB shall nominate a procurement focal point for this Project. The appointed focal point will take necessary training, both on PPR 2008 and Bank Procurement Guidelines. The focal persons will help the respective agencies in day-to-day procurement follow-up and preparation of periodic procurement reporting.

ii. *Procurement Panel:* A Procurement Panel will be appointed by BWDB consist of three members; two international/expatriates and one national consultants. Selection of the panel members would have to be satisfactory to the Bank. The procurement panel will ensure the quality assurance of the bidding process and implementation of large value contracts that would be specified in the Procurement Plan. Detail tasks include: carry out the procurement process which would include short listing of consultants, pre-qualification of contractors and suppliers, review and issuance of bidding documents/ request for proposal, evaluation of bids /proposals and recommendation of award. The Procurement Panel would also oversee the contract management during implementation and changes in the scope, quality and variations in the contracts. The procurement consultants of the panel should have sound knowledge in international procurement. They would be recruited on the need basis; service of international/expatriate consultant would be on a part time basis and for the national procurement consultant for a longer duration.

iii. *Independent Evaluation by the Bank.* The major contracts would be reviewed by the Bank thoroughly and as needed independent consultant would be recruited to review such contracts at various stages of evaluation, award and to evaluate proposed changes in the contract.

iv. *Establish a functional webpage for BWDB with procurement* related information accessible to the public. Information pertaining to bidding and procurement above the specified thresholds, as per PPR, will be published in Central Procurement Technical Unit's (CPTU's) website. In addition, BWDB will publish procurement information on its own website. This information will include: invitation to bid, bid documents and RFPs (wherever applicable); latest information on procurement plan/contracts; contract award information; and information covering the poor performance of contractors, suppliers and consultants, including a list of debarred firms. The website would be accessible to all bidders and interested persons equally and free of charge.

v. *Establish a system for handling complaints* and a database for recording, monitoring and follow up on all the procurement activities under the project in the BWDB; and,

vi. *Introduce a Procurement Risk Mitigation Plan (PRMP) by BWDB* through reports submitted to IDA on a periodic (semi-annual) basis with a set of features as mentioned below.

183. The PRMP will have following features:

i. *Alert bidders in pre-bid meeting*: BWDB through a notification will alert bidders during pre-bid meeting on consequences of corrupt practices (fraud and corruption, collusion, coercion, etc.). The alert message, among others, will include that if bidders are found to have adopted such practices, there may be remedial actions including debarment from bidding processes in conformity with the Bank's Guidelines. For national competitive bidding, national bidders debarred, if any, under the PPA will not be able to participate. In addition, in the pre-bid meeting, the bidders will be clarified for preparation of bids correctly.

ii. *Alert internal officers/staff*: BWDB will issue alert letter(s) notifying on the fraud and corruption indicators and the possible consequences of corrupt and similar behavior in procurement practices and action to be taken against the official staff if they are involved in such practices. Moreover, BWDB will highlight that, in case of noncompliance or material deviation from IDA's Procurement Guidelines, IDA may take remedial actions (i.e., withdrawal of funds, declaration of mis-procurement) for concerned contracts.

iii. *Bid opening minutes*: During the same day of bid opening, photocopies of the Bid Opening Minutes (BOM) with readout bid prices of participating bidders will be submitted by the Bid Evaluation Committee (BEC) for circulation to all concerned. For prior review packages, such BOM will be shared with the IDA.

iv. *Low competition among bidders and high price of bids*: The case(s) of low competition (not solely based on number of bidders) in ICB and NCB cases, coupled with high-priced bids will be inquired into and further reviewed by BWDB. The review and decision in this regard would be in the context of qualification criteria, the contract size (too small or too large), location and accessibility of the site, capacity of the contractors, etc.

v. *Measures to reduce coercive practices*: Upon receiving allegations of coercive practices resulting in low competition, BWDB will look into the matter and take appropriate measures. For prior review contracts, observations of BWDB will be shared with IDA, along with the evaluation reports. BWDB may seek assistance from law enforcing agencies to provide adequate security for bidders during bid submission. For ICB contracts, provision for bid submission through international/national courier services will be allowed and confirmation of the receipt of the bid will be informed to the bidders through e-mail.

vi. *Rebidding*: In case of re-bidding, BWDB will inquire into the matter, record and highlight the grounds of re-bidding (i.e. corruption or similar, high bid prices etc.) along with recommended actions to be taken. For prior review of cases, all such detailed reports will be sent to IDA.

vii. *Filing and record-keeping*: BWDB will preserve all records and documents regarding their public procurement in accordance with provisions of the PPA. These records will be made readily available on request for audit/investigation/review by the Development Partners and the Government.

viii. *Publication of award of contract*: BWDB will publish contract award information within two weeks of contract award on its website, dgMarket/UNDB online, and CPTU's websites with the following information: identity of contract package, date of advertisement, number of bids sold, number of submitted bids, bid prices as read out at bid opening, name and evaluated price of each bid, number of responsive bids along with name of bidder, name of bidders whose bids were rejected and brief reasons for rejection of bids, name of the winning bidder, the price it offered, and proposed completion of date of contract.

184. *Procurement Plan*: A procurement plan covering all major procurement packages has been prepared for the entire duration of the project. It will also be available in the Project's database and in IDA's external website for this project. The Procurement Plan will be updated in agreement with BWDB, at least annually, to reflect the actual project implementation needs and adjustments thereof.

185. *Review by IDA of Procurement Decisions*: The review by IDA of procurement decisions and selection of consultants will be governed by Appendix 1 of the Bank's Guidelines. For each contract to be financed by credit, the threshold for prior review requirements and post review contracts will be identified in the Procurement Plan. During the first 18 months of the project, IDA will carry out prior review of the following contracts. This prior review threshold will be updated annually based on the performance of BWDB:

i. For Goods. All the ICB Contracts and Direct Contracts irrespective of estimated cost. The NCB Contracts estimated cost equivalent or more than US$500,000.

ii. For Works. All the ICB contracts and Direct Contract irrespective of estimated cost. The NCB Contracts estimated cost equivalent or more than US$5,000,000.

iii. For Non-consulting service. The Contracts estimated cost equivalent or more than US$500,000.

iv. For Consultant's Services. Prior review will be required for consultants' services contracts estimated to cost US$ 200,000 equivalent or more for firms and US$ 100,000 equivalent or more for individuals. All single-source contracts will be subject to prior review by and in agreement with IDA. All ToRs of the consultants are subject to the IDA's prior review; and

Detailed Procurement Arrangements (major procurements)

Table 3.2: Goods

Ref No.	Contract Description	Estimated Cost (Million US$)	Selection Method	Prior Review By Bank	Expected Bid Opening Date
CEIP-1/G1	Motor Vehicles	2.1	ICB	Yes	Aug-2013
CEIP-1/G2	Motor Cycles	0.016	NCB	No	Sep-2013
CEIP-1/G3	Speed Boart	0.06	NCB	No	Oct-2013
CEIP-1/G4	Computers and related accessories	0.25	NCB	No	Aug-2013
CEIP-1/G5	Engineering Equipment	0.02	NCB	No	Oct-2013
CEIP-1/G6	Office Equipment	0.028	NCB	No	Aug-2013
CEIP-1/G7	Furniture	0.012	NCB	No	Aug-2013
CEIP-1/G8	Motor Vehicles	1.4	ICB	Yes	July-2015
CEIP-1/G9	Motor Cycles	0.016	NCB	No	July-2015
CEIP-1/G10	Speed Boart	0.05	NCB	No	Oct-2015
CEIP-1/G11	Computers and related accessories	0.015	NCB	No	Aug-2015
CEIP-1/G12	Engineering Equipment	0.015	NCB	No	Oct-2015
CEIP-1/G13	Office Equipment	0.020	NCB	No	Jul-2015

Table 3.3: Works

Ref No.	Contract Description	Estimated Cost (Million US$)	Selection Method	Prior Review By Bank	Expected Bid Opening Date
CEIP-1/W1	Rehabilitation and upgrading of Polders (Batch 1)	100	ICB	Yes	Nov-2013
CEIP-1/W2	Rehabilitation and upgrading of Polders (Batch 2)	65	ICB	Yes	Oct-2014
CEIP-1/W3	Rehabilitation and upgrading of Polders (Batch 3)	52	ICB	Yes	Jan-2015
CEIP-1/W4	Rehabilitation and upgrading of Polders (Batch 4)	61	ICB	Yes	Jan-2015

Table 3.4: Services

Ref No.	Contract Description	Estimated Cost (million US$)	Selection Method	Review By Bank (Prior/ Post)	Expected proposal Opening Date
CEIP-1/A2, B1/ S1	Consultancy service to Implement (a) social afforestation and (b) social action plan (incl. setting up WMOs)	2.6	QBS / QCBS	Yes	Sep-2013
CEIP-1/C1/S2	Construction Supervision & Detailed Design, preparation of EIA and RAP for remaining Polders	15	QBS / QCBS	Yes	Sep-2013
CEIP-1/C2/S3	Third Party Monitoring & Evaluation (M&E) of overall project implementation, GAAP, RAP, EIA, EMP	3.20	QBS / QCBS	Yes	Nov-2013
CEIP-1/C3/S4	Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone.	8.20	QBS / QCBS	Yes	Dec-2013
CEIP-1/D1/S5	Procurement Specialist(International)	0.90	IC	Yes	Sept-2013
CEIP-1/D1/S6	Procurement Specialist(International)	0.9	IC	Yes	Sept-2013
CEIP-1/D1/S7	Procurement Specialist(National)	0.22	IC	Yes	Sept-2013
CEIP-1/D1/S8	PMU Procurement Specialist (National)	0.4	IC	Yes	
CEIP-1/D1/S9	PMU Financial Specialist	0.3	IC	Yes	Sept-2013
CEIP-1/D1/S10	PMU Sr. Environment Officer (Dhaka)	0.2	IC	Yes	Jan 2014
CEIP-1/D1/S11	PMU Sr. Social Officer (PMU/Field)	0.2	IC	Yes	Jan 2014
CEIP-1/D1/S12	PMU Sr. Forestry Officer	0.2	IC	Yes	May 2014
CEIP-1/D1/S13	PMU Communication Officer	0.15	IC	Yes	Jan 2014
CEIP-1/D1/S14	PMU Sr. Revenue Staff	0.15	IC	No	
CEIP-1/D1/S15	PMU Social Expert (Field)	0.14	IC	No	
CEIP-1/D1/S16	PMU Environment Expert (Field)	0.14	IC	No	
CEIP-1/D1/S17	IPOE / Coastal, Estuarine and River Morphologist	0.2	IC		
CEIP-1/D1/S18	IPOE/ Sediment, Tidal river management Expert	0.2	IC	Yes	
CEIP-1/D1/S19	IPOE/ Design Expert in Embankment and Hydraulic Structures	0.2	IC	Yes	
CEIP-1/D1/S20	IPOE/ Social Expert	0.2	IC	Yes	
CEIP-1/D1/S21	IPOE/ Env and Water polder Expert	0.2	IC	Yes	
CEIP-1/D2/S22	Consulting Services for Institutional Capacity Building	0.9	QBS/QC BS	Yes	
CEIP-1/D3/S23	Consulting Services for Feasibility study of CEIP Phase 2	3	QBS/QC BS	Yes	

C. Safeguards

Social Management

186. The project's **social impacts** and safeguard compliance are related to land acquisition and population displacement during the upgrading of embankments (as per new climate resilient design) and the construction of water control structures. For the first procurement package, a full social assessment and RAP have been prepared. For the remaining three packages, social impacts will be determined during implementation. The phase-1 CEIP will not affect any tribal people residing dispersedly in the project districts; therefore OP 4.10

on indigenous people has not been triggered. World Bank policy on involuntary resettlement (OP 4.12) is triggered for this project.

187. **Planning approach**. Given that project interventions will be grouped into 4 packages (with 3 to 6 polders in each package), BWDB has developed a SMRPF to guide the planning and design of all investments on social safeguard compliance during implementation. It has also developed a RAP for the first package of phase-1 construction. Social screening, social impact assessment (SIA) and RAP will be carried out for all remaining packages following the guidance of the SMRPF. These plans will be shared with the Bank for review and clearance before the works packages are accepted for financing under the project. After Bank review, RAPs for any construction package will be disclosed in country and in Bank Infoshop before award of civil works contract.

188. **Social Management and Resettlement Policy and Framework (SMRPF).** The SMRPF includes a resettlement policy framework and a social inclusion/gender framework. Among other issues, the SMRPF provides (a) a legal framework outlining the principles and guidelines which will be used to acquire lands and mitigate the adverse impacts; (b) facility for screening of social safeguard issues related to involuntary resettlement; (c) mitigation principles and planning guideline; (d) a grievance redress procedure for the project affected persons; (e) stakeholder consultation framework; and (f) arrangement for implementation as well as M&E of the RAPs.

189. **Resettlement Action Plan**. The first construction package is designed to improve four polders in Khulna and Bagerhat districts. Major civil works for improvement of these polders include embankments upgrading and re-sectioning of existing embankments to protect against storm surges (including the impact of climate change), construction of water control structures, and excavation/re-excavation of canals. According to the census survey carried out as of February 2012, the first package will affect 6,203 households and persons in their residence, place of businesses and other assets, and 184 common resource structures (CRS) largely on the existing embankments[60]. Unlike the project affected households on the lands proposed for acquisition, the households, shops and CRSs on the existing embankments will need to be relocated from the existing embankments during civil works construction temporarily or permanently. The RAP has, therefore proposed a compensation mechanism in the form of assisted relocation and livelihood restoration and a living allowance ("rent") for landless embankment settlers for the temporary period of physical displacement. The project preparation consultant has estimated the RAP cost for the first package at BDT 928 million (US$ 11.6 million). Land acquisition and resettlement of the project affected persons will be financed from project fund. The RAP (main volume) has resettlement impacts and detailed budget for land acquisition and resettlement for each of polders in separate sub-volumes.

190. **Institutional arrangement and capacity building**. BWDB will establish a SECU within the PMU. The SECU will include at least one well experienced senior social specialist in the Dhaka office. The PMU will also extend its capacity at the field level with two mid-level social specialists. The PMU will be assisted by an experienced NGO for assistance in social mobilization, plantation, and implementation of RAPs on site. To enhance the capacity on social safeguards, BWDB will conduct orientation to the Executive Engineers and Assistant Engineers deputed in the field offices under the PMU upon placement. PMU will continue similar discussions and sharing of experience on social safeguards during project implementation.

191. **Social mobilization.** The project will support consultation with and strengthening of polders' stakeholders and beneficiaries as well as formal and informal water management organizations. Under Component B1, the project will pilot intensive social mobilization in 6 polders to establish participatory WMOs. The establishment of WMOs will follow an six step process, as identified in the *Guidelines for*

[60] The number of people affected was surveyed for 5 polders (four polders in the first package of investment and polder 39/2C in Pirojpur district, which was originally in the first package of investment and later dropped as it required further detailed work).

Integrated Planning for Sustainable Water Resources Management, published by BWDB in 2008. Social mobilization is expected to last around two years, during which time the WMOs will be established and trained in participatory planning, as well as in operation and minor maintenance activities. Small works, including minor periodic maintenance and operation of minor hydraulic infrastructure would be undertaken by the WMOs under a memorandum of understanding with BWDB. In the remaining polders, Polder Management Committee(s) will be established to determine the competing needs and uses for water resources, and to decide on the operation of hydraulic infrastructure. Should the participatory approach prove to be successful, it would be scaled up in more polders.

192. **Gender**. Women in Bangladesh contribute significantly to the family's economy, both through their remunerative work on farms and through unpaid traditional work at home. BWDB will follow a strategy of gender inclusive project design, implementation, and operation. Women in the communities are and will continue to be consulted at each stage of project cycle and their representation will be ensured in project management including inventory of resettlement impacts, valuation of affected property, grievance resolution and relocation. BWDB will encourage the employment of poor women in earth work through the LCS and it is expected that at least 30% of WMOs members will be women. BWDB will provide gender-related training to sensitize its officials and increase capacity of the LCS and WMOs.

193. **Community Consultation**. Extensive discussions will be carried out with communities during the project planning and implementation process. BWDB is preparing a Bangla translation of the SMRPF summary and the RAP of the first package. It will ensure that copies of the translated documents are available at its headquarters and division offices, MoWR, public libraries, local government offices in the project districts, and other places accessible to the public. The entitlement matrix of the RAPs for construction packages will be made available to all affected persons in Bangla before the award of civil works construction.

194. **Grievance Redress Mechanism.** Given the scope and nature of the social issues under the project, and the number of people affected either temporarily or permanently, a multi-level GRM will be established for the project. BWDB will establish GRC in each union in the command area of the polders for resolving land acquisition and resettlement related grievances. GRM at the Field Office of BWDB will deal with project related issues other than land acquisition and resettlement and cases forwarded from the union GRCs. The PMU will remain to address any unresolved cases from local GRCs and involve the MoWR in only critical circumstances. All complaints and grievances received at GRCs will be documented at the field and at the PMU and resolved in two weeks from the date of receipt of the complaints. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon BWDB.

Environmental Management

195. **Project Component with Environmental Footprint.** Component A, which represents 75% of total funding, will involve infrastructural development with extensive earth work and afforestation. Rehabilitation and improvement of Polders will involve raising the embankment height; need based realignment of embankment, introducing mechanical compaction for environment, re-excavation of drainage channels (*khals* and canals), construction/repair of drainage sluice and flushing inlet and construction of channel closure regulator. Other intervention with environmental footprint under Component A include the planting of selected mangrove and other salt tolerant species as a protective belt on the tidal inundation zone on the embankment foreshore and commercial species grown in social forestry mechanisms to meet livelihoods needs of landless, marginalized and poor villagers. All other project components will facilitate the successful execution and long sustainability of Component A. Component B3 will support (i) the preparation of EIAs for all remaining polders; and (ii) the implementation of the EMP and environmental mitigation and enhancement measures. Component C2 will support the supervision of the EMP implementation.

Component D will (i) facilitate the establishment of the Environment, Social and Communication unit within the PMU to supervise the proper implementation of the EMP, and (ii) strengthen the capacity of the existing environment and social department within BWDB to ensure long term environmental sustainability of the project.

196. **Baseline Information of the Project Area.** The coastal area comprises rich biodiversity, but is highly vulnerable to natural disasters in particular floods and storm surges. The coastal area covers different types of land uses ranging from agriculture/fallow lands, settlements, water bodies/rivers and forests. The Ganges Tidal Plain West and the Chittagong Coastal Plain zones are mostly covered by mangroves and other forests. Inside the 139 polders, 64% of the area is devoted to agriculture/fallow lands and 30% to settlements on average. Coastal areas are endowed with both fresh and brackish water resources. Brackish waters are mainly in the estuarine part of the rivers and tidal canals/creeks. The coastal area covers about 3.6 million acres of net cultivated area with average cropping intensity of 175% where mostly local and HYB rice crops area grown. Soil salinity is the most limiting factor for agricultural practices in this region especially during the dry season. The ecosystems mainly includes marine, brackish water, freshwater, mangrove, Sundarbans, floodplain, island, peninsula, and terrestrial ecosystem (roadside and homestead). Moreover, shrimp farming pond (*Gher*) ecosystem is found in this area. The mangrove forests are not only the transitional zones between fresh and marine water ecosystems but also serve as a natural fence against cyclonic storm and tidal surges. The major natural hazards and disaster are cyclonic storm, river floods, water logging, salinity (both soil and water), and river erosion. About 30% of all polders are now experiencing water logging in the coastal area.

197. **EA Category.** The project will trigger environmental safeguard policies for EA (OP/BP 4.01), Natural Habitats (OP/BP 4.04) and Forests (OP/BP 4.36). Although no direct impacts on physical cultural resources is identified for polder 35/1, 35/3, 32 and 33, screening mechanism incorporated into the EA process for the rest of the thirteen polders may identify subprojects with archeological, paleontological, historical, religious, or unique natural values. Physical cultural resources (OP/BP 4.11) are also triggered for the project. According to the Bank's safeguard policy, CEIP is a **Category 'A'** project. According to the Bangladesh Environmental Conservation Rules (ECR) 97 categorization, all construction/reconstruction/expansion of flood control embankment/polder/ dykes fall under **Red** Category.

Environmental Impacts and Mitigation

198. **Overall Impacts of CEIP intervention** Overall the project bears significant positive environmental aspects. It will increase the resilience of vulnerable committees living in natural disaster prone coastal areas and it will develop the capacity of BWDB in environmental management. The project's physical intervention is expected to reduce loss of crops and assets by withstanding storm surges, taking into account the impact of climate change, and to decrease salinity intrusion which, in turn, will increase agricultural production in the long run. Increased agricultural production and the construction works of the project will generate employment opportunities for the poor and landless. The following table shows a summary of the environmental impacts obtained from the EIA.

Table 3.5: Potential positive and negative environmental impacts

Indicator	Polder 32	Polder 33	Polder 35/1	Polder 35/3	**Total**
Loss of Agriculture Land (ha)	66.41	16.74	25.85	9.92	**119**
Loss of Fish Habitat (ha)/capture	0	0	10	0	**10**
Loss of Fish Habitat (ha)/culture	0	2.74	3.18	4.85	**10.8**
Number of trees to be cut	256	06	1,159	20,974	**22,395**
Reduction of Water logged area (ha)	3,238	430	1,040	447	**5,155**
Increased area protected from tidal flooding (ha)	2,834	2,580	4,160	2,852	**12,426**
Water availability for agricultural land (ha)	518	670	3,880	1,453	**6,521**
Reduction of Saline prone area (%)	35	30	30	42	

Note: culture include pond and shrimp gher

199. Since the activity will involve extensive earthwork, sources of material and disposal of dredged material are the main concern of the project. The anticipated impacts are loss of agricultural land, encroachment of fish habitat, loss of biomass, degradation of land scape, siltation due to loose soil, limited air and noise pollution during construction, change in landscape, displacement of people, and psychological impact on people who have to change livelihood. Collection of soil material for earthen work from surrounding areas may create destruction of nearby structures, erosion from collection site, borrow pit may induce nuisance plant growth which will effect agriculture production, increased siltation in the water bodies. During dredging substrate removal will inevitably affect spawning, suspended sediment in the water affects the respiratory system of fish, growth may also be affected since food supply and feeding success are reduced in the turbid conditions, and location of labor camp will create odor and solid waste.

Environmental Management System

200. **Environmental Impact Assessment (EIA).** Four polders (Polders 32, 33, 35/1 and 35/3) have been selected for the first phase of physical intervention. For each of the polders, a polder specific EIA has been conducted. The EIA includes (i) site specific baseline information which contains detail information on physical, biological and socio-economic environment, (ii) specific impacts assessment and mitigation measures to address adverse impacts and (iii) development of appropriate management plans for implementing, monitoring and reporting environmental mitigation and enhancement measures suggested for the aforementioned polders.

201. **Environmental Management Framework (EMF).** As the EIAs were only prepared for the first package of investment (4 polders), an EMF was also prepared for the remaining investment. The EMF has highlighted relevant general policies, guidelines, codes of practice and procedures to be taken into consideration for integration of environmental aspects into the project design. The EMF will help BWDB ensure compliance with the World Bank's environmental safeguard policies and the Government's relevant environmental policies, rules, regulations and procedures.

202. **Environmental Management Plan (EMP).** A comprehensive EMP, which focuses on managing construction phase-related impacts, should suffice in managing the potential impacts during construction phase. The EMP will be attached to the Bidding Document. The environmental management parameter will be included in the Bill of Quantities (BoQ). Since many contractors do not have a clear understanding of the scope of work required by an EMP, some quote very low price for the implementation of the EMP and eventually cannot implement it successfully. To mitigate this risk, a fixed Budget will be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting. The contractor needs to submit an Environmental Action Plan (EAP) based on the EIA and EMF in line with the construction schedule and guideline. The EAP needs to be reviewed by the supervision consultant and cleared by BWDB and World Bank.

203. Extensive monitoring of the environmental concerns of the CEIP project will be required as per World Bank guideline. The monitoring program will help to evaluate: (i) the extent and severity of the environmental impacts against the predicted impacts and baseline; (ii) the performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures. The monitoring plans should be included in the EMP for specific sub-projects. Moreover, for all type of monitoring, a comprehensive **database of the polder specific Environmental Impact and Monitoring information** should be created, which will help to evaluate the impacts easily.

Institutional Responsibility and Reporting

204. The contractor is responsible for implementing the EMP during construction works. The Construction Supervision Consultant will be primarily responsible for supervision of the implementation of the EMP. At field level and through the environment specialist that will be recruited as part of the PMU, BWDB will conduct inspections and surveys. The field level environment expert will report to the Senior Environment Specialist at Head Quarter. The M&E consultant will be responsible for independent monitoring and implementation of EMP, and external M&E (under component C2). Department of Environment (DoE) will be consulted if complicated issues arise during construction and operation stages. BWDB will apply for annual site clearance from DoE. WMOs will be trained to ensure environmental management during project operation. The Environment, Social and Communication Unit of the PMU will oversee the environmental management during project operation.

205. BWDB will prepare a **by-yearly progress report** on environmental management and will share with the World Bank for review. In addition, the effectiveness of screening, monitoring and implementing the EMP will be carried out by an independent M&E Consultant hired as a third party monitor. The **Annual Environmental Audit Report** prepared by the third party monitoring firm will be shared with the safeguards secretariat.

206. The **SECU** within the PMU will be responsible for coordinating and providing technical support to ensure the proper (i) implementation of the EMP for the first package of investments and all subsequent packages and (ii) preparation of EIA for the remaining polders. The Sr. Environmental Specialist must be recruited by project effectiveness.

207. **Grievance Redress Mechanism.** BWDB will establish a GRM as a mean to ensure social and environmental accountability and to answer queries and address complaints and grievances about any irregularities in application of the guidelines adopted in this EMF for assessment and mitigation of social and environmental impacts.

208. **Public Consultation & Disclosure.** Preliminary public consultations and workshops for 4 polders have already been conducted. As the project is rated *Category A*, the EMF as well the EIA for the package of 4 Polders have been prepared, reviewed by the Bank and made publicly available on **February 15, 2013** i.e. 120 days prior to the proposed Board date of **June 20, 2013**.

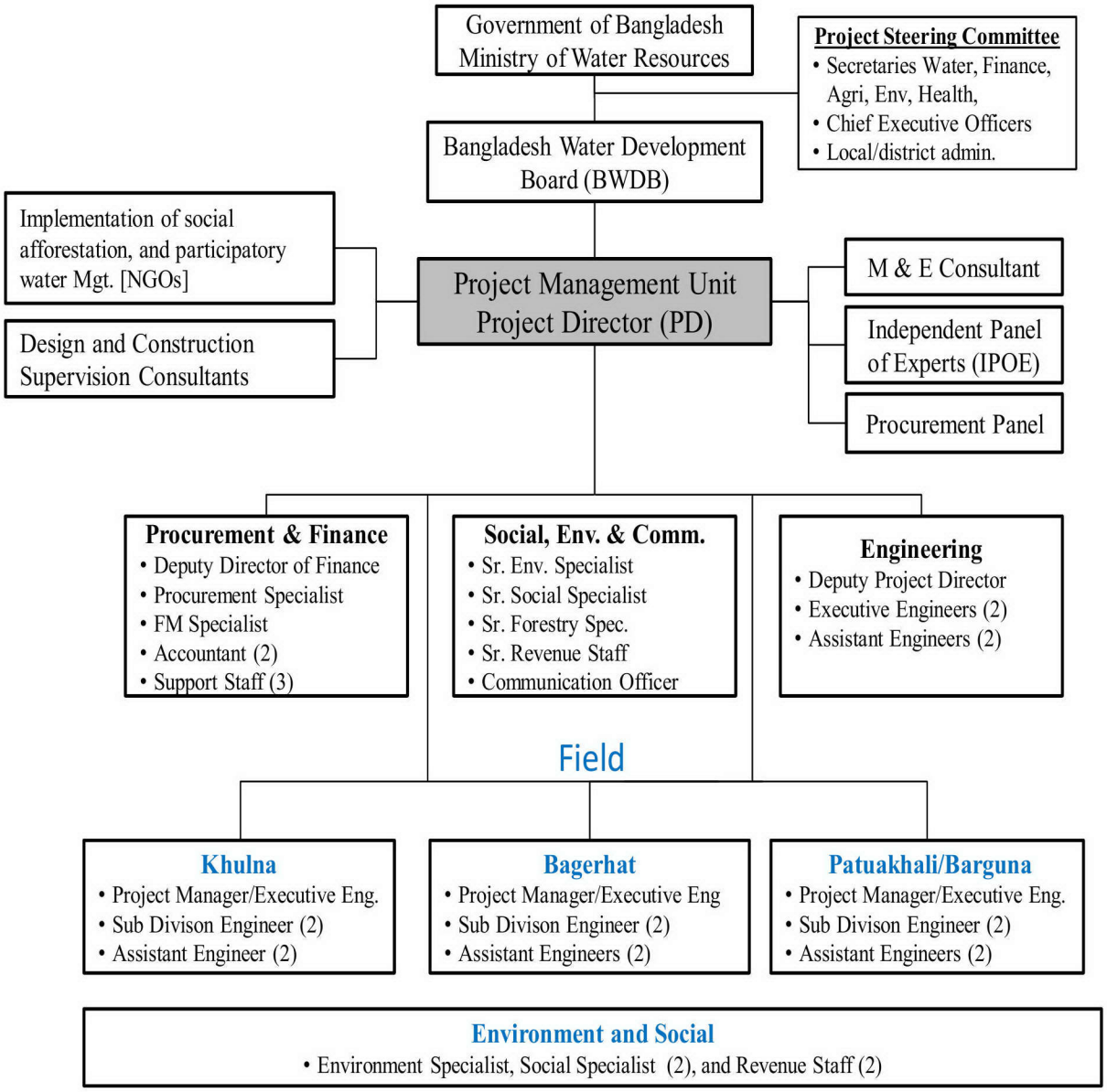
Monitoring and Evaluation

209. BWDB will set up its monitoring system to report on a quarterly basis. The PMU will be responsible for monitoring, reporting and evaluation. Independent review of the BWDB land acquisition and resettlement process will be carried out twice a year using a sample of 20 percent of the polders. In addition, an independent mid-term review (MTR) and an end-term impact evaluation of land acquisition and resettlement will be carried out for each construction package.

Project on International Waterways OP/BP 7.5

210. OP/BP 7.5 is applicable to the project as some of the embankments to be rehabilitated are located along the Bay of Bengal and along the distributaries of the Ganges River Basin which are international waterways. Normally the Bank requires the Beneficiary state to formally notify other riparians of the proposed project. However the project team has sought an *Exception to the Riparian Notification Requirement* on the basis that (a) the proposed project will rehabilitate embankments which have existed in the same location since 1960's.The upgrading and improvement of existing embankment will not reach a level that exceeds the original scheme design nor change its nature or extend its scope as to make it appear a new or different scheme, and (b) the task team has determined that the rehabilitation work envisaged under this project will not adversely change the quality or quantity of water flow to the other riparians, and will not be adversely affected by the other riparians possible water use. The Regional Vice President of the World Bank has approved such exception on February 27, 2013.

Figure 1 Project Management Organogram



ANNEX 4: OPERATIONAL RISK ASSESSMENT FRAMEWORK (ORAF)

Bangladesh: Coastal Embankment Improvement Project - Phase I (CEIP-I) (P128276)

Stage: Negotiations

1. Project Stakeholder Risks							
1.1 Stakeholder Risk	Rating	Substantial					
Description: The population in the coastal districts is high, and past interventions on the coastal embankment system lacked communication and consultation with local stakeholders. The attention of project stakeholders is expected to be high.	**Risk Management:** Proposed project design is discussed with community groups for feedback. BWDB will engage a Communication Officer, in line with the Right to Information Act, in the PMU to ensure that all relevant information regarding the selection of polders, the embankment design, and the social and environmental management measures are publicly available.						
	Resp: Client	Stage: Both	Recurrent: ☑	Due Date:	Frequency:	Status: In progress	
3. Implementing Agency (IA) Risks (including Fiduciary Risks)							
3.1 Capacity	Rating	Substantial					
Description: BWDB has a long experience in coastal embankment systems. It has successfully implemented the IDA financed *Coastal Embankment Rehabilitation Project* (borrower's performance was rated Satisfactory at ICR) and is currently rehabilitating embankments destroyed under Cyclone Sidr under the *ECRRP Project*. However, the agency faces governance risks, particular with respect to contract management and procurement and BWDB does not have adequate procurement capacity to manage high value contracts (see 3.2 Governance). Financial Management: BWDB has relatively good capacity in financial management in terms of a robust financial management organization and a computerized accounting system in operation.	**Risk Management:** Project implementation will be supported by a dedicated Project Management Unit that will receive technical assistance and adequate budget to implement the project. The PMU will be established shortly after effectiveness and maintained throughout the duration of the project						
	Resp: Client	Stage: Implementation	Recurrent: ☑	Due Date: Shortly after effectiveness	Frequency:	Status: Not Yet Due	
	Risk Management: A financial management specialist will be recruited within the PMU to undertake project FM functions and to prepare quarterly IFRs. Use of BWDB's computerized accounting system and its Internal Audit Directorate in the project will be agreed under project financial management arrangement.						
	Resp: Client	Stage: Implementation	Recurrent: ☑	Due Date: Shortly after effectiveness	Frequency:	Status: Not Yet Due	
4. Project Risks							
4.1 Design	Rating	Moderate					
Description: The project design draws on a complete updating of the coastal embankment network, and a set of criteria to determine priority areas of investment. The detailed polder design will face some levels of technical complexity.	**Risk Management:** BWDB will appoint an Independent Panel of Expert (IPOE) to provide act as independent "peer reviewers" and undertake quality control functions of various technical output of the project.						
	Resp: Client	Stage: Preparation	Recurrent: ☑	Due Date:	Frequency:	Status: In Progress	
4.2 Social and Environmental	Rating	Substantial					
Description: The project will involve extensive civil works related to embankment upgrading	**Risk Management:** BWDB will prepare an EIA for each polder that will identify assessment of impacts and provide mitigation measures for project implementation.						

(increase of height and base) and construction of new hydraulic/water control structures which may have significant long term environmental impact on the polder system. Considering the extent of environmental impact on the biodiversity and populous coastal area the project is categorized as Category A. The project is anticipated to have positive social benefits for the coastal populations who will benefit from increased protection and improved agricultural productivity. However, the project could face delays in implementation because of complexities associated with land acquisition and implementation of the resettlement action plan.	Resp: Client	Stage:	Recurrent: ☑	Due Date:	Frequency:	Status: In progress
	Risk Management: BWDB will contract the implementation of RAP actions to a reputable NGO. Third party monitoring will be done by communities to ensure transparency and accountability, and to mitigate against potential delays					
	Resp: Client	Stage: Implementation	Recurrent: ☑	Due Date:	Frequency:	Status: Not Yet Due
4.3 Program and Donor	Rating	Moderate				
Description: Several donors have been active in the coastal areas. There is a risk of overlapping activities and lack of coordination.	**Risk Management:** To mitigate this risk, the Bank and BWDB will (i) make project documents available as per the World Bank policy on Access to Information and GOB's Right of Information Act; (ii) closely coordinate with the ADB team regarding the *Coastal Climate Resilient Infrastructure Project*, and (iii) will continue to regularly inform the PPCR donors about project progress through its quarterly report [The proposed CEIP is co-financed with a $25 million PPCR Grant. Development partners in Dhaka were fully consulted during the preparation of Bangladesh's *Strategic Program for Climate Resilience* which identified coastal embankment as a priority for intervention.					
	Resp: Both	Stage: Both	Recurrent: ☑	Due Date:	Frequency:	Status: In progress
4.4 Delivery Monitoring and Sustainability	Rating	Substantial				
Description: The GoB typically faces issues with the continued adequate budget allocations for operation and maintenance of critical infrastructure, and BWDB has, in the past faced problems with continued maintenance because of budget shortfalls.	**Risk Management:** Adequate funding for O&M will be available under the project. In addition, the project will pilot the establishment of WMOs, which will undertake minor maintenance work in addition to operation, and is expected to lead to reduced maintenance costs over time.					
	Resp: Client	Stage: Implementation	Recurrent: ☑	Due Date:	Frequency:	Status: Not Yet Due

5. Project Team Proposed Rating Before Review	
Preparation Risk Rating: Substantial	**Implementation Risk Rating: Substantial**
Description: The preparation risk of the project is considered substantial, given limited capacity within BWDB.	Description: The implementation risk of the project is considered substantial, given some of the governance issues within BWDB. This will be addressed through the implementation of mitigating actions identified in the GAAP.

6. Overall Risk	
Preparation Risk Rating: Substantial	**Implementation Risk Rating: Substantial**
Description:	Description:

Nondisclosable Information for Management Attention (Optional)
Comments:

Annex 5: Governance and Accountability Action Plan (GAAP)

BANGLADESH: COASTAL EMBANKMENT IMPROVEMENT PROJECT PHASE-I (CEIP-I)

Introduction

211. Improving governance and fighting corruption are part of the Government's development agenda set forth in the 6th Five Year Plan and the Bank's mission of promoting sustainable growth and reducing poverty. This GAAP for the CEIP-I contributes to these efforts by outlining a framework for actions, institutional arrangements, and additional specific measures to minimize governance and corruption risks in the project. This GAAP is designed to reflect the specific responsibilities of BWDB (the implementing agency), and the World Bank, to facilitate effective and appropriate use of the funds for the project, preclude the incidence of corruption and enhance good governance.

212. This plan is based on an assessment of the governance risks, particularly fraud and corruption, the context for addressing Governance and Anti-Corruption (GAC) issues in Bangladesh and specifically for the entities involved in CEIP-I. It is based on the Bank's experience in addressing governance and anticorruption issues, and, in particular, on the Bank's experience in financed operations with BWDB as an implementing partner. The GAAP will be adjusted as necessary during implementation to reflect governance issues which may emerge and/or to strengthen or add actions. It will be monitored regularly through indicators and reflected in the Quarterly Progress Report prepared by the implementing agency, as well as in World Bank aide memoires for supervision missions.

Country Context and Background

213. Bangladesh is a high risk environment for governance. The judiciary system continues to be weak largely because of poor conflicts-of-interest regulations. The implementation of Bangladesh's *Right to Information Act* 2009 has been slow, partly because of poor records, lack of public awareness, and weak capacity. Despite some attempts to enhance accountability in the legal framework for corporate governance and public sector regulation, poor performance and taking advantage of office are common in the public sector including state-owned enterprises. The Bank's *Country Assistance Strategy* (FY11-14) for Bangladesh has also defined weak governance as a constraint to inclusive growth and committed the Bank to embedding more systematic approaches to governance challenges across the portfolio.

214. Governance in the water sector has had particular challenges. The sector is affected by political considerations, short term planning horizons of successive Governments, limited incentive structures, and probable corruption in contracting. The proposed project will be implemented by BWDB. The project's components include (A) Rehabilitation and Improvement of Polders ($291 million); (B) Implementation of Social and EMPs ($56 million); (C) Construction Supervision, M&E of Project Impact, Coastal Zone Monitoring ($32 million); (D) Project Management, TA, Training and Strategic Studies ($21 million); and (E) Contingent Emergency Response ($0 million).

215. BWDB has a long experience in implementing Bank financed projects, beginning in the 1970s with *Coastal Area Rehabilitation Project* (Cr 339-BD). Implementation under more recent projects, including the *Coastal Embankment Rehabilitation Project* (Cr. 27830), *Component C of Emergency Recovery and Restoration Project* (Cr. 45070) and the *Water Management Improvement Project* (Cr 43590), has varied between moderately satisfactory and satisfactory. Because of this ongoing engagement, institutional weaknesses and governance and corruption risks for the proposed project are

mostly known which have contributed to the detailed risk assessment and design of the mitigation measures in this GAAP.

Governance and Corruption Risks

216. The governance and corruption risks for the CEIP-1 fall into **four** major categories: (i) Institutional Risks; (ii) Procurement Risks; (iii) Contract Execution Risks; and (iv) Social and Resettlement Risks.

217. **Institutional Risks**. BWDB suffers from issues involving the civil service which affect procurement efficiency and performance. Stronger accountability for performance and internal controls to counter fraud and corruption are needed. Systems for provision of information to the public and handling complaints or feedback from third parties on performance are nascent.

218. **Procurement Risks**. BWDB has had governance issues in the past, most notably in procurement administration with instances of inappropriate bidding practices including mis-procurement. The major component of the project will be for construction costs associated with the rehabilitation and strengthening of the coastal embankments. These contracts are expected to be large, and present significant procurement risks. Possible risks include collusion among the bidders; corruption in the pre-qualification of contractors, fraudulent documents; corruption between the bidder and the engineer; and corruption between the winning bidder and the approving authority. Conflicts of interest may present a serious problem, most notably through relationships with Government officials, whether direct or indirect, including through companies and/or relatives of officials.

219. **Contract execution Risks**. BWDB has shown weaknesses in the past that have included poor monitoring, award delays and issues related to contract management. There is a risk for collusion and corruption between contractors, engineers in the field, and the PMU, including, but not limited to, aspects related to quality assurance, extension of time, variations to contracts, and price adjustments.

220. **Risks in delivery of benefits under the RAP**. Fraud is possible in the identification of recipients by either delivery agents or individuals seeking benefits, as well as in inflating numbers of benefits recipients with false or 'ghost' entries. In addition, some risks exist that the determination of land ownership will be made on false claims, thus entitling the owners to compensation. Finally, land acquisition is a lengthy process that can put the timely delivery of the project at risk.

Actions to Mitigate Governance and Corruption Risks

221. GAC concerns will be addressed through a combination of project design and special measures to reflect **three basic principles**: (a) ensure maximum transparency and provision of information about every step or action undertaken including the individuals or entities involved; (b) ensuring that multiple parties are in place to provide external assessment of the actions that are undertaken in order to have a robust system of scrutiny and checks; and (c) enhanced use of mechanisms for feedback from individuals outside the implementation of the project, particularly through use of social accountability. Below is a summary of the actions to be undertaken followed by a matrix summarizing the actions, responsible entities, timelines, and warning signs to trigger additional review through Bank supervision and/or investigation.

222. **Institutional Risks**. To mitigate the institutional risks, the PMU has been strengthened with externally-hired staff to manage the day-to-day implementation within the BWDB. Specifically, there will be (i) 3 units (one dedicated for procurement and finance, one for social, environmental and

communication and one for technical and engineer implementation) supporting the PMU; (ii) in addition, an internationally recruited Construction Supervision Consultants who would be the "engineer" for the civil works contracts, and (iii) an experienced NGO will be recruited to implement the RAP.

223. As per the *Right to Information Act (RTI)*, BWDB should appoint an RTI officer dedicated for the institution. In the current absence of such RTI officer, the Communication officer, hired through the PMU, will be designated as RTI officer and dedicated to the project as well as an internal appellate authority (having jurisdiction to hear appeals and review decision) for requests for information. The Communication officer will be provided with sufficient training on the Right to Information regime and adequate staff and administrative support to carry out an expansive communications program of proactive disclosure. The Communication officer will also develop a communication strategy to ensure broad access to information for civil society and media of all aspects of the project performance.

224. Multiple oversight entities will scrutinize BWDB's performance, particularly on governance and countering corruption. *First*, BWDB's performance will be overseen by a PSC chaired by the Secretary of MoWR or his/her designee. *Second*, an independent M&E Consultant will be recruited to carry out M&E of project performance. *Third*, BWDB will recruit an IPOE consisting of renowned experts to review the designs for the project. The IPOE primarily provides technical review but also will ensure additional scrutiny to guard against corruption. With individuals of professional competence and well-regarded reputations, it has unique technical capacity to recognize misconduct in performance of works that others might miss. *Fourth*, BWDB will appoint a Procurement Panel to oversee the procurement of large contracts.

225. **Procurement Risks**. These risks are addressed through the overall design of the project and through enhanced transparency, in addition to following Bank ICB guidelines with its requirements for firm timelines, transparency, and other mechanisms to guard against corruption. Works, goods, and services procured under the project have been grouped into a few large contracts to be administered directly from Dhaka. This concentration of contracts allows for extensive scrutiny and special arrangements for each procurement and subsequent management of execution. In order to avoid undue influence on procurements, a detailed mapping of each step in the procurement process with a designation of a finite list of persons with access to specified documents and associated information will be put in place and shared with the World Bank and monitored/verified through Bank supervision. The mapping will be reviewed by the Bank in order to ensure appropriate access to sensitive documents on a need-to-know basis and maximum publication of other documents.

226. A Procurement Panel will be setup of two international/expatriate and one national consultants, and would be responsible for key procurement actions for large value contracts as specified in the procurement plan. These would include short listing of consultants, pre-qualification of contractors and suppliers, review and issuance of bidding documents, evaluation of bids /proposals and recommendation of award. This would also ensure that the bidding process is followed with full integrity and thoroughness, following appropriate guidelines.

227. *Avoiding Conflict of Interest.* All officials of the MoWR and BWDB who are involved with the process of procurement for the project, including issuance of recommendations for contract awards, as well as PP members, shall be required to submit declarations of no conflict of interest in these procurements. These declarations shall specify that there is no conflict of interest between bidding organizations and their personnel and (a) PP members or (b) other officials of the MoWR and BWDB involved with the procurement process or their close relatives. The declarations will be submitted prior to the commencement of evaluation of bids. BWDB will maintain these declarations on file as well as provide them to the Bank. If during the procurement process a member is found by any Project oversight

entity or by the Bank to have concealed a conflict of interest, that individual shall be immediately replaced. The GoB is aware that if such information is revealed following the conclusion of the procurement process the Bank will consider appropriate remedies.

228. Bidding documents including the Request for Proposal, instructions to bidders/consultants, and model contracts would include measures to mitigate misconduct. For instance, bidders would be required to: disclose in full any agents used by the bidders during the procurement process, along with the terms on which those agents were hired (both scope of work and remuneration); and certify any conflict of interest most notably relationships with Government officials, whether direct or indirect (e.g., via direct relationships with the officials related to the subject tender, or via companies and/or relatives of officials). These documents would also define the scope of the Bank's audit rights.

229. Transparency of the procurement process will be enhanced through a package of measures. The designated Communication Officer will develop and implement a detailed plan for the disclosure of information by the project. This will include disclosure of all relevant documentation and plans related to the procurement process with the goal of providing access to information to the wider community beyond interested bidders and supporting design, management, and construction consultants. Part of this plan will include a website dedicated to the CEIP-I prominently identified on the BWDB's website with a dedicated page for summaries of procurement actions. These documents will be placed on the website within two weeks of their issuance to the public domain (including after a Bank no objection, in cases where this is required). This documentation will include:

- Pre-qualification documents for ICB contracts more than US$10 million;
- All Invitations to Bid;
- Bidding documents;
- Bid opening minutes;
- Information on contract award.

230. Within the PMU an enhanced complaints and response mechanism will be established in BWDB to operate throughout the life of the project, including during the procurement stage. There will be one mechanism established at the field office level, and one in Dhaka. BWDB will maintain a log of complaints which will track the status of response or follow-up. Depending on the nature of the complaint, the unit will assign the review of complaints to internal auditors or third party auditors, or may transfer the investigation of complaints to other appropriate investigative bodies such as the police or the Anti-Corruption Commission. Complaints received shall be responded to within ten days of receipt, with a copy to the PSC and the World Bank.

231. **Contract Execution Risks**. Separate entities will be involved with execution of contracts and therefore will also provide a check against misrepresentation. In the execution of the civil works contracts, the PD's will serve as the **Employer's** representative, while the Construction Supervision Consultants will serve as the **Engineer** for construction supervision. At the site, Resident Engineers, appointed by the Construction Consultants with a team of specialists and inspectors will supervise the Contractor. A Third Party will be engaged to perform the M&E assessment of the project's impact.

232. The IPOE will monitor technical aspects involved with the civil works and provide a report to the PD, PSC and the Bank on a regular basis on its assessment of progress of the project, quality of works and other construction and design issues. Technical audit can be initiated when found necessary to assess through appropriate mechanisms.

233. The contracts would have robust audit clauses that permit access to company documents related to both the procurement and contract implementation, and to any documents generated by the company

during those processes (not just financial records). The latest Guidelines for audit clause language, which extend to companies that bid for contracts but did not win them, also apply to procurements under this project.

234. **Risks in delivery of benefits under the RAP**. The proactive information disclosure measures involving the website and the enhanced complaints mechanism will be utilized for the implementation of the RAP as well. In addition, implementation will be through external NGOs with experience and skills to carry out the benefits program. M&E Consultants would conduct monitoring including a survey on the effectiveness of the RAP among the population in the targeted areas, and will employ a group of NGOs to conduct its monitoring efforts. The NGOs responsible for RAP delivery will hold public hearings at least once a quarter on the implementation of the plans. Accountability meetings will be held with the public and CSOs in the coastal area and in the capital (given the national interest in the project and the presence of strong, interested NGOs and academic institutions in Dhaka) to explain the RAP.

235. The project will issue photo ID cards to the beneficiaries after proper scrutiny and validation of their identities. Management of payments will be made to bank accounts established in the name of the beneficiaries. Where no bank account exists, the NGO will help households to establish a bank account. Where this is not possible, payments will be based on written documents and contracts properly agreed and registered in the presence of resettlement NGOs. In all the cases, cash entitlements of beneficiaries will be determined and documented using databank and automated system and an instrument like eligibility statement will be prepared and certified by appropriate authorities and assignees. Such records would be maintained for audit and post review by BWDB, the Bank, and selected representative of the NGOs. Payments for acquisition of properties and other compensation made by the Deputy Commissioners over and by BWDB over US$20,000 equivalent for each beneficiary would be subject to prior review by IDA and other payments would be subject to post review. The prior review threshold level would be reviewed after one year and adjusted appropriately.

236. Specific measures will be designed on (i) consultation, feedback and grievance-redress mechanisms to alert project staff to problems identified by beneficiaries, affected people, and other stakeholders; (ii) participatory planning to ensure the project meets the needs of beneficiaries; and (iii) participatory monitoring to identify problems. Where PCs do not already exist, the project will establish them. PCs are made up of local stakeholder groups at the field level and are in charge of monitoring project progress in implementation of civil works construction and resettlement plans, as well as in afforestation and social forestry programs. Issues identified can be reported via the field level, district level or project level GRMs. In addition, WMOs will be established in 4 – 6 Polders to ensure proper O&M (of minor works).

Monitoring and Bank Supervision

237. GAAP will be monitored regularly through indicators and reflected in the Quarterly Progress Report prepared by the implementing agencies. The M&E Consultant engaged independently to act as a Third Party monitor will also monitor the implementation of the GAAP using the Matrix prepared below as monitoring tool. Any delay in implementing the GAAP will be brought to the attention of the **PSC** so that mitigation measures can be quickly found.

238. The World Bank will also closely monitor the implementation of the GAAP. The project will require intensive supervision by Bank staff. Supervision missions, especially at the start of the project, will be more frequent and would involve qualified staff in all disciplines, including procurement and financial management, as well as social and resettlement specialists, and engineers. The Bank will report on the GAAP status through its aide memoires for supervision missions.

239. The Bank will apply sanctions as per its guidelines if it determines incidences of fraud, corruption, collusion and coercive practices. These sanctions may include fines, blacklisting, suspension of disbursements, or ultimately cancellation with respect to that contract. The Bank will seek first to remedy cases of corruption through cooperation with the implementing agencies. Any entity that is found to have misused funds may be excluded from subsequent funding. The GAAP matrix proposes actions for each of these issues, timeline for each action, and responsible agency for implementation.

240. The GAAP will be adjusted as necessary during implementation to reflect governance issues which may emerge and/or to add actions.

CEIP-I- Matrix of Action

Issues/Risks/ Objective	Actions	Agency responsible	Timeline	Early Warning Indicators to Trigger Additional Action
Institutional Risks				
Need to **strengthen capacity** to handle large volume procurement, financial management, contract management, communications, and monitoring functions	Establish PMU with internally or externally hired staff as per the agreed Organogram.	BWDB	Key staff recruited 3-6 months after project effectiveness.	Delays in conduct of procurement, execution of contracts and processing of payments.
	Retain existing consultants or engage new consultants for design, construction supervision	BWDB	Contracted 1st year;	
	Contract Third Party M&E functions	BWDB	Contracted 2nd year	
	Increase frequency of Bank supervision missions, especially during the first 2 years.	WB	At least twice a year	
Need for proactive provision of **information** and enhanced transparency	Appoint a Communication Specialist as part of the PMU to act as RTI officer (until BWDB engages an RTI officer) in accordance with the RTI act.	BWDB	3 -6 months after project effectiveness	Lack of information officer or frequent replacement
	Quarterly Reporting on Project Implementation by PMU	BWDB	Quarterly	
	Set up a website and provide regular information on project performance as well as procurement information	BWDB	Website set up by end of Year 1. Website regularly updated	Delays in establishment of website/ publishing information
Procurement Risks				
Reduce risk of corruption in **procurement**.	Retain design of few contracts processed in Dhaka to enhance scrutiny	BWDB	On-going	Procurement red flags in ex ante and ex post review
	Publish/agree detailed mapping of procurement processes, including finite list of who has access to documents when in the process	BWDB	On-going	Inconsistencies with 'need to know' principles in procurement mapping, evidence of unauthorized access to information
	Enforce ICB procurement guidelines for documentation, timelines, and transparency	BWDB, Bank	On-going	
	Appoint a Procurement Panel	BWDB	3-6 months after project effectiveness	Panel members not recruited
	Enhance complaints mechanism with reporting established and follow-up guidelines	BWDB	On-going	Nature and frequency of complaints
Potential for or reduce risks of **conflict of interest** among participants in procurement	Declarations of no conflict of interest by BWDB personnel, including members of PP and bidders	BWDB	BWDB personnel by effectiveness; bidders at submission	
	Review statements of financial interests encompassing key project staff	BWDB	Within one month of submission	

	Require bidders' statements concerning agents and other possible connections to persons involved with procurement.	BWDB	At bidding stage	
Contract Execution and Project Management Risks				
Avoid collusion of parties involved and ensure transparent management of contracts	BWDB website includes information on contract execution (e.g. gross estimate of completion of works etc.) Establish enhanced complaints mechanism, including ICT Numerous level of scrutiny: - PD serve as Employer's representative - Construction Supervision Consultant as Engineer - Nominate Resident Engineers at the site - M&E Consultant to oversee project performance	BWDB BWDB Construction Consultants, M&E	As information becomes available By project effectiveness	Website does not include updated information
Fraud and Corruption in Delivery of RAP Benefits				
Potential for improper targeting of beneficiaries and/or false delivery	Contract out implementation of RAP to experienced NGOs, with reputable track record for similar programs Ensure third party monitoring by the M&E Consultants Conduct survey among beneficiaries Enhance complaints mechanism, including use of ICT Suo moto disclosure of information	NGOs M&E M&E M&E BWDB	Contract in place Contract in place Unit in place by effectiveness or before Designated office in place by effectiveness, begin implementing expanded disclosure plan three months after effectiveness	Reviewers (BWDB, WB) receive plausible complaints borne out by frequency or other corroboration Survey results identify improprieties

Annex 6: Economic and Financial Analysis

BANGLADESH: COASTAL EMBANKMENT IMPROVEMENT PROJECT PHASE-I (CEIP-I)

241. The economic analysis of the CEIP project covers 17 polders, and is based on the Cost-Benefit Analysis (CBA) approach. The CBA is first conducted for Components A and B2, then extended to capture the results into an aggregated CBA at project level[61]. The analysis uses a discount rate of 10 percent. It considers a time horizon of 33 years, to account for the project's long-term benefits related to climate change.

A. Polder classification

242. The polders covered by the project can be affected by storm surge, by river flooding or by both. For simplicity, this analysis estimates either the storm surge or the river flood impacts, depending on which is the ***dominant*** cause of damage. As such, the estimates provided in this analysis are conservative. Two groups of polders have been identified, according to the above criteria (Table 6.1).

243. ***Polders mostly affected by storm surge*** are those exposed to the ocean, thus most likely to be hit by the cyclone. Once the existing embankment is overtopped, it is likely that it will be breached[62]. As a result, saline water flows into the polder and reaches a minimum depth of 1.5-1.75 meters. The depth of the saline water and the flow speed causes significant damages. However, water starts to recede within a few hours.

244. ***Polders mostly affected by river flooding*** are those facing major rivers, such as Baleswar and Passur. For these polders, flooding can be induced by stream flow inundation, or a combination of stream flow inundation and heavy precipitation. For these polders, once water overtops the embankment, it flows continuously in the polder for a few days. This leads to the inundation of the whole polder. However, the current is not as strong as the current of storm surges.

Table 6.1. Polders affected by storm surge and river flooding

Dominant characteristics	Polder number
Mostly affected by storm surge	**35/1**, 39/2C, 14/1, 15, 40/2, 41/1, 43/2C, 47/2, 48
Mostly affected by river flooding	**32, 33, 35/3**, 16, 17/1, 17/2, 23, 34/3

Source: Discussions with the Institute of Water Modeling (IWM). We conducted separate CBA for the polders marked in 'bold'.

245. For polders affected mostly by storm surge, an individual CBA has been carried out for polder 35/1, then for the group of remaining 8 polders. For those affected mostly by river flooding, individual CBAs have been carried out for polders 32, 33 and 35/3, then for the group of the remaining 5 polders.

B. Methodology

The economic analysis refers to the year 2011. Table 6.2 identifies the main costs and benefits related to the project. Direct costs include investments and O&M costs linked to civil works, afforestation, resettlement, supervision and monitoring. Benefits include:

i) avoided damages due to storm surge (or river flooding)[63]
ii) improved crop production due to better drainage
iii) forest benefits due to foreshore afforestation[64]

[61] All project components, except for Component D related to project management.
[62] The underlying reasons are: most of the embankments were built almost 40 years ago and exceeded their designed life span; they suffer from poor maintenance; and they were compacted manually, instead of by use of machine.
[63] This results from heightening, re-sectioning or retiring the embankment.

Table 6.2. Benefits and costs linked to the project

	Polders affected by storm surge/river flooding
Costs	Civil works* Afforestation Resettlement Supervision and Monitoring
Benefits	**i) Avoided damages due to storm surge/river flooding**
	Crop production Fisheries Livestock Non-agricultural sectors Roads Property Lives**
	ii) Improved crop production due to better drainage
	iii) Forest benefits

*Related to embankment, khal, drainage structure. ** The benefit of lifesaving due to the project has not been estimated in monetary terms in this analysis.

246. ***Valuation approach.*** The economic analysis includes the investment and O&M costs related to civil works, afforestation and resettlement, estimated at economic prices. The economic prices are derived from financial prices multiplied by a standard conversion factor of[65] 0.9.

247. Civil works start at different times for different polders. Thus, the costs cover years 1-3 of the project for some polders (35/1, 32, 33 and 35/3) and years 2-7 for the remaining polders. Benefits start after the project investment is completed. A sensitivity analysis considers changes to the main parameters, such as costs of the project, thus capturing all physical and price contingencies.

248. Valuation of benefits is extremely difficult and subject to limitations. This is primarily due to the uncertainties related with the storm surge occurrence and climate change issues. The valuation approach for each type of benefit is presented below.

i) Avoided damages due to storm surges/river flooding. In the absence of the project, storm surges/river floods would inundate the polders, affecting all assets, such as crops, livestock, roads and property. With project, the upgraded embankments will reduce the frequency of overtopping, thus reducing the probability of inundation from certain storm surges/floods. Based on the above, the avoided damages due to storm surges/flooding are calculated as:

*Avoided damages = Value of assets exposed * Expected damage ratio * Reduced probability of inundation*

249. The first two factors (value of assets exposed and the expected damage ratio) reflect the mean damages inflicted by storms (floods) against which the new embankment protects (and the old embankment does not). Estimating this value is challenging, because different storms (floods) affect polders differently, depending on their strength, wind velocity, water level, etc. It is expected that the

[64] Forests dissipate the energy that causes large waves and thus partially protects the embankments from the force with which the water strikes them.

[65] This is the ratio of economic price value of all goods in an economy at their border price equivalent values to their domestic market price value. See also World Bank (2011); ADB (2010) for the same standard conversion factor used in Bangladesh.

magnitude of damages be positively correlated with the strength of storms, however, no study has yet quantified the cause and effect relationship between these factors. Box 1 and Table 6.3 analyze the situation for *polders affected mostly by storm surges* - essentially for polder 35/1. It estimates the mean damages based on the magnitude of damages caused by Sidr in the polder, adjusted for changes in the affected sectors (Sidr damages * 0.75). For *polders affected mostly by river flooding*, mean damages are estimated based on sector-specific damage and loss functions derived either from Sidr experience or based on consultation with several experts. Because these floods are likely to cover the whole polders for an extended period of time, the mean damages are assumed to be equal to those caused by Sidr (Sidr damages * 1). Because of the uncertainties related to damage incidence caused by different storm intensities, a sensitivity analysis to changes in mean damages caused by storm surges is conducted at the end of this annex.

250. Reduced probability of inundation is thoroughly discussed in Box 2 and the results for the 4 individual polders are presented in Table 6.4. Accordingly, for polder 35/1, the probability of overtopping the existing embankment varies from 17 percent in year 1 to 50 percent in year 33. By contrast, the probability of overtopping the upgraded embankment varies from 2 to 4 percent during the same period.

ii) ***Improved crop production*** due to better drainage is estimated based on the extended cropped area due to reduced waterlogging and an improved cropping pattern, as a result of reduced salinity during dry season.

iii) ***Forest benefits*** include the value of tangible products (timber, fuelwood, golpata), based on planned yields and current prices. In addition, forests protect the embankments located behind them, a benefit already incorporated in the analysis through reduced O&M costs during the lifetime of the embankment.

Box 1. Estimating the damages inflicted by a storm surge

Estimating the damages due to a storm surge is challenging. The only available data quantify the damages affected by cyclone Sidr on the coast and on different polders. To complete the CBA for polder 35/1, we estimate below the mean damages (= exposed assets * expected damage ratio) caused by any storm surge against which the new embankment protects (and the old embankment does not).

IMW data reveal that for polder 35/1, the return period of the new embankment is 1 in 55 years (year 1). Because of climate change issues, the return period of this embankment would reduce to 1 in 25 years (year 33). At the same time, based on historical data, cyclone Sidr was estimated to have a return period of 1 in 35 years for polder 35/1 (though only 1 in 10 years with respect to the entire Bangladeshi coast). Thus, the new embankment protects against Sidr-like surges, as well as other surges with return periods between 1 in 25 and 1 in 55 years. In other words, for polder 35/1, an 'average' storm against which the project protects can be identified with any storm with return periods varying between 1 in 25 and 1 in 55 years.

The current embankment is very weak. Any surge with return period higher than 6 years, would overtop and breach it. This allows water to reach a depth of 1.5-1.75 meters for a few hours. Under these circumstances, it is reasonable to assume that the damages to agriculture and fisheries caused by any storm surge overtopping the embankment would be similar to those caused by Sidr. Damages to property (houses) and roads may differ from those caused by Sidr because of different storm intensities. Conservatively assuming that damages to property and houses are only 50 percent of those caused by Sidr in the polder, the mean damage of a storm against which the new embankment protects would be 0.75 of that caused by Sidr. Table 6.3 below presents other scenarios of damage estimations. The base analysis uses the central estimate (0.75), while a sensitivity analysis considers the other scenarios of the project.

Table 6.3. Mean damages caused by a storm surge in polder 35/1

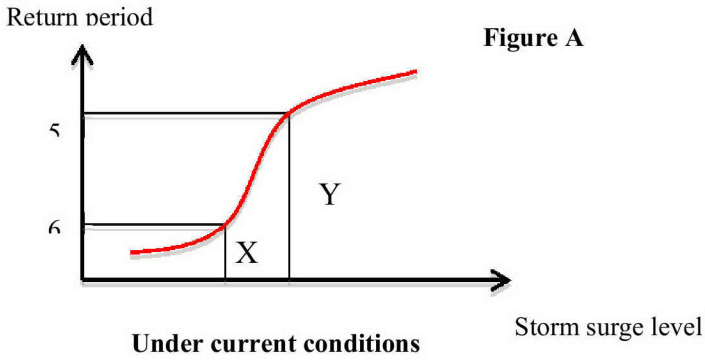
	Unit	Property	Road	Crop	Livestock	Fisheries	Other sectors	Total avoided damage	Damage ratio*
Sidr	BDT mil	500	200	200	70	134	44	1,171	1
Scenario 1	% Sidr damages	75%	75%	100%	100%	100%	100%		0.85
	BDT mil	395	139	212	68	134	44	993	
Scenario 2	% Sidr damages	50-60%	50-60%	100%	100%	100%	100%		0.70-0.80
	BDT mil	290	102	212	68	134	44	850	
Scenario 3	% Sidr damages	25%	25%	100%	100%	100%	100%		0.55
	BDT mil	132	46	212	68	134	44	636	

Note: * refers to the ratio between the damage caused in each scenario and that caused by Sidr

Box 2. How much do embankments reduce the probability of polder inundation?

We present this methodology by using data for polder 35/1, based IWM modeling[66] (Table 6.3). Accordingly, the polder has a current embankment height of X meters, with a return period of 6 years (Figure A). In other words, on average, the probability of the embankment being overtopped is 1 in 6 years, (i.e. 17%).

Figure A

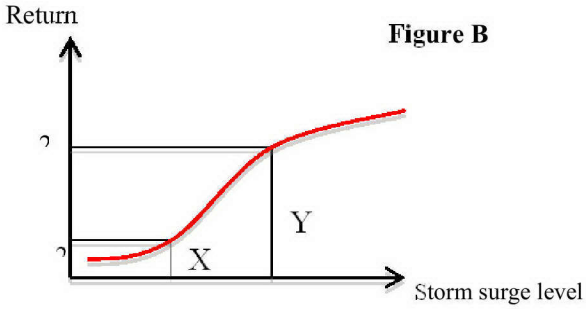


Under current conditions

The project will raise the embankment height to Y meters, having a return period of 55 years. This means that the probability of the new embankment being overtopped is 1 in 55 years, on average (i.e. 2%). Thus, the project will reduce the risk of getting inundated from 17% to 2% in each year. Based on the above, the benefit of raising the embankment is the reduction in the risk or probability (**15%**) of getting inundated multiplied by the mean damages inflicted by a storm surge that has a return period between 6 and 55 years.

The methodology becomes more complicated if climate change scenarios are taken into account. With climate change, due to eustatic SLR and other related factors – such as subsidence – the return period of the existing embankment reduces, from 6 to 2 years (Figure B). This means that the probability being overtopped increases from 17% in year 1 to 50% in year 33. Similarly, the return period of the upgraded embankment declines from 55 to 25 years, which means an increase in the probability of being overtopped from 2% in year 1 to 4% in year 33.

Figure B



With climate change

Table 6.4 presents the results for flood-affected polders 32, 33 and 35/3. Accordingly, the probability of the existing embankment being overtopped increases from 10% (year 1) to 67% (year 33). At the same time, if the project takes place, the probability of being overtopped varies from 1% to 4% during the same period. For the sake of simplicity and in absence of improved information, the economic analysis uses a linear increase in this trend over the 33-year period.

[66] The Institute of Water Modeling (IWM) provided polder-level information on probabilities of the current and new embankment being overtopped, based on storm surge and river flood modeling.

Table 6.4. Estimated reduction in probability of polder inundation

	Polders				Notes
	35/1	32	33	35/3	
Return periods (no. of years)					
- for existing embankment (year 1)	6	10	10	10	a
- for existing embankment (year 33)	2	1.5	1.5	1.5	b
- for designed embankment (year 1)	55	100	70	90	c
- for designed embankment (year 33)	25	25	25	25	d
Overtopping probability (%)					
- for existing embankment (year 1)	17	10	10	10	1/a
- for existing embankment (year 33)	50	67	67	67	1/b
- for designed embankment (year 1)	2	1	1.4	1.1	1/c
- for designed embankment (year 33)	4	4	4	4	1/d
Reduction in overtopping probability due to the project (%)					
- for year 1	15	9	9	9	1/a-1/c
- for year 33	46	63	63	63	1/b-1/d

Notes: return periods for the existing and the designed embankments are based on IWM data and modeling[67].

C. Economic analysis

252. The CBA is first conducted for Components A and B2 then extended to capture the results into an aggregated CBA at project level.

CBA for Components A and B2 (US$271 million, or 84 percent of total project base cost)

253. This economic analysis is performed in three steps: (i) CBA for individual polders affected mostly by storm surge (polder 35/1); (ii) CBA for individual polders affected mostly by river flooding (polders 32, 33 and 35/3); (iii) CBA for all polders. The sections below explain the valuations of each impact. A detailed excel document associated with this annex provides and describes all the coefficients used for each valuation in all the 17 polders.

CBA for polder 35/1 (affected by storm surge)

254. With an area of 13,100 ha and a population of 99,200 people, polder 35/1 is the largest of the 17 polders covered by this project. The existing embankment extends over 63 km and is home for about 17 percent of the population in the polder. Cultivated area covers 10,400 ha[68]. The polder is vulnerable to storm surges, which cause significant losses of assets and agricultural production. To reduce these losses, the project will upgrade this polder through civil works, such as heightening of the embankment and improved drainage sluices.

Costs

255. These costs include: (i) investment costs, mostly related to construction works, afforestation and resettlement (BDT2.2 billion in present value terms, PV); (ii) O&M costs, which annual value represents about 3 percent of the investment cost (BDT0.6 million). Overall, the present value (PV) of these costs is estimated at **BDT2.8 billion**.

[67] Bangladesh Water Development Board. 2012. CEIP. Draft Final Report, September 2012.
[68] If shrimp production is also included, the total cultivated land is 10,700 ha.

Benefits

256. These benefits include avoided damages from storm surges (crops, fisheries, livestock, roads…) and additional benefits (e.g. forest). As discussed in Section 2, the avoided damages from storm surges are estimated as mean damages caused by storms against which the new embankment protects multiplied by the reduced probability of inundation because of the project. The latter varies from 15 percent in year 1 to 46 percent in year 33 for polder 35/1 (Box 1 and Table 6.4).

257. ***Crops***. Aman, Aus, and Boro rice are among the major crops in Bangladesh. Their cropping calendars differ according to Rabi and Kharif seasons and so does the frequency of storm surges[69]. Thus, crop losses due to storm surges have been estimated based on: crop production during Rabi/Kharif in regular years; probability of an average storm surge striking during Rabi/Kharif; the percentage of crop land affected; and the percentage of standing crop lost in the affected land.

258. Available data on cultivated areas, yields and prices lead to an annual crop value of BDT830 million (Table 6.5). In addition, historical records show that Bangladesh is about twice as likely to be hit by a tropical storm surge during Rabi compared to Kharif (67 percent vs. 33 percent) (IWM data). Communications with the Department of Agricultural Extension reveal that when a storm strikes, about 65 percent of crop land is affected (based on Sidr experience); and about 64 percent of the standing crop is lost on the affected land. As a result, the current damage due to a storm surge similar to Sidr is estimated at BDT 212 million. Assuming an annual growth of the agricultural sector of 2.4 percent[70] the avoided crop damage is estimated at BDT390 million in PV terms.

Table 6.5 Estimated crop production in polder 35/1 (2011)

Crop[a]	Cropped area[b] (ha)	Yield (mt/ha)	Price (000 BDT/mt)	Total (million BDT)
T. Aman (LV/LIV)	4,255	2.2	15.5	142
T. Aman (HYV)	5,310	3.9	15.5	318
Boro (HYV)	225	4.0	15.5	14
T. Aus (LV)	280	2.5	15.5	11
T. Aus (HYV)	1,150	3.5	15.5	63
Wheat	40	2.6	18.0	2
Chilli	35	1.0	49.6	2
Pulses	4,530	1.0	40.6	184
Potatoes	100	15.0	4.5	7
W.Vegetables	280	10.0	5.4	15
S.Vegetables	230	10.0	2.3	12
Spices	45	3.0	0.1	2
Oil Seeds	40	1.0	0.04	1
Sugarcane	20	30.0	0.6	2
Orchard	335	10.5	3.5	16
Total	**16,875**			**830**

Notes: [a] Crops during Kharif season include T. Aman (LV/LIV), T. Aman (HYV), by products (straw), pulses and W. vegetables. All the other crops grow during Rabi. [b] Cropped area is the sum of the areas under all crops in a year. For 2011, it is estimated at 10,400 ha * 162.2% = 16,875 ha (see total in the table).

[69] Aus is grown in pre-monsoon (Kharif-I: March-June), Aman is grown in the monsoon season (Kharif-II: July-October), and Boro is grown in the post-monsoon season (Rabi: Nov-Feb.).
[70] Yu et al. 2010

259. ***Livestock.*** The polder currently includes 16,000 cattle, 9,400 goats and sheep and 193,700 poultry. Data from the Department of Agricultural Extension shows that the death rate caused by cyclone Sidr in the polder was 18 percent for cattle, 38 percent for goats and sheep and 37 percent for poultry. Using the same death rates, a storm surge similar to Sidr would cause about 2,900 deaths of cattle, 3,500 deaths of goats and sheep and 71,000 deaths of poultry. Based on the economic price of livestock, the current damage due to a storm surge similar to Sidr is estimated at BDT68 million. Considering an annual growth of the livestock sector[71] of 3 percent, the avoided livestock loss is estimated at BDT120 million.

260. ***Fisheries.*** Fisheries are one of the fastest growing sub sectors in this polder, mostly due to fish and shrimp aquaculture. The economic value of fish and shrimp production in the polder is about BDT299 million[72]. Sidr cyclone affected about 90 percent of the fish production at the time of the event. However, considering that most fish types have two production cycles during one year, any storm surge similar to Sidr would cause a loss of 45 percent of the annual fish production, or BDT134 million. Based on an annual growth of fisheries sector of 3.7 percent[73], the avoided loss in fish production is estimated at BDT280 million.

261. ***Property.*** The polder is currently home for 17,800 households. Currently, only 4 percent of rural households could afford pucca houses[74], 10 percent could afford semi-pucca75 houses and 86 percent lived in kutcha houses76 (BBS 2005). As a result, there are 1,000 pucca, 1,800 semi-pucca and 14,900 kutcha houses (year 1).

262. The growth of population (1.35 percent per year[77]) and income (6.5 percent per year[78]) over time indicate that households will increasingly move to pucca houses. Thus, it is expected that in 30-year time, 73 percent of households will live in pucca houses, 17 percent in semi-pucca houses and only 10 percent in kutcha houses. This corresponds to an estimated 20,000 pucca, 4,500 semi-pucca and 2,800 kutcha houses on the polder by year 33.

263. Cyclone Sidr damaged all houses in the polder. It fully damaged most *kutcha* houses (76 percent) and caused partial damage to the remaining *kutcha*, *pucca* and *semi-pucca* houses. Thus, it is considered that any Sidr-like storm would damage existing houses in the same proportion. Assessing the different types of damage is based on the cost of house repair and the value of contents damaged[79]. As a result, the avoided property damage due to the project is estimated at **BDT1.3 billion**.

264. ***Roads.*** Roads are highly sensitive to inundation. They become partially damaged with inundation of less than 1 meter, and fully damaged when inundation exceeds 1 meter (World Bank 2010). In 2007, road network extended on 73 km, including 30 km of *pucca* road and 43 km of *kutcha* road. By year 33, it is expected that road network will increase by 22 percent[80] and *pucca* roads will replace all *kutcha* roads. This would correspond to 91 km of pucca road.

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[71] Based on communications with the Livestock Department.
[72] Estimated based on area, yield and price data collected from the Department of Fisheries, Upazilla Fisheries Office.
[73] Based on communications with the Fisheries Department.
[74] *Pucca* house is a brick house with a concrete roof. Only households with a monthly income of at least BDT 3500/capita could afford a pucca house.
[75] Typical characteristics of semi-pucca housing are: foundation made of earthen plinth or brick and concrete, walls made of bamboo mats, CI sheet and roof made of CI sheet with timber framing. Only households with a monthly income of at least BDT 2000/capita could afford a semi-pucca house.
[76] Typical characteristics of kutcha housing are: foundation made from earthen plinth with bamboo, walls made of organic materials, and roof thatched made of straw, split bamboo etc.
[77] Communication with Sharankola Upazilla Office.
[78] Projection of the GDP per capita, based on BBS data.
[79] These costs are estimated at TK75,000/pucca house (50 percent of content damage), TK25,000/semi-pucca house (50 percent of content damage) and TK12,500 (full repair and content damage) (World Bank 2010, data adjusted to 2011 prices).
[80] World Bank. 2010. Economics of adaptation to Climate Change. Bangladesh. World Bank.

265. Cyclone Sidr fully damaged 27 percent of *pucca* and 23 percent of *kutcha* roads; it damaged only partially the remaining roads. Using these ratios and on the cost of repairing *pucca* and *kutcha* roads[81], the direct road damage avoided by the project is estimated at BDT110 million. In addition, economic losses due to road closure (e.g. production losses due to delays) are estimated at about 22 percent of the total damages to the road infrastructure[82], namely BDT25 million. Repairing damages to bridges and culverts along these roads increased total loss of transport sector damages by 100 percent[83], or BDT135 million. Overall, total avoided losses due to the project amount to **BDT360 million.**

266. ***Other sectors***. Sidr affected also other non-agricultural productive sectors, through production losses of small and medium enterprises, local trade and businesses. These losses were estimated at 3.7 percent of total damages calculated for the above sectors, or BDT44 million for the project's 4th year[84]. In lack of more accurate information, we assume that the project avoids damages in the same proportion as in the case of Sidr. Considering the annual economic growth (6.5 percent per year), the avoided losses add up to **BDT130 million**.

267. ***Lives***. Sidr caused about 600 deaths on the polder in 2007. Based on the rate of population increase in the polder (1.35 percent), the number of deaths would vary from 600 to 960 during the selected time horizon, under the same housing conditions, if the project did not exist. However, in reality, housing conditions will most likely improve. This is because of the alternative protective measures (pucca houses, cyclone shelters, early warning systems) that would protect more of people over time. Considering that the number of people protected by the embankment decreases proportionally with the increasing trend of pucca houses[85], the number of lives saved is estimated to vary from 580 in year 4 to 275 in year 33. Though no monetary valuation is attempted in this report, the lifesaving benefit appears to be important.

268. ***Improved crop production due to better drainage***. Cultivated area in the polder covers 10,400 ha, most of which under single (49 percent) and double crop (40 percent). Cropping intensity is lower than the national average (162 percent vs. 181 percent[86]). This is due to several reasons, including: past crop damages due to Sidr and Aila cyclones; impossibility to grow some crops in winter due to high soil salinity; limited use of agricultural land due to inundation of coastal areas with saline tidal water. In addition, yields are also relatively low. This is a result of many factors, including use of local varieties of rice; insufficient irrigation due to water salinity; lack of knowledge on improved agricultural technologies aiming at higher value crops.

269. The project will not be directly involved in the overall development of agriculture in the polder[87]. However, the project will support agricultural development in several ways: (i) By upgrading the embankment, the project will protect against storm surges with a return period of less than 25 years; (ii) By repairing the sluice gates, it will remove drainage congestion and will arrest intrusion of saline water. In dry season the embankment will stop the inflow of saline water. In monsoon, cultivated area would be protected from inundation by tides. (iii) By reducing the inflow of saline water, the project will also create the necessary environment for farmers to undertake the Crop Diversification Program[88] promoted by the

[81] The cost of repairing pucca roads are BDT2 million per km of fully damaged roads and BDT1 million per km of partially damaged roads. Similarly, the cost of repairing kutcha roads are BDT 0.4 million per km for fully damaged road and BDT 0.16 million per km for partially damaged road (World Bank 2010, see above).

[82] GoB. 2008. Damage, loss and needs assessment for disaster recovery and reconstruction. GoB. April 2008.

[83] As above.

[84] As above.

[85] From 4 to 71 percent of total houses during years 1-33, based on the country's Household Income and Expenditure Survey (2005) and the Statistical Yearbook of Bangladesh (2006).

[86] CEIP 2013. Coastal Embankment Improvement Project, Phase 1. Volume V. Land use reports. Agriculture and Livestock. September 2012.

[87] This will be under the responsibility of relevant organizations such as Department of Agriculture Extension, Research Organizations, etc.

[88] This program supports planting of: high-value crops such as potato, sweet potato, pulses (lentil, chickpea, mungbean), oil crops (mustard, sunflower, groundnut) mainly on high or medium land; orchard crops (banana, papaya, guava) in flood free lands under irrigation; salt-tolerant crops in saline lands.

Government. As a result, the project will lead to improved cropping intensity, diversified cropping patterns and improved yields.

270. Table 6.6 provides a distribution of cropland according to different cropping patterns. A drainage model applied in the polder shows that cropping intensity would decrease to 153 percent in the absence of the project; and would increase to 206 percent, if the project takes place. In addition, a farm budget model estimates an average net economic return per hectare of cultivated land of BDT37,100[89] (without project) and BDT56,900 (with project). As a result, the incremental return for the polder is BDT205 million. This benefit is assumed to start in the 5th project year, based on local expert opinion. Considering that this benefit increases annually proportionally with the agricultural sector (2.4 percent per year), the PV is **BDT1.7 billion**.

Table 6.6. Areas under different cropping patterns (ha, except for the last row)

Area	Present situation	Future without project	Future with project
Single crop	5,075	5,747	730
Double crop	4,175	3,839	8,340
Triple crop	1,150	814	1,330
Total	**10,400**	**10,400**	**10,400**
Cropping intensity (%)	**162**	**153**	**206**

Source: results of the drainage model application to polder 35/1 (based on IWM data)

271. ***Forest benefits.*** They primarily include non-wood forest products, such as leaves, fruits and forage harvested from these forests. Based on their prices, the economic benefits are estimated at **BDT5 million**.

272. *In conclusion, adding up the above estimations, the PV of the net benefits for polder 35/1 is BDT1.5 billion, with an economic IRR of 15 percent (Table 6.7). This is a conservative estimate, as it does not capture the value of lives saved by the project.*

Table 6.7 Economic CBA for polder 35/1 (BDT million, NPV)

	Polder 35/1
COSTS (1)	**2,780**
Investment	2,190
O&M	590
BENEFITS (2)	**4,250**
i) Avoided losses due to storm surge/river flooding	2,580
Crop production	390
Fisheries	280
Livestock	120
Roads	360
Property	1,300
Other sectors	130
Lives	n.c.
ii) Improved crop production due to better drainage	1,670
iii) Forest benefits	n.n.
NET BENEFITS (2-1)	**1,470**
Economic IRR	**15%**

Notes: n.c. = not calculated; n.n. = less than BDT10 million

[89] In this polder, crops include not only cereals, but also higher value crops such as pulses (on 4,530 ha) and vegetables (on 510 ha).

CBA for polders 32, 33 and 35/3 (affected by river flooding)

273. This section explains the valuation of costs and benefits for polder 32. Estimation for the individual polders 33 and 35/3 follows the same methodology and the results are summarized in Table 6.7. Polder 32 extends over 8,100 ha and has a population of 38,400 people. Cultivated area covers 6,500 ha. Total embankment extends on 50 km, however many segments have been damaged due to Sidr and Aila overtopping. Thus, in many places, the river side slope is subject to severe river erosion and wave action. The project will upgrade the polder through several actions such as heightening of the embankment, slope protection work and repairing and adding drainage sluices.

Costs

274. These costs include: (i) investment costs, mostly related to construction works, afforestation and resettlement (BDT0.9 million); (ii) O&M costs, which annual value represents about 3 percent of the investment cost (BDT0.3 million). Overall, the PV of these costs is estimated at **BDT1.2 billion.**

Benefits

275. These benefits include avoided damages from river flooding (crops, fisheries, livestock, roads) and additional benefits (forest products and improved drainage). As discussed in Section 2, the avoided damages from floods are estimated as mean damages caused by floods against which the new embankment protects multiplied by the reduced probability of inundation because of the project. The latter varies from 9 to 63 percent during years 1-33 for polder 32 (Box 1 and Table 6.3). In addition, flooding is assumed to cause no deaths, based on past experience.

276. ***Crops***. *Aman* and *Aus* rice varieties are among the most important crops on the polder. Based on data from the Agricultural Department, cropped area on flood level F0 is 3,100 ha, of which 300 ha covered by Aus and 2,800 ha covered by Aman. Similarly, on flood level F1, cropped area is 3,600 ha, including 50 ha of Aus and 3,550 of Aman. Based on local yields[90], the polder provides an annual production of 1,511 t of Aus and 11,800 t of Aman. Past experience on damages from river flooding in the polder and results of recent modeling[91] indicate that damages account for about 25 percent from crops grown on flood level F0 and about 50 percent of those on flood level F1. As a result, losses from flooding would account for 650 t of Aus and 4,400 t of Aman every year. At an economic price of BDT15,500 per ton of cereals, the annual avoided damages total BDT78 million. Assuming an annual growth of the agricultural sector of 2.4 percent,[92] and the reduced probability of inundation (estimated above), the avoided crop damage is estimated at **BDT220 million** in PV terms.

277. ***Livestock***. The Department of Agricultural Extension provides data on the number of livestock deaths caused by river flooding in the Upazilla. Total polder area represents about 40 percent of Upazilla's surface. Assuming that livestock deaths are distributed in the same proportion, the polder would have about 97 deaths of cattle, 96 deaths of goats and sheep and 380 deaths of poultry. Based on the economic price of livestock, the current damage due to river flooding is estimated at BDT2 million (year 4). Considering an annual growth of the livestock sector[93] of 3 percent, the avoided livestock loss attains **BDT4 million**.

[90] Yield data include 1.5t/ha for Aus (Lv), 2.7t/ha for Aus (Hyv), 1.6t/ha for Aman (Lv) and 2.5t/ha for Aman (Hyv) (data collected from the Agricultural Department).
[91] Zaman, A. M., S. M. Rahman and M. R. Khan. 2009. Development of sector response functions for a water resources decision support system, 18th World IMACS/MODSIM Congress, Cairns, Australia 13-17 July 2009.
[92] Yu et al. 2010
[93] Based on communications with the Livestock Department.

278. ***Fisheries***. Similarly to the case of polder 35/1, the avoided losses to fisheries are based on the annual value of fish and shrimp production and the incidence of loss caused by river flooding (45 percent). As a result, the loss of fish production would be BDT13 million. Based on an annual growth of fisheries sector (3.7 percent), the avoided loss in fish production is estimated at **BDT40 million**.

279. ***Property***. The avoided property losses due to floods are estimated based on the distribution of houses (*pucca, semi-pucca* and *kutcha*) over time, and the damage incidence that would occur in the absence of the project. Similarly to polder 35/1, it has been estimated that there are 500 *pucca*, 900 *semi-pucca* and 7,200 *kutcha* houses (year 1). Projections based on population and income growth in the polder indicate that by year 33, there will be 8,800 *pucca*, 2,000 *semi-pucca* and 1,200 *kutcha* houses on the polder. Because river flooding is expected to inundate the whole polder, it will likely cause partial damage to all *pucca* and *semi-pucca* houses and total damage to all *kutcha* houses. Based on the cost of house repair and the value of contents damaged[94], the value of avoided property loss is estimated at **BDT670 million**.

280. ***Roads***. Road network on this polder is more extensive than that of polder 35/1 (177 km vs. 90 km). In 2007, it included 28 km of *pucca* road and 149 km of *kutcha* road. By year 33, it is expected that road network will increase by 22 percent and *pucca* roads will replace all *kutcha* roads. This would correspond to 216 km of *pucca* road. Using the damage incidence due to flooding and the cost of repairing *pucca* and *kutcha* roads, the direct road damage avoided by the project is estimated at BDT514 million. In addition, economic losses due to road closure as well as repairing damages to bridges and culverts along these roads are estimated at BDT740 million. Overall, total avoided losses due to the project amount to **BDT1.3 billion.**

281. ***Other sectors***. Using the same damage ratio to other non-agricultural sectors as in the case of Sidr (3.7 percent of total damages), the avoided losses to other sectors add up to **BDT120 million**.

282. ***Improved crop production due to better drainage***. Cultivated area in polder 32 is 6,500 ha. Similar to the polder 35/1, cropping intensity in this polder is lower than the national average (129 percent vs. 181 percent) and yields are also relatively low. Thus, by upgrading the embankment and repairing the sluice gates, the project will arrest intrusion of saline water and will create a suitable environment for farmers to undertake the Crop Diversification Program promoted by the Government. As a result, the project will lead to improved cropping intensity, diversified cropping patterns and improved yields.

283. Table 6.8 provides a distribution of cropland according to different cropping patterns. Results of a drainage model applied in the polder shows that cropping intensity would decrease to 118 percent without project, and would increase to 166 percent, if the project takes place. In addition, results of a farm budget model shows an average net economic return per hectare of cultivated land of BDT23,000 (without project) and BDT41,000 per hectare (with project). As a result, the incremental return for the polder is BDT117 million. This benefit is assumed to start in the 5th project year, based on local expert opinion. Considering that this benefit increases annually proportionally with the agricultural sector, the PV is estimated at **BDT950 million**.

[94] These costs are estimated at TK75,000/pucca house (50 percent of content damage), TK25,000/semi-pucca house (50 percent of content damage) and TK12,500 (full repair and content damage) (World Bank 2010, data adjusted to 2011 prices).

Table 6.8. Areas under different cropping patterns (ha, except for the last row)

Area	Present situation	Future without	Future with project
Single crop	5,300	5,700	2,900
Double crop	500	400	3,000
Triple crop	700	400	600
Total	**6,500**	**6,500**	**6,500**
Cropping intensity (%)	**129**	**118**	**166**

Source: results of the drainage model application to polder 32 (based on IWM data)

284. ***Forest benefits.*** They primarily include non-wood forest products, such as leaves, fruits and forage harvested from these forests. Based on their prices, the economic benefits are estimated at **BDT10 million**.

285. ***Conclusion.*** *Adding up the above estimations, the NPV for polder 32 is BDT2.2 billion, with an economic IRR of 22 percent (Table 6.9). Based on the same approaches, the CBA shows an economic IRR of 25 percent for polder 33 and 33 percent for polder 35/3. The higher IRR for these polders is mainly due to the extensive road network[95] on which the embankment would avoid substantial damage.*

Table 6.9. Economic CBA for polders 32, 33 and 35/3 (BDT million, NPV)

	Polder 32	Polder 33	Polder 35/3
COSTS (1)	**1,150**	**1,390**	**860**
Investment	880	1,060	650
O&M	280	330	210
BENEFITS (2)	**3,300**	**4,770**	**4,090**
i) Avoided losses due to storm surge/river flooding	***2,340***	***3,520***	***3,290***
Crop production	220	160	160
Fisheries	40	100	290
Livestock	n.n.	10	10
Roads	1,290	2,470	2,240
Property	670	600	290
Other sectors	120	190	290
Lives	0	0	0
ii) Improved crop production due to better drainage	***950***	***1,230***	***790***
iii) Forest benefits	***10***	***20***	***10***
NET BENEFITS (2-1)	**2,150**	**3,380**	**3,230**
Economic IRR	**22%**	**25%**	**33%**

Notes: n.n. = less than BDT10 million

CBA for all polders

286. The CBA for the two groups polders affected by storm surge (or river flooding) uses the same methodology applied for the individual polders belonging to each group. Estimating the costs is based on adding up all investment and O&M costs obtained at polder level. Estimating the benefits is more difficult and is based on two main criteria:

(a) aggregating physical data at polder level, for each group of polders (e.g. total agricultural production, total number of livestock, total road network);

[95] more than 200 km vs. 125 km for polder 32 in year 4.

(b) using common parameters developed for the polder-level CBA that reflect the ratio of damage in the absence of the project (e.g. livestock death rate due to storm surge, percentage of damage to roads, etc.).

For example, the avoided losses of crop production in the remaining 8 storm-surge affected polders are estimated based on the aggregated value of crop production in each of these polders and the damage ratio that would have occurred in the absence of the project (already estimated for polder 35/1). Similarly, the avoided damages to road network in the remaining 5 flood-affected polders are estimated based on the total length of roads in these polders and the damage incidence caused by floods (estimated for polder 32). As a result, the economic IRR for all polders is estimated at 22 percent, and summarized in Table 6.10.

Table 6.10. Economic CBA for all polders under Components A and B2 (BDT million, NPV)

	Polders affected by storm surge	Polders affected by river flooding	All polders
COSTS (1)	**10,100**	**7,200**	**17,300**
Investment	7,700	4,400	12,100
O&M	2,400	2,800	5,200
BENEFITS (2)	**19,600**	**27,200**	**46,800**
i) Avoided losses due to storm surge/river flooding	10,300	18,200	28,500
Crop production	1,100	1,000	2,100
Fisheries	1,700	1,000	2,700
Livestock	300	0	
Roads	2,800	11,200	14,000
Property	4,300	3,700	8,000
Other sectors	100	1,100	1,200
Lives	n.c.	0	n.c.
ii) Improved crop production due to better drainage	9,300	9,000	18,300
iii) Forest benefits	n.n.	100	100
NET BENEFITS (2-1)	**9,500**	**20,000**	**29,500**
Economic IRR	**17%**	**30%**	**22%**

Notes: n.c. = not calculated; n.n. = less than BDT50 million

CBA for Components A, B and C (US$305 million, or 95 percent of total project base cost)

287. This economic analysis includes the same benefits as in Section 3.1, and all costs related to Components A, B and C. The analysis leads to an IRR of 20 percent (Table 6.11). These are conservative results, by not capturing several benefits that will take place in the future, e.g. improved delta monitoring in the future and the lives saved.

Table 6.11. Economic CBA for all polders under components A, B and C (BDT million, NPV)

	All polders
COSTS (1)	**19,200**
Investment	13,600
O&M	5,600
BENEFITS (2)	**46,800**
i) Avoided losses due to storm surge/river flooding	28,500
Crop production	2,100
Fisheries	2,700
Livestock	-
Roads	14,000
Property	8,000
Other sectors	1,200
Lives	n.c.
ii) Improved crop production due to better drainage	18,300
iii) Forest benefits	100
NET BENEFITS (2-1)	**27,600**
Economic IRR	**20%**

Notes: n.c. = not calculated; n.n. = less than BDT50 million

Sensitivity analysis

288. A sensitivity analysis is conducted in relation to changes in the ***mean damages caused by a storm surge*** against which the project protects. The base analysis considered that the potential damage from an average storm overtopping the embankment is 0.75 from that of Sidr. The sensitivity analysis calculates the IRR of the project for other scenarios, as shown in Table 6.12. On the aggregate, for any chosen scenario, the project's economic IRR is higher than 19 percent[96].

Table 6.12. Sensitivity analysis to changes in the mean damages due to storm surges

Scenarios	Mean damages (% of Sidr damages)	Project's economic IRR (%)
Base analysis	**0.75**	**20**
Scenario A	0.55	19
Scenario B	0.85	21
Scenario C	1	22

289. A sensitivity analysis to ***changes in project costs*** is shown in Table 6.13. A 20 percent increase in costs (which is equal to the price and physical contingencies allocated to the project) would reduce the project's IRR to 18 percent. The project remains economically attractive at a cost increase of 50 percent.

Table 6.13. Sensitivity analysis to changes in project's costs

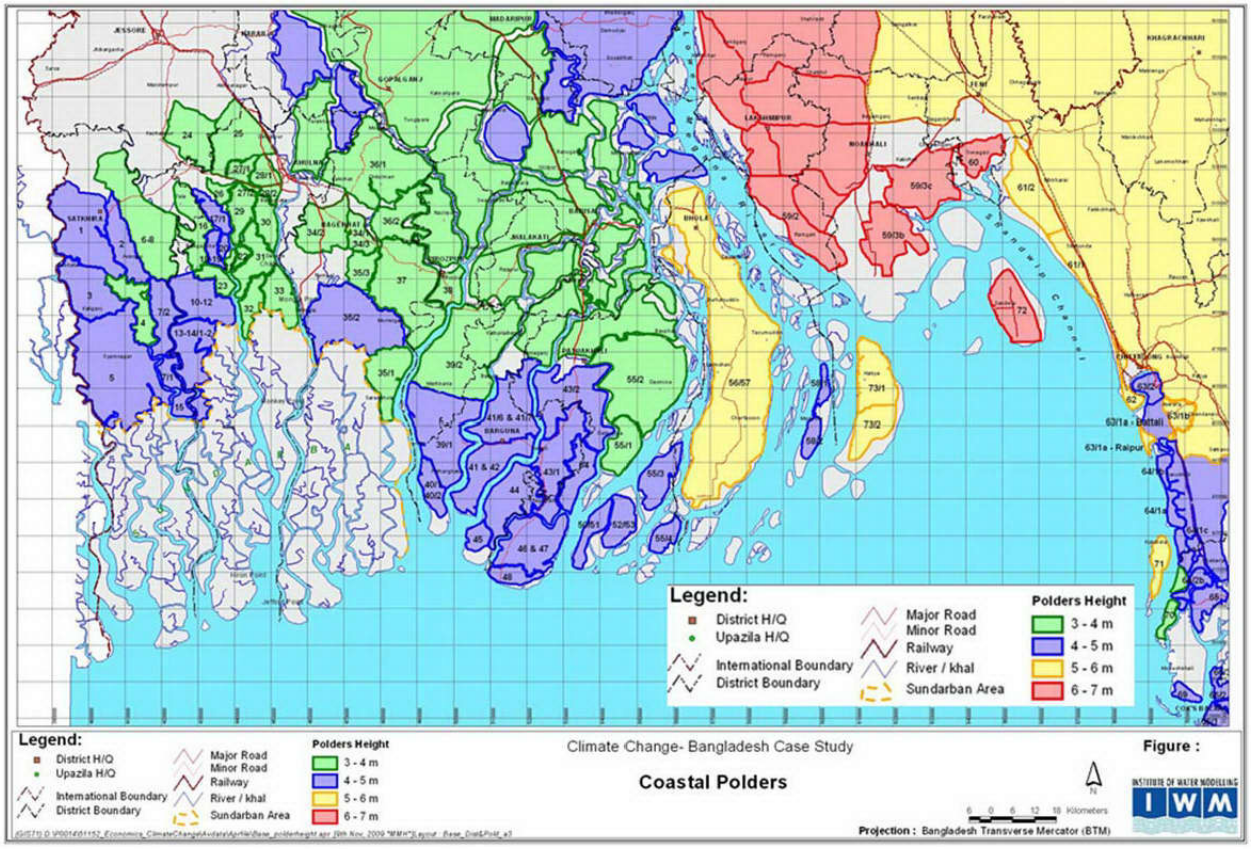
Scenarios	Project's economic IRR (%)
Base analysis	**20**
Cost increase by 20%	18
Cost increase by 40%	15
Cost increase by 50%	14

[96] This is mostly because: (i) benefits on polders affected mostly by storm surge, are only relatively sensitive to changes in these damages because of the high share of additional benefits (e.g. improved crops due to better drainage, which do not depend on the surge strength); (ii) benefits on polders affected mostly by river flooding do not depend on storm surge strength).

Annex 7: Supporting Material and Maps

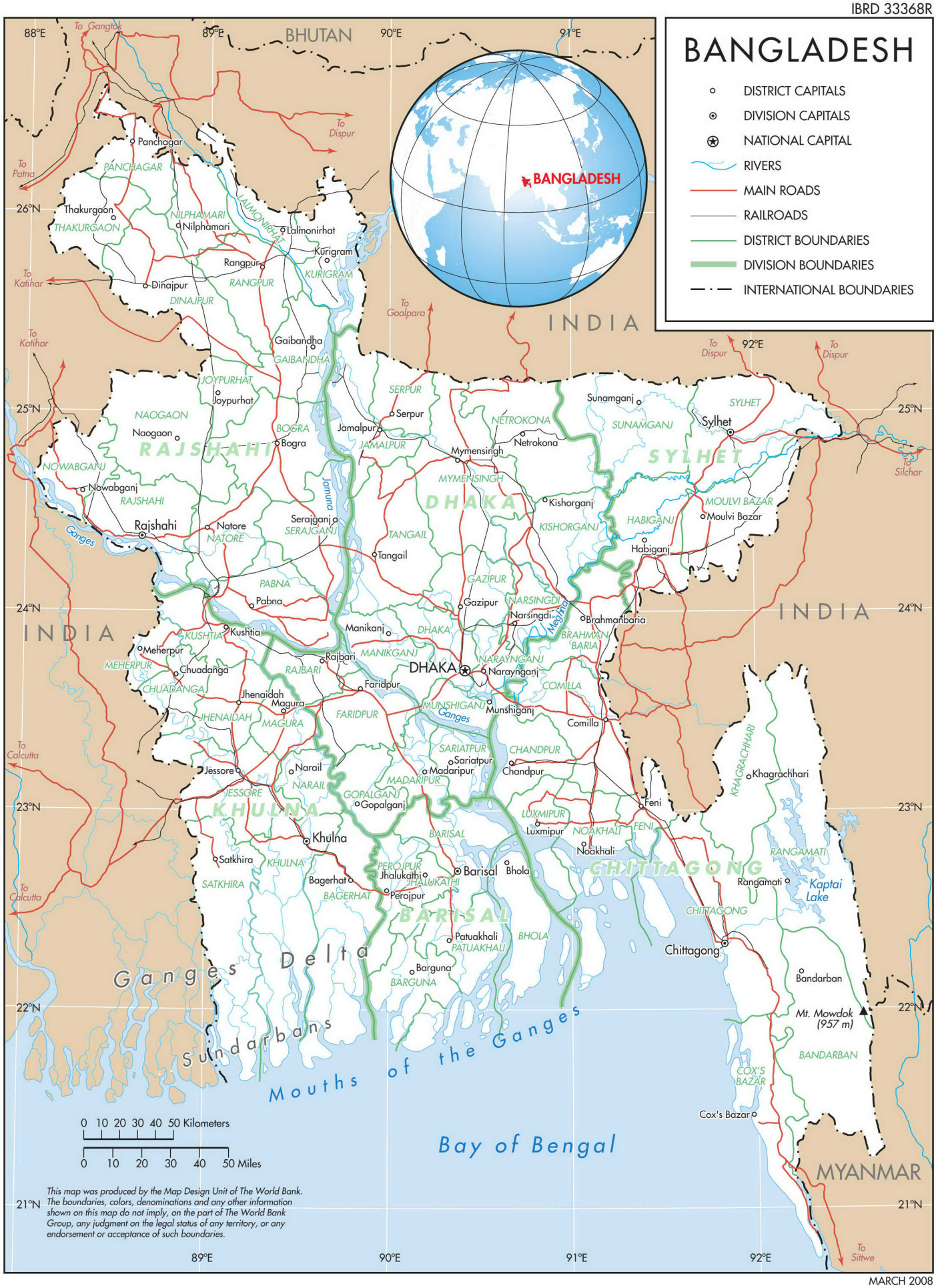
BANGLADESH: COASTAL EMBANKMENT IMPROVEMENT PROJECT PHASE-I (CEIP-I)

Polder Map



Over the last 50 years 139 polders, approximately 6,000 km of embankment, 2900 regulator and flushing inlets were constructed. Polders height varies depending on their location.

IBRD 33368R



This map was produced by the Map Design Unit of The World Bank. The boundaries, colors, denominations and any other information shown on this map do not imply, on the part of The World Bank Group, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries.

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