DATA COLLECTION SURVEY ON EFFECTIVE APPROACHES FOR IMPLEMENTATION OF NATIONAL ADAPTATION PLAN IN BANGLADESH

FINAL REPORT

FEBRUARY 2024

JAPAN INTERNATIONAL COOPERATION AGENCY

CTI ENGINEERING INTERNATIONAL CO., LTD.
SANYU CONSULTANTS INC.

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ABBREVIATIONS AND ACRONYMS

BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BDP2100	Bangladesh Delta Plan 2100
BHWDB	Bangladesh Haor and Wetland Development Board
BMD	Bangladesh Meteorological Department
BRRI	Bangladesh Rice Research Institute
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CEGIS	Center for Environmental and Geographic Information Services
DDM	Department of Disaster Management
DMC	Disaster Management Committee
DOE	Department of Environment
DPE	Directorate of Primary Education
DPHE	Department of Public Health Engineering
DRRO	Disaster Risk Reduction Organization
DSS	Department of Social Services
DSHE	Directorate of Secondary and Higher Education
DWA	Department of Women Affairs
DYD	Department of Youth Development
GED	General Economics Division
HBRI	Housing and Building Research Institute
IRRI	International Rice Research Institute
IWM	Institute of Water Modeling
JICA	Japan International Cooperation Agency
JST	JICA Survey Team
LDC	Least Developed Country
LGD	Local Government Division
LGED	Local Government Engineering Department
MCPP	Mujib Climate Prosperity Plan
MoEFCC	Ministry of Environment, Forests and Climate Change
NAP	National Adaptation Plan
NAP IP	National Adaptation Plan Investment Plan
NDC	Nationally Determined Contributions
NGO	Non-governmental Organization
PP2041	Perspective Plan of Bangladesh 2021-2041
PWD	Public Works Department
RHD	Roads and Highways Department

SDGs	Sustainable Development Goals
SHEP	Smallholder Horticultural Farmers Empowerment & Promotion
SMC	School Management Committee
SPARRSO	Space Research and Remote Sensing Organization
WARPO	Water Resources Planning Organization
WS	Workshop

1. SURVEY DESCRIPTION

1.1 Background

The People's Republic of Bangladesh (hereinafter referred to as "Bangladesh"), with most of its territory less than 5 meters above sea level and a large delta region, is susceptible to sea level rises, cyclones, and changes in rainfall patterns. According to the Global Climate Risk Index 2021 published by Germanwatch in 2021, Bangladesh is considered to be the seventh most vulnerable country in the world, having the largest population among the top seven countries, which is approximately 170 million people as of 2022.

Bangladesh has prioritized adaptation measures in its climate change policies and plans. The 8th Five-Year Plan (July 2020- June 2025) aims for sustainable growth through commitments to the Paris Agreement, the Sendai Framework for Disaster Risk Reduction, and the Sustainable Development Goals. Bangladesh has also adopted the Nationally Determined Contributions (hereinafter referred to as "NDC"), the National Adaptation Plan (hereinafter referred to as "NAP"), and the Bangladesh Delta Plan 2100 (hereinafter referred to as "BDP2100") as part of its long-term water management plan.

Climate change adaptation measures should be implemented in a multi-sectoral manner based on climate change risks. Past efforts in disaster risk reduction and agriculture provide valuable lessons for these measures. Bangladesh and Japan International Cooperation Agency (hereinafter referred to as "JICA") have cooperated in these sectors for more than 50 years, and the knowledge developed through this cooperation can support the implementation of national-level climate change adaptation policies. In addition, Japan's experience with various disasters can also provide effective approaches and lessons for Bangladesh.

1.2 Objective

This study reviews completed and ongoing projects and studies under the cooperation of Bangladesh and JICA, related to water, disaster risk reduction, and agriculture (cultivation-related only) that contribute to climate change adaptation.

The study also examines the important fields and issues identified in NAP and extracts effective approaches for climate change adaptation in line with such NAP and BDP 2100. With such results, this study provides policy recommendations to the Government of Bangladesh to promote national-level plans (NAP and BDP 2100) for climate change adaptation in Bangladesh. It should be noted that the purpose of the study is knowledge-sharing, and the study is not intended to promote JICA finance.

1.3 Study Area

The target area for the survey is the entire area of Bangladesh. The field survey was conducted in the Dhaka metropolitan area, Jashore, Khulna City, Barisal Shadar, Patuakhali Sadar, Mymensingh, and Habiganj.

1.4 Key Partner Organization

Ministry of Environment, Forests and Climate Change (hereinafter referred to as "MoEFCC") is the key partner organization.

1.5 Schedule:

The period of the survey is from 14 August 2023 to 29 February 2024 (for approx. 6.5 months).

1.6 Outcomes:

The outcomes of the survey are effective approaches and concept ideas.

2. POLICIES, STRATEGIES AND IMPACTS RELATED TO CLIMATE CHANGE IN BANGLADESH

2.1 Review of Policies, Plans, etc. in Bangladesh Regarding Climate Change Adaptation

The list of the main documents related to climate change adaptation in Bangladesh is shown in Table S2.1.1. Among those documents, NAP and BDP 2100 are the main documents to be reviewed.

Table S2.1.1 Policies, Plans, etc. in Bangladesh for Review Regarding Climate Change Adaptation

No.	Document name	Items to be reviewed
1	NAP	Goals, basic policies, strategies, and investment portfolios, the list of the investment plans
2	BDP2100	Goals, basic policies, strategies, business plans Challenges in implementing business plans, especially from the perspectives of feasibility, effectiveness, and sustainability
3	Nationally Determined Contributions	Policies, guidelines, strategies, priority activities, etc. from the perspective of water resource management in rural areas, disaster management, and the agricultural sector
4	The 8th Five-Year Plan (July 2020- June 2025)	
5	Perspective Plan of Bangladesh 2021-2041	
6	Mujib Climate Prosperity Plan (-2030)	
7	Latest IPCC Sixth Assessment Report	Projections of future climate change impacts and assumed events in Bangladesh

Source: JST

2.1.1 Bangladesh Delta Plan 2100

BDP 2100 is a long-term strategy developed by the General Economics Division (hereinafter referred to as "GED") of the Planning Commission of the Government of Bangladesh in 2018. It focuses on economic growth, environmental conservation, and climate resilience, addressing the challenges of climate change and natural disasters. The plan aims to sustainably manage water, ecology, environment, and land resources, considering their interplay with natural disasters and climate change. BDP 2100 adopts an adaptive approach, allowing for the review and update of strategies, policies, institutions, and investments in response to changing circumstances.

BFP2100 has 6 goals shown as follows and 80 project implementation plans. Its total capital investment cost is BDT 2,978 billion and the cost of the feasibility studies and operating and maintenance costs are expected to be BDT 4,091 billion.

- Goal 1: Ensure safety from floods and climate change-related disasters;
- Goal 2: Enhance water security and efficiency of water usage;
- Goal 3: Ensure sustainable and integrated river systems and estuaries management;
- Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use;

- Goal 5: Develop effective institutions and equitable governance for in-country and transboundary water resources management;
- Goal 6: Achieve optimal and integrated use of land and water resources.

2.1.2 National Adaptation Plan of Bangladesh (2023-2050)

NAP was approved by the government on October 31, 2022, aiming to reduce climate risks and vulnerabilities through effective adaptation strategies. The plan is designed to gather and analyze information, develop risk scenarios, and generate experience and science-based adaptation strategies in line with Bangladesh's priorities outlined in the Sustainable Development Goals (hereinafter referred to as "SDGs"), BDP 2100, Perspective Plan, the 8th Five-Year Plan (hereinafter referred to as "8FYP"), and other relevant policy documents. The Goals described in NAP are shown as follows. In NAP Investment Portfolio, 113 interventions in the 8 sectors (Water resources, Disaster, social safety and security, Agriculture, Fisheries, aquaculture and livestock, Urban areas, Ecosystems, wetlands and biodiversity, Policies and institutions, and Capacity development, research and innovation) are listed and described, that requires USD 230 billion over the 27-year implementation period.

- Goal 1: Ensure protection against climate change variability and induced natural disasters.
- Goal 2: Develop climate-resilient agriculture for food, nutrition, and livelihood security.
- Goal 3: Develop climate-smart cities for an improved urban environment and well-being
- Goal 4: Promote nature-based solutions for the conservation of forestry, biodiversity, and the well-being of communities.
- Goal 5: Impart good governance through the integration of adaptation into the planning process.
- Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation.

2.1.3 Nationally Determined Contribution

The primary objective of NDC is to reduce national greenhouse gas emissions and adapt to the impacts of climate change. NDC in Bangladesh was compiled and submitted to the United Nations Framework Convention on Climate Change in September 2015, for three sectors, that are Power, Industry, and Transport. It proposed 12 million tons (5%) unconditional reduction in greenhouse gas emission from the Business-as-Usual scenario by 2030 and a further 24 million tons (10%) conditional reduction in greenhouse gas emission with support from the international community taking the base year 2011. NDC was updated in August 2021 to cover four sectors, that are Energy, Industrial Processes and Product Use, Agriculture, Forestry, and other Land use and Waste. NDC update aims to further mitigation actions that Bangladesh may take to tackle its growing emissions and play its role in global efforts.

2.1.4 Perspective Plan of Bangladesh 2021-2041

The government of Bangladesh has adopted Vision 2041 which is a continuation of Digital Bangladesh Vision 2021. It seeks to eliminate extreme poverty and reach Upper Middle-Income Country status by 2031, and High-Income Country status by 2041 with poverty approaching extinction. To convert Vision 2041 into a development strategy, policies, and programs, the 'Perspective Plan of Bangladesh 2021-2041' (hereinafter referred to as "PP2041") has been launched.

The main focus of PP2041, described as the environmental management strategy would be to integrate environmental and climate change considerations into the growth strategy. The strategies, policies, and institutional reforms are shown as follows, and specific strategies, policies, and priorities in the water, disaster risk reduction, and agriculture sectors are also described in PP2041.

1) Integrating environmental costs into the macroeconomic framework
2) Implementing the BDP2100 to build resilience and reduce vulnerability to climate change
3) Reduce air and water pollution
4) Ensure Sustainable Management of Forestry Resources
5) Strengthen Environmental Coordination and Environmental Institutions
6) Strengthen Climate Change Trust Fund
7) Develop a Sound Environment and Climate Change Financing Strategy

2.1.5 The 8th Five-Year Plan (July 2020- June 2025)

The Eighth Five-Year Plan (8FYP, July 2020 - June 2025) is a flagship document as the first in the series of Five-Year Plans to complete the agenda of achieving the social and economic transformation visualized in PP2041. 8FYP would also be instrumental in attaining SDGs, realizing BDP2100 for smooth transition following the Least Developed Country (hereinafter referred to as “LDC”) graduation. 8FYP mainly centers on six core themes, which include.

1) Rapid recovery from COVID-19
2) GDP growth acceleration, employment generation, and rapid poverty reduction with a broad-based strategy of inclusiveness
3) A sustainable development pathway resilient to disaster and climate change
4) Sustainable use of natural resources and successful management of the inevitable urbanization transition
5) Development and improvement of critical institutions, and
6) Attaining SDG targets and coping with the impact of LDC graduation

2.1.6 The Mujib Climate Prosperity Plan

The Mujib Climate Prosperity Plan (hereinafter referred to as "MCPP") is a strategic investment framework for climate financing in Bangladesh. Its objectives are to shift from vulnerability to resilience and prosperity by enhancing resilience, creating jobs, and expanding opportunities. It also aims to fast-track the delivery of SDGs by leveraging the financing of 8FYP, Vision 2041, and BDP 2100. The MCPP proposes an economic transformation with actions such as maximizing resilience with loss and damage financing, strengthening employment in a green economy, promoting well-being and traditional living, and securing energy independence. The total estimated investment for MCPP is USD 83.55 billion.

2.2.7 IPCC, the 6th Assessment Report

In the 6th Assessment Report of IPCC (hereinafter referred to as “AR6”), 5 scenarios were analyzed.

(1) Temperature

AR6 projects a global temperature increase of 1.5°C to 1.6°C in the near term (the 2030s), 1.7°C to 2.4°C in the mid-term (2050s) and 1.8°C to 4.4°C in the long term (end of the century). According to NAP, Climate projections for Bangladesh indicate a warming of 0.44°C to 0.69°C in the near term (2030s) and 1.3°C to 2°C in the mid-term (2050s) for the SSP1-2.6 and SSP5-8.5 scenarios.

(2) Rainfall

Rainfall variation due to future climate change for Bangladesh ranges between 0.1-1.4 percent in the 2030s and 2.4-3.5 percent in the 2050s.

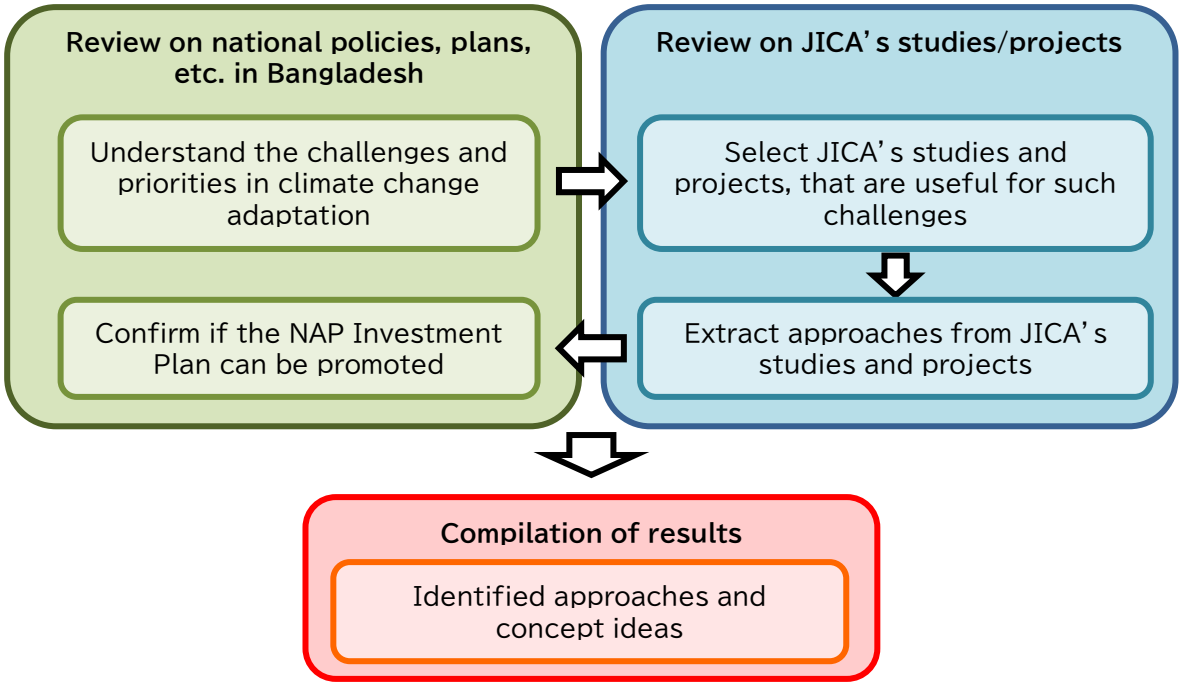
(3) Sea-level Rise

Sea-level rise causes salinity intrusion, and it is one of the major hazards in low-lying coastal areas of Bangladesh. Future sea-level rise is projected to be between 0.11 - 0.12 m in the near term, 0.23 - 0.27 m in the mid-term, and 0.54 - 0.86m.

3. SURVEY METHOD AND RESULTS

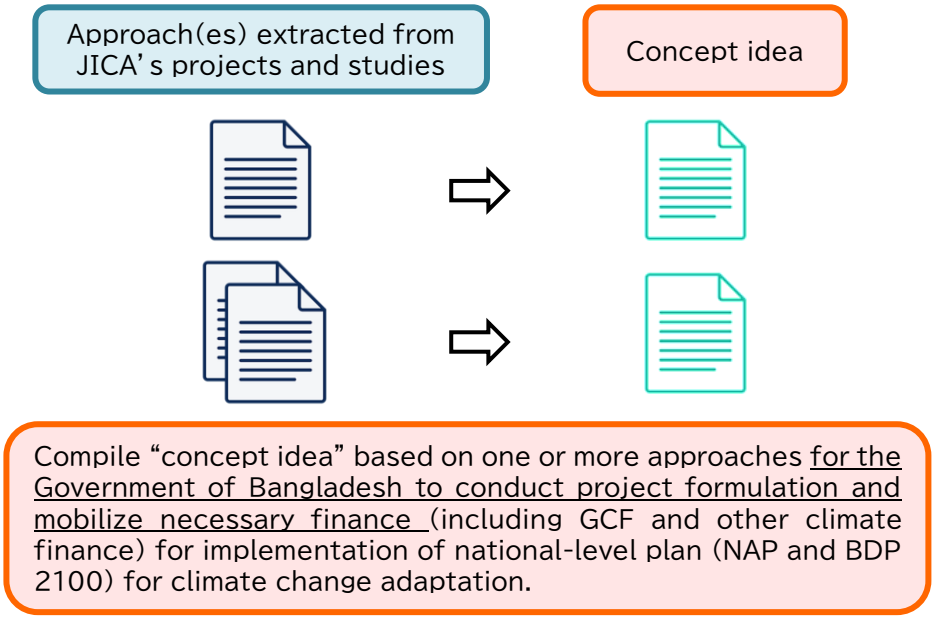
3.1 Flow of the Survey Implementation

Firstly, national policies, plans, etc. related to the climate change adaptation in Bangladesh are reviewed to understand the priorities and challenges of such adaptations. A review of JICA's past and ongoing studies and projects in water, disaster risk reduction, and agriculture sectors follows it and effective adaptation approaches for NAP and BDP 2100 implementation are extracted from such studies and projects. Finally, some of the approaches combined (or one approach) create "concept ideas" as new applications for climate change adaptation. With such results, this study provides policy recommendations to the Government of Bangladesh to promote a national-level plan for climate change adaptation in Bangladesh. Figure S3.1.1 shows the flow of project implementation and Figure S3.1.2 describes the relation between the approaches and the concept ideas.



Source: JST

Figure S3.1.1 Conceptual Flow of the Project Implementation



Source: JST

Figure S3.1.2 Relation between the Approaches and the Concept ideas

3.2 Selected Studies/Projects, Extracted Approaches, and Concept Ideas

As shown in Table S3.2.1, 23 JICA-funded and completed or ongoing studies/projects in Bangladesh were selected and reviewed further to extract key activities, results, lessons learned, etc., that can help promotion of the implementation of NAP and BDP 2100. The list of the extracted approaches is shown in Table S3.2.2.

Table S3.2.1 23 Selected Studies/projects

No.	Studies/projects name	Year
Water Sector		
1	(T/C) Feasibility Study on a Rainwater Tank Social Business with Micro Credit Loan	2010-2013
2	(T/C) The Project for Improvement of Comprehensive Management Capacity of DPHE on Water Supply	2015-present
3	(T/C) Project for Sustainable Mitigation of Arsenic Contamination under the Integrated Local Government System	2005-2008
4	(T/C) Upazila Integrated Capacity Development Project (UICDP) Phase 1 and 2	2017-present
Disaster Risk Reduction Sector		
5	(T/C) The Project for Capacity Enhancement on Formulation and Implementation of Local Disaster Risk Reduction Plan	2020-present
6	(T/C) Development of Human Capacity in Operation of Weather Analysis and Forecasting/ Project for Strengthening the Capacity of Weather and Climate Services	2009-2013, 2022-present
7	(T/C) The Project for Capacity Development of Management for Sustainable Water-Related Infrastructure	2013-2017
8	(T/C) Project for Planning Capacity Enhancement and Establishment of a Technology Adaptation Cycle on Comprehensive Nodi (River) Management	2020-present
9	(Grant) Meteorological Radar System Development in Dhaka, Rangpur, Moulvibazar, Cox's Bazar and Khepupar	2005-2008, 2007-2009, 2015-present
10	(Grant) Programme for Construction of Multipurpose Cyclone Shelters in the Area Affected by the Cyclone Sidr	2008-2010
11	(Loan) Haor Flood Management and Livelihood Improvement Project	2014-present
12	(Loan) Disaster Risk Management Enhancement Project (DRMEP)	2016-present
13	(SATREPS) Research on Disaster Mitigation Measures against Floods and Storm Surges	2014-2019
14	(Grass-root T/C) Mobilizing and Organizing Humanitarian Operations and Risk reduction activities in disaster-prone coastal Areas (MOHORA)	2017-2021
15	(Grass-root T/C) Development of Youth-led Community Disaster Preparedness System	2010-2011
16	(Grass-root T/C) Community-Based Disaster Risk Reduction in Urban Areas	2016-2019
17	(Grass-root T/C) Capacity Enhancement for Disaster Preparedness Using Community Radio	2013-2017
Agriculture Sector		
18	(T/C) Market-oriented Agriculture Promotion Project for Smallholder Horticulture Farmers Through Multi-stakeholder Partnerships	2021-present
19	(Grass-root T/C) Practice and Dissemination of Disaster-resistant Climate Change-adaptive Agriculture in Haor	2022-present
20	(Loan) Food Value Chain Improvement Project (FVCIP)	2020-present
21	(Loan) Small Scale Water Resources Development Project (Phase-1&2)	2007-2023
22	(Grant) Improvement of the Capacity of Public Food Storage in the People's Republic of Bangladesh	2012-2015
23	(Loan) Small and Marginal Sized Farmers Agricultural Productivity Improvement and Diversification Financing Project	2014-2021

Where, T/C: Technical cooperation
Source: JST

Table S3.2.2 17 Extracted Approaches

No.	Approach name
Water Sector	
1	Large scale-concrete hollow block tanks for public water supply in local communities
2	Rainwater harvesting in coastal areas through the collaboration between social businesses and communities
3	Reducing health damage caused by arsenic-contaminated drinking water with residents and hospitals
4	Securing safe water resources in rural areas based on water potential
Disaster Risk Reduction Sector	
5	Flash flood measures and livelihood improvement in Haor areas
6	Sustainable flood mitigation infrastructure development
7	Flood mitigation method and planning suitable for various/diverse-scale rivers
8	Upazila-level disaster risk reduction planning and implementation
9	Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help
10	Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment
11	Development and maintenance of meteorological radar systems
12	Improved and accurate weather observation and forecasting

No.	Approach name
13	Risk assessment, forecasting, and countermeasures for flood and storm surge risk reduction
Agriculture Sector	
14	Dissemination of new climate change-adapted paddy rice varieties in the Haor area
15	Stepwise development of small-scale irrigation and drainage system with initiative of communities (WMCAs)
16	Smallholder horticultural farmers empowerment & promotion (Bangla-SHEP)
17	Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity

Source: JST

3.3 Water Sector

(1) Approach

In the water sector, 4 approaches are extracted as shown in Table S3.3.1.

Table S3.3.1 Summary of Approaches in the Water Sector

No	Approach name	Summary
1	Large scale-concrete hollow block tanks for public water supply in local communities	In rural areas where there has been an issue of a chronic shortage of drinking water, concrete hollow block tanks storing rainwater at public facilities (e.g., schools) are planned and constructed for drinking water supply to facility users (e.g., students, teachers, school staff, etc.) and neighboring residents
2	Rainwater harvesting in coastal areas through the collaboration between social businesses and communities	In rural coastal areas where salinity issues are seen in drinking water, this approach, collaborating with a private company and local NGOs installs rainwater tanks, grows awareness about rainwater harvesting, and develops a social business model that achieves sustainable and affordable safe water access, primarily targeting the BOP.
3	Reducing health damage caused by arsenic-contaminated drinking water with residents and hospitals	With the aim of installing sustainable arsenic contamination control measures, this approach raises awareness of residents on arsenic water problems and provides a fund collection system among residents. This approach also strengthens the planning capacity of the residents' committee for alternative water sources and assists arsenic poisoning patience management at hospitals in Upazilas where arsenic contamination is serious.
4	Securing safe water resources in rural areas based on water potential	To increase the number of safe water resources and provision in rural areas where the rate of safe drinking water coverage ratio is relatively low, the water resource management system, water development planning, and operation and maintenance capacity are strengthened.

Source: JST

(2) Concept Ideas

In the water sector, 2 concept ideas are compiled in the manner shown in Table S3.3.2.

Table S3.3.2 Relation between Approaches and Concept Ideas in the Water Sector

No	Approach name	Concept idea	
		Name	Features
1	Large scale-concrete hollow block tanks for public water supply in local communities Rainwater harvesting in coastal areas through the collaboration between social businesses and communities	Project for rainwater harvesting for residents and communities in rural areas	• Proposing large-scale tanks made of concrete hollow blocks for communities (hospitals, schools, etc.) and low-cost rainwater tanks for residents, aiming to improve the community lives by utilizing rainwater
2	Reducing health damage caused by arsenic-contaminated drinking water with residents and hospitals Securing safe water resources in rural areas based on water potential	Project for utilization and management of safe water resources and improvement of livelihood in rural areas	• Proposing similar activities conducted in Phase 1 of the upper approach, selecting some districts and different priority Upazilas. • Capacity strengthening of residents (mainly for O&M) is taken from the lower approach and is combined with the upper one.

Source: JST

3.4 Disaster Risk Reduction Sector

(1) Approach

In the disaster risk reduction sector, 9 approaches are extracted as shown in Table S3.4.1.

Table S3.4.1 Summary of Approaches in the Disaster Risk Reduction Sector

No	Approach name	Summary
1	Flash flood measures and livelihood improvement in Haor areas	This approach develops submersible embankments and roads and provides agriculture and fishery support to protect Boro rice cultivation from flash flood damage and improve the quality of life and livelihood of local communities in the Haor area. This approach involves communities from the planning stage to the O&M stage and also motivates them by providing livelihood support so that the ownership of the communities is strengthened for better stricture maintenance and sustainability.
2	Sustainable flood mitigation infrastructure development	This approach aims to ensure the flood control function, improve the efficiency of maintenance and management, and reduce life cycle costs. To support this, various manuals are prepared and a pilot project for embankment rehabilitation is conducted. With such implementation of the pilot project, a suitable design for sustainable water-related structures is verified. An action plan was also created to disseminate and efficiently use various manuals.
3	Flood mitigation method and planning suitable for various/diverse-scale rivers	This approach establishes tools for systematic and diverse river control and planning for large-scale rivers and flood mitigation planning methods for middle and small-scale rivers.
4	Upazila-level disaster risk reduction planning and implementation	The formulation of disaster risk reduction plans that reflect local disaster characteristics and their implementation based on smooth coordination among relevant agencies are useful in managing disaster risks effectively at the local level. In particular, it is important to understand local disaster risks properly by sharing knowledge among local-level stakeholders such as Upazilas and Unions, to plan pre/post-disaster activities based on the understanding, and to monitor their implementation
5	Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help	This approach is to promote disaster risk reduction based on the spirit of "self-help", "mutual-help", and "public-help", which intend to raise the awareness of residents through disaster-related education in schools, to enhance the capacity of DMCs established in local administrations, and to strengthen relationships among relevant stakeholders. The approach also provides opportunities to share disaster-related knowledge between residents and local government and to think about future disaster risk reduction to enhance the disaster preparedness of the community as a whole.
6	Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment	This approach aims to increase the number of people who can be evacuated during a cyclone by installing evacuation shelters in areas at high risk of cyclone damage. On the other hand, the shelters will be used as elementary schools during normal times, thereby contributing to improving the learning environment for primary education. The shelters need to be designed in a gender-sensitive and evacuation-friendly manner. In addition, the shelters should be equipped with stable electricity and water supply.
7	Development and maintenance of meteorological radar systems	An extensive and detailed understanding of weather information in and around Bangladesh is critical for the prevention and mitigation of weather-related disasters. The approach is to develop, update, and maintain multiple meteorological doppler radar systems that cover the entire country of Bangladesh, which aim to contribute to the mitigation of damage caused by weather disasters such as floods and tropical cyclones through the enhancement of the meteorological observation network.
8	Improved and accurate weather observation and forecasting	In order to mitigate weather-related disasters, it is important to provide accurate weather forecast information and communicate it to relevant organizations and residents in a reliable and easy-to-understand manner. This approach aims to improve systems and mechanisms for weather information collection, analysis, forecasting, and dissemination.
9	Risk assessment, forecasting, and countermeasures for flood and storm surge damage reduction	This approach involves research aimed at establishing analysis and forecasting methods for flood and storm surge damage, and riverbank erosion prevention measures. By proposing and testing measures to prevent and mitigate water-related disasters, this approach will contribute to building a society with disaster resilience.

Source: JST

(2) Concept Ideas

In the disaster risk reduction sector, 6 concept ideas are compiled in the manner shown in Table S3.4.2

Table S3.4.2 Relation between Approaches and Concept Ideas in the Disaster Risk Reduction Sector

No	Approach name	Concept idea	
		Name	Features
1	Flash flood measures and livelihood improvement in Haor areas Dissemination of new climate change-adapted paddy rice varieties in the Haor area	Project for haor flood management, livelihood improvement and new rice varieties' application	• River structure improvement, rural road improvement, and agricultural promotion. • Securing rice yields by planting different varieties and applying the new varieties of rice.
2	Flood mitigation method and planning suitable for various/diverse-scale rivers	Project for comprehensive flood mitigation planning for mid-and-small scale rivers	• River flood mitigation planning for prior mitigation measures in mid- to small-scale rivers
3	Upazila-level disaster risk reduction planning and implementation Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help	Project for local disaster risk reduction plans based on cooperation among self-help, mutual-help, and public-help	• Local disaster risk assessment and project formulation • Youth-led community-based disaster risk reduction • Strengthening disaster risk reduction capacity based on collaboration between residents and government
4	Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment Large scale-concrete hollow block tanks for public water supply in local communities	Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment	• Construction of multi-purpose shelters based on design external forces considering climate change • Improvement of evacuation routes, drinking water facilities, solar panels, separate toilets for men and women
5	Enhancement of infrastructure rehabilitation and reconstruction systems	Integrated development, maintenance and rehabilitation of coastal polders toward more resilience	• Integrated facility maintenance of polder based on climate change impacts • Maintenance and management of polder and related water infrastructure facilities by relevant administrative agencies • Prompt implementation of restoration projects after the disaster
6	Improved and accurate weather observation and forecasting Development and maintenance of meteorological radar systems Risk assessment, forecasting and countermeasures for flood and storm surge risk reduction	Enhancement of flood and storm surge warning system based on upazila-wise flood and storm surge damage prediction model and rainfall information obtained from meteorological radar	• Strengthening the rainfall observation network • Elaboration of forecasts for sudden and localized flood events • Providing easy-to-understand and urgent information in the event of floods and storm surges

Source: JST

3.5 Agriculture Sector

(1) Approach

In the agriculture sector, 4 approaches are extracted as shown in Table S3.5.1.

Table S3.5.1 Summary of Approaches in the Agriculture Sector

No	Approach name	Summary
1	Dissemination of new climate change-adapted paddy rice varieties in the Haor area	In the Haor area, Boro rice production and inland fisheries are key income sources. However, flash floods from neighboring India threaten Boro rice annually. The introduction of a new Boro rice variety that can be harvested before flash floods helps mitigate their impact. Additionally, new varieties resistant to cold, blast disease, and those that yield high or taste good have been developed. Planting a mix of these new varieties can reduce the risk of yield reduction due to weather.

No	Approach name	Summary
2	Stepwise development of small-scale irrigation and drainage system with initiative of communities (WMCAs)	This approach builds facilities for small-scale irrigation and drainage. In addition, it fosters the Water Management Co-operative Associations (hereinafter referred to as WMCAs) to manage the facilities. In this approach, sub-projects are implemented in the target area. The sub-projects consist of four components 1) Flood Management, 2) Drainage Improvement, 3) Water Conservation, and 4) Command Area Development.
3	Smallholder horticultural farmers empowerment & promotion (Bangla-SHEP)	The "Bangla-SHEP" approach is an innovative agricultural extension method that helps smallholder horticultural farmers shift from "selling what they grow" to "growing what the market needs". This approach is based on stakeholder collaboration, where farmers decide which crops to grow through their own market research. The Department of Agricultural Extension (hereinafter referred to as "DAE") provides cultivation techniques, private companies sell necessary agricultural inputs at fair prices, and microfinance loans are available if needed. By adopting Bangla-SHEP, farmers can produce crops that meet market demands and stabilize their income.
4	Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity	This approach involves constructing air-conditioned food storage facilities to maintain food quality and machinery for efficient loading and unloading of rice bags. This is crucial for national food security and food distribution to the poor. Despite increasing self-sufficiency, food security remains a challenge due to the climate sensitivity of rice yields. Enhancing rice stockpile capacity can help mitigate market supply fluctuations caused by varying harvest conditions.

Source: JST

(2) Concept Ideas

In the agriculture sector, 4 concept ideas are compiled in the manner shown in Table S3.5.2

Table S3.5.2 Relation between Approaches and Concept Ideas in the Agriculture Sector

No	Approach name	Concept idea	
		Name	Features
1	Dissemination of new climate change-adapted paddy rice varieties in the Haor area	Practice and dissemination of climate-adapted rice seeds in the haor	<u>Reducing the risk of production decline</u> • Stable livelihoods for farmers in the Haor area • Stable supply of rice to the domestic market
2	Stepwise development of small-scale irrigation and drainage system with initiative of communities (WMCAs)	Small-scale irrigation and drainage system development	<u>Stepwise development</u> • Stepwise development, which consisted of 1) new development, 2) additional development, and 3) flagship development was proposed. • The lessons learned during "the new development" were utilized to set or revise the scope of works of "the additional development" and "the flagship development."
3	Smallholder horticultural farmers empowerment & promotion (Bangla-SHEP)	Project for local disaster risk reduction plans based on cooperation among self-help, mutual-help, and public-help	<u>Planting marketable crops</u> • Farmers conduct market research to understand demand trends <u>Stabilization of crop unit prices</u> • Create a farmers' association to stabilize shipments
4	Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity	The Project for Increasing Food Stockpiling Capacity to Strengthen the Resilience of Food Self-Sufficiency	<u>Short-term vision</u> • Adjust for time differences between yield and consumption <u>Medium-term vision</u> • Stockpiling in response to disasters • Export business of surplus rice

Source: JST

4. Recommendations

The policy recommendations for the Government of Bangladesh are summarized in Table S4.1.1 to implement the approaches and concept ideas identified in this survey.

Table S4.1.1 Recommendations in the Water, Disaster Risk Reduction, and Agriculture Sector

Sector	Title	Recommendation
Water	Capacity enhancement of key implementation agencies	• DPHE is expected to lead the development continuously and guide City Cooperations and rural local governments • The mid and long-term water development plans at the upazila level with their water potential maps and technical guidelines. This information should be institutionalized and applied for technical support by DPHE for those related agencies
	Regular maintenance activities by the maintenance committee	• To conduct regular maintenance, the establishment and involvement of users' maintenance committees are essential at the beginning stage of the project implementation.
	Consideration for gender and vulnerable people	• when water management interventions are planned, The social conditions for women and children should be carefully studied and reflected in designs. In addition, capacity building and raising awareness of them should be considered.
	Raising awareness of safe water use	• Along with the government-led activities, local awareness-raising activities are still required. In order to raise awareness, education for children works effectively and brochures as educational material on safe water should be shared at schools and home.
Disaster Risk Reduction	Capacity Enhancement of Key Implementation Agencies in Local Disaster Risk Reduction	• It is important to further strengthen the coordination and management capacity of DDM toward project identification and formulation in coordination with relevant organizations at central and local levels. • The accumulation of knowledge on hazard and disaster risk assessment should be promoted. • It is also important to promote the human resource development of local consultants and NGO personnel, as well as local DDM offices, local governments, and local communities.
	Scientific-based risk analysis and its continuous improvement	• To improve the validity and reliability of damage prediction models based on scientific knowledge, it is important to continuously update the models through comparative verification between actual phenomena and prediction results. • It is also important to continuously collect local-level socio-demographic information and reflect it in the risk assessment system to ensure the accuracy of impact-based disaster prediction.
	Consideration for Gender and Vulnerable People	• To ensure the smooth evacuation of people to cyclone and flood shelters, it is necessary to improve accessibility by improving road conditions around shelters and increasing transport facilities. • Improving the living conditions of shelters is necessary to reduce sanitation, nutrition, and gender safety issues
Agriculture	Dissemination of New Varieties Led by the Government	• The accompaniment type of assistance is suitable for the dissemination of new varieties in the Haor area. To alleviate the anxiety that farmers feel about cultivating inexperienced varieties, NGOs should visit and instruct farmers who have introduced new varieties.
	Feedback on Cultivation Records to Researchers	• Notifying DAE and BRRI of disease or pest outbreaks is necessary for farmers to know how to deal with them. It also helps DAE to disseminate information about diseases and pests to other farmers.
	Maintaining Equity for Good Organizational Management	• It is important to maintain equity in the division of the administrative tasks of the facility and in the distribution of the benefits which the facility brings among farmers cooperatives such as the WMCA.
	Evaluation for Sub-project Improvements	• In an existing project, some WMCAs have applied for additional development based on the success cases of other areas. To arrange and introduce successful examples, it would be useful to conduct an evaluation that analyzes the success factors of each sub-project such as natural and social conditions.

Source: JST

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CHAPTER 1 SURVEY DESCRIPTION

1.1 Background

In recent years, damage due to the effects of climate change has been occurring all over the world, and various mitigation and adaptation measures are being taken in each country. In particular, adaptation measures are required in various sectors such as disaster mitigation, agriculture, and urban/rural development in order to protect lives, national land, crops, living environments, etc. from natural disasters caused by climate change.

The South Asian region, which continues to experience steady economic growth and population growth, is expected to continue to suffer considerable damage from the effects of climate change. Among them, the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh"), which faces the Bay of Bengal, has most of its territory as low-lying land less than 5 meters above sea level, as well as a delta into which a large amount of river flow flows from the huge basin consisting of the Padma, Jamuna, and Meghna Rivers. Due to its characteristics as a region, Bangladesh is highly susceptible to the effects of climate change, such as sea level rises, cyclones, and changes in rainfall patterns. According to the Global Climate Risk Index 2021 published by Germanwatch in 2021, Bangladesh is considered to be the seventh most vulnerable country in the world, having the largest population among the top seven countries, which is approximately 170 million people as of 2022.

Bangladesh has placed adaptation measures as a priority issue among climate change countermeasures and is formulating climate change policies and business plans. The 8th Five-Year Plan (July 2020 – June 2025), which defines climate change adaptation as one of the most important policies, aims to achieve sustainability growth through commitments and goals to the Paris Agreement, the Sendai Framework for Disaster Risk Reduction, and the Sustainable Development Goals (hereinafter referred to as "SDGs"). In addition, Bangladesh has adopted Nationally Determined Contributions (hereinafter referred to as "NDC") as a climate change adaptation policy and formulated the National Adaptation Plan (hereinafter referred to as "NAP"), and Bangladesh Delta Plan 2100 (hereinafter referred to as "BDP2100") as a long-term water management plan until 2100, and other relevant policies and plans at the national level.

It is important for climate change adaptation measures to be implemented in a multi-sectoral manner based on climate change risks. It is effective to fully utilize the results and lessons learned from past efforts in related sectors such as disaster risk reduction and agriculture, which form the basis of countermeasures. In this regard, Bangladesh and JICA have a track record of cooperation in the disaster mitigation sector and agricultural sector with rural water resource management. Therefore, the co-created knowledge developed through past cooperation should provide effective approaches and lessons for Bangladesh to support the implementation of national-level climate change adaptation policies. In addition, Japan's knowledge and experience are expected to present effective approaches and lessons for Bangladesh regarding climate change adaptation as the country has experienced a variety of disasters.

1.2 Objective

This study reviews completed and ongoing projects and studies under the cooperation of Bangladesh and JICA, related to water, disaster risk reduction, and agriculture (cultivation-related only) that contribute to climate change adaptation.

The study also examines the important fields and issues identified in NAP and extracts effective approaches for climate change adaptation in line with such NAP and BDP 2100. With such results, this study provides policy recommendations to the Government of Bangladesh to promote national-level plans (NAP and BDP 2100) for climate change adaptation in Bangladesh. It should be noted that the purpose of the study is knowledge-sharing, and the study is not intended to promote JICA finance.

1.3 Survey Area

The target area for the survey is the entire area of Bangladesh. The field survey was conducted in the Dhaka metropolitan area, Jashore, Khulna City, Barisal Shadar, Patuakhali Sadar, Mymensingh, and Habiganj.

1.4 Related Ministries and Organizations in Bangladesh

Ministry of Environment, Forests and Climate Change (hereinafter referred to as “MoEFCC”) is the focal organization. Other central and local governments, research institutes, contractors, NGOs, etc. that have jurisdiction over past/ongoing projects with JICA’s assistance in the target sectors of this study were engaged in exchanging their views. In addition, several development partners participated in a workshop held during this survey.

1.5 Schedule and Assignment of Survey Team

The entire period of the survey is from 14 August 2023 to 29 February 2024, with surveys in Bangladesh, which were done in November 2023 and the other in January and February 2024 for approximately half a month, respectively.

JICA Survey Team (hereinafter referred to as "JST”) consists of four Japanese experts as follows.

- Mr. Satoshi TAKATA, Team leader/climate change adaptation policy
- Mr. Daisuke FUJITA, Disaster Risk Reduction sector and climate change adaptation
- Dr. Toshihiko KUNO, Agricultural sector and climate change adaptation
- Ms. Marie MITSUYASU, Agricultural sector and climate change adaptation assistant

To show the progress of the work, the following reports are to be prepared for the survey.

- Inception Report: November 2023
- Interim Report: February 2024
- Final Report: February 2024

In Bangladesh

Task	Name	Company	2023					2024	
			8	9	10	11	12	1	2
Team leader/climate change adaptation policy	Satoshi TAKATA	CTII				■			■
Disaster risk reduction sector and climate change adaptation	Daisuke FUJITA	CTII				■			■
Agricultural sector and climate change adaptation	Toshihiko KUNO	SCI				■			■
Agricultural sector and climate change adaptation assistant	Marie MITSUYASU	SCI				■			

▲ WS

In Japan

Task	Name	Company	2023					2024	
			8	9	10	11	12	1	2
Team leader/climate change adaptation policy	Satoshi TAKATA	CTII		□	□		□	□	□
Disaster risk reduction sector and climate change adaptation	Daisuke FUJITA	CTII		□	□		□	□	□
Agricultural sector and climate change adaptation	Toshihiko KUNO	SCI		□	□		□	□	□
Agricultural sector and climate change adaptation assistant	Marie MITSUYASU	SCI		□	□		□	□	□

where, CTII: CTI Engineering International Co., Ltd., SCI: Sanyu Consultants Inc., WS: Workshop
Source: JST

Figure 1.5.1 Staffing Schedule

CHAPTER 2 POLICIES, STRATEGIES AND IMPACTS RELATED TO CLIMATE CHANGE IN BANGLADESH

2.1 Review of Policies, Plans, etc. in Bangladesh Regarding Climate Change Adaptation

The list of the main documents related to climate change adaptation in Bangladesh is shown in Table 2.1.1. Among those documents, NAP and BDP 2100 are the main documents to be reviewed.

Table 2.1.1 Policies, Plans, etc. in Bangladesh for Review Regarding Climate Change Adaptation

No.	Document name	Items to be reviewed
1	NAP	Goals, basic policies, strategies, and investment portfolios (the list of the investment plans in the target sectors are shown in "Attachment 2".)
2	BDP2100	Goals, basic policies, strategies, business plans Challenges in implementing business plans, especially from the perspectives of feasibility, effectiveness, and sustainability
3	Nationally Determined Contributions	Policies, guidelines, strategies, priority activities, etc. from the perspective of water resource management in rural areas, disaster management, and the agricultural sector
4	The 8th Five-Year Plan (July 2020- June 2025)	
5	Perspective Plan of Bangladesh 2021-2041	
6	Mujib Climate Prosperity Plan (-2030)	
7	Latest IPCC Sixth Assessment Report	Projections of future climate change impacts and assumed events in Bangladesh

Source: JST

2.2 Climate Change Impacts and Responses in Bangladesh

The major national policies and strategies against climate change impacts and responses in Bangladesh described in Table 2.1.1 were reviewed and the summaries of such documents are shown here.

2.2.1 Bangladesh Delta Plan 2100

(1) Overview

BDP 2100 is a long-term comprehensive development plan focusing on economic growth, environmental conservation, and climate resilience in the view of the long-term challenges posed by climate change and natural disasters. GED of the Planning Commission of the Government of Bangladesh formulated the BDP 2100 in 2018 based on the best practices in delta management in the Netherlands. BDP 2100 aims to integrate and resolve long-term challenges of sustainable management of water, ecology, environment, and land resources in the context of their interaction with natural disasters and climate change. BDP 2100 takes an adaptive approach in which strategies, policies, institutions, and investments to achieve the above goals will be reviewed and updated as appropriate in response to changing circumstances.

(2) Visions and Goals

The vision and goals in BDP2100 are stated as shown in Table 2.2.1.

Table 2.2.1 Vision and Goals in BDP 2100

BDP 2100 approach to long term Vision:
The BDP 2100 approach is to first develop a broad-based long-term vision of the evolution of the Bangladesh Delta by the end of the 21st Century. Thus, an integrated, comprehensive, and long-term Delta Vision might be formulated as: "Achieving safe, climate resilient and prosperous delta"
The mission for BDP 2100 is formulated as:
"Ensure long-term water and food security, economic growth, and environmental sustainability while effectively reducing vulnerability to natural disasters and building resilience to climate change and other delta challenges through robust, adaptive, and integrated strategies, and equitable water governance".
BDP 2100 approach to long-term goals:
This long-term vision needs to be translated into specific goals or targets for implementing the Delta Vision. This is done by combining long-term development outcomes in terms of the country's aspirations for economic growth and poverty reduction in the perspective of 2041 with targets for reducing long-term vulnerability from water and climate change-related hazards plus targets for environmental protection. The BDP 2100 proposes 3 higher-level national goals which have also been considered in the upcoming Perspective Plan 2041 and 6 water, ecology, and land use-specific goals that contribute to these higher-level goals.
Higher level goals:
Goal 1: Eliminate extreme poverty by 2030. Goal 2: Achieve upper middle-income status by 2030 and Goal 3: Being a Prosperous Country beyond 2041.
BDP 2100 specific goals:
Goal 1: Ensure safety from floods and climate change-related disasters; Goal 2: Enhance water security and efficiency of water usage; Goal 3: Ensure sustainable and integrated river systems and estuaries management; Goal 4: Conserve and preserve wetlands and ecosystems and promote their wise use; Goal 5: Develop effective institutions and equitable governance for in-country and transboundary water resources management; Goal 6: Achieve optimal and integrated use of land and water resources.

Source: BDP2100

(3) Sector-wise Issues Related to Climate Change

Climate change can have vast adverse effects on the country's development. The climate factors work through a large number of sectors that add up to substantial losses economy-wide. According to BDP2100, at the macro-level, the combined effects of climate change could range from a loss of 1.1% of GDP per year in a moderate climate change environment to 2.0% of GDP per year in an extreme climate environment. The assumed sector-wise issues caused by climate change are summarized below.

1) Water Resources Management

The water resources management sector issues related to climate change are summarized in Table 2.2.2.

Table 2.2.2 Water Resources Management Issues Related to Climate Change

Items	Major issues and challenges
Rainfall	The rainfall pattern in Bangladesh is going to be more variable and erratic in the future. Pre-monsoon and monsoon rainfall will increase under the Business-As-Usual (BAU) scenario. On an annual basis, the rainfall is expected to increase in most regions during 2030. But, during 2050, southern parts of the country along with the eastern hills might get reductions in rainfall. Under the Extreme scenario, as the temperature rises, more erratic behavior of rainfall along with variation in amounts is projected.
Droughts	In the drought-prone agroecological regions of Bangladesh, the period of dry days ranges between 32-48 days, starting from 24 March to 21 May. During this period the temperature also rises more than 40°C for 5 to 15 days within the same agro-ecological regions. In addition, some soils have low moisture holding capacities, which show different degrees of doughtiness. The drought risk has been shifted forward as surface water reduction from a diversion of river water upstream in India and inadequate rainfall in the dry season continues to lower the water table. So, climate change that lowers rainfall further in the dry season could hurt agriculture in many areas, especially Barind Tract.

Items	Major issues and challenges
Sea Level Rise (SLR)	Sea level rise and consequently, salinity intrusion are the most prominent issues now in Bangladesh delta for its complex geographical position. IPCC (2013) predicts sea level rise from 0.2 meters to 1 meter for low to high emission scenarios in 2100 for the Bay of Bengal. The rising sea level impedes freshwater availability in coastal areas, expediting intrusion of the salinity front. Both surface water and soil salinity along the coast may be increased with the rising sea level. Projections suggest that in base (2005) condition about 10% area is under 1 ppt salinity and 16% under 5 ppt salinity; these areas will increase up to 17.5% (1 ppt) and 24% (5 ppt) by 2050 in the Extreme scenario.

Source: BDP 2100

2) Disaster Risk Reduction

The disaster risk reduction sector issues related to climate change are summarized in Table 2.2.3.

Table 2.2.3 Disaster Risk Reduction Issues Related to Climate Change

Items	Major issues and challenges
Flood	Recent evidence reveals that the magnitude and frequency of mega floods are increasing as a consequence of climate change. Research suggests that the flood extent will be increased for all areas of the country by mid-century (2050) based on the Extreme scenario. Both banks of the Brahmaputra-Jamuna Rivers will be worst affected in this scenario. On average, 3-9% of the additional area will be inundated from the base (1978-2007) on the left side of Jamuna River. On the other hand, some portion of the Barind region adjacent to the right bank of Jamuna River will be more inundated (around 30%) from the base by 2050 due to flooding in the Extreme scenario.
River Erosion	Flow records over 50 years long for the station Bahadurabad (Brahmaputra/ Jamuna rivers) show that peak discharge is increasing and is peaking earlier. The average timing of the peak was in the middle of August but is now in the first week of August. The rising peak discharges of the Ganges and the Brahmaputra mean an increasing probability of future river erosion. Along with erosion, there is also some land accretion from river movements and associated transport of sediments. From 1973 to 2015, a total of 52,313 ha of land has been accreted. On balance land accretion is significantly lower than land erosion for all three major rivers, although net erosion is the largest for the Brahmaputra/Jamuna River. Changes in the river flow and sediment transport due to the multi-faceted impacts of climate change are expected to increase the dynamics of these rivers even more.
Cyclone and Storm Surge	The intensity of cyclonic storm surges as well as the depth and extent of storm surge-induced coastal inundation are likely to increase in changing climate through rising sea surface temperature and sea level. The IPCC further reports that future cyclonic storm surges and related coastal floods in Bangladesh will likely become more severe as future tropical cyclones increase in intensity. In the Extreme scenario, the areas vulnerable to inundation depths of more than 1 meter and 3 meters, respectively would be 14% and 69% higher than the current baseline scenario. A 10-year-return period cyclone in an extreme scenario will be more intense by 2050 and cover 43% of the vulnerable area, 17% more than the current coverage.

Source: BDP 2100

3) Agriculture

The major climate change factors that will have a direct impact on agricultural production and livelihoods are summarized in Table 2.2.4. Being the most climate-sensitive sector, agriculture and rural livelihoods could be the most seriously impacted for the following reasons:

- Farmers could be potentially at risk of climate-driven heat stress, flooding, malnutrition, and water-related and vector-borne diseases.
- A decline in crop yields from a rising temperature and crop loss from flooding would result in falling farm incomes that will undercut poverty reduction efforts.
- Rising sea levels, salinity intrusion, drought, and other climate-driven changes would result in the loss of farmland which could drive thousands of people to migrate out of the affected regions into urban centers putting additional pressure on already stretched urban infrastructure and services.

Table 2.2.4 Agriculture Issues Related to Climate Change

Items	Outcomes	Impacts on agriculture
Climate change may increase rainfall variability, i.e. heavier and more erratic rainfall	Higher river flows, causing over-topping and breaching of embankments; widespread flooding. Riverbank erosion resulting in loss of homes and agricultural land; Increased sedimentation in riverbeds leading to drainage congestion and waterlogging.	Reduced crop yield affects diet and nutrition; IPCC estimates that, by 2050, rice production in Bangladesh could decline by 8% and wheat by 32%, compared to 1990; Existing crop mixes are not sustainable under climate change in some areas.
Lower and more erratic rainfall	Increasing droughts, especially in drier northern and western regions	Livelihood activities in drought-prone areas will suffer as a result of the increased impact of droughts due to climate change
Melting of the Himalayan glaciers	Higher river flows in the warmer months of the year, followed by lower river flows and increased saline intrusion after the glaciers have shrunk	Lower agricultural yields due to decreased water availability
Sea level rise	Submergence of low- lying coastal areas and saline water intrusion up coastal rivers and into groundwater aquifers; reducing freshwater availability; damage to the Sundarbans mangrove forest; and drainage congestion inside coastal polders	Adverse effects on agriculture in the coastal zone.
Increasingly frequent and severe tropical cyclones	Higher wind speeds and storm surges	More damage to crops in the Coastal Zone
Higher temperature and evaporation lead to excessive water use and water scarcity	A decline in surface water and groundwater resources; over-exploitation of groundwater causes heavy metal contamination	Rise in temperature of 1°C–2°C reduces yields of high-yielding varieties of rice; Increased incidence of insect pests, diseases, and microorganisms. Low yields due to high temperature stress and water scarcity; By 2050, a reduction in 4.5 million tons of rice output compared to production in 2002.

Source: BDP 2100 Technical Team Analysis, GED, 2015

(4) Project Implementation Plan and Fund

The Investment Plan consists of a total of 80 projects: 65 are physical projects, and 15 are institutional and knowledge development projects in the first phase up to 2030. Its total capital investment cost is BDT 2,978 billion and the cost of the feasibility studies and operating and maintenance costs are expected to be BDT 4,091 billion. On the other hand, the total annual resources available are targeted to reach BDT 623 billion by FY2025 and to grow with GDP thereafter. The Investment Projects proposed by 6 hotspots are shown in Attachment 1.

2.2.2 National Adaptation Plan of Bangladesh (2023-2050)

NAP was approved by the government on October 31, 2022, aiming to reduce climate risks and vulnerabilities through effective adaptation strategies. The plan is designed to gather and analyze information, develop risk scenarios, and generate experience and science-based adaptation strategies in line with Bangladesh's priorities outlined in the SDGs, BDP 2100, Perspective Plan, the 8th Five-Year Plan (hereinafter referred to as "8FYP"), and other relevant policy documents. The Goals and Strategies described in NAP are shown in Table 2.2.5.

Table 2.2.5 Goals and Strategies in NAP

Goal	Strategy
Goal 1: Ensure protection against climate change variability and induced natural disasters.	S 1.1: Combat cyclonic storm surges, sea level rise and salinity intrusion
	S 1.2: Manage floods, erosion, and drought risks
	S 1.3: Protect life, livelihoods, infrastructures, and ecosystems against slow-onset and other climate extremities
Goal 2: Develop climate-resilient agriculture for food, nutrition, and livelihood security.	S 2.1: Promote extension of climate-smart agriculture
	S 2.2: Develop climate-resilient fisheries, aquaculture, and livestock
	S 2.3: Manage sustainable agro-inputs and transformative value chains
	S 2.4: Strengthen extension services for agriculture, fisheries, and livestock
Goal 3: Develop climate-smart cities for an improved urban environment and well-being	S 3.1: Promote green and blue infrastructure for urban environmental management and conservation
	S 3.2: Develop climate-smart cities to increase urban resilience
	S 3.3: Develop climate-resilient health care and WASH facilities for improved human well-being and livability in cities
Goal 4: Promote nature-based solutions for the conservation of forestry, biodiversity, and the well-being of communities.	S 4.1: Scale up ecosystem-based adaptation for wetlands conservation
	S 4.2: Restore and conserve habitat, ecosystems, and biodiversity
	S 4.3: Expand community-based afforestation and/or reforestation
Goal 5: Impart good governance through the integration of adaptation into the planning process.	S 5.1: Reform policies for mainstreaming adaptation
	S 5.2: Develop a framework for adaptation monitoring, evaluation, and learning
	S 5.3: Engage the private sector in adaptation implementation
	S 5.4: Empower local government institutes, community-based organizations, women, people with disabilities, and youth for locally-led adaptation
	S 5.5: Enhance climate financing for adaptation
Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation.	S. 6.1: Develop transformative capacities and management of knowledge
	S. 6.2: Introduce innovation in reducing climate change and disaster risks and consequent losses and damages
	S. 6.3: Research and innovation for agriculture, fisheries, and livestock.
	S.6.4: Advanced research on climate change impacts on ecosystems and application of ecosystem-based adaptation.
	S. 6.5: Action research for innovation in climate-resilient infrastructure, improved health, and WASH technologies

Source: NAP

NAP is developed to devise effective medium- and long-term adaptation strategies and interventions to reduce negative climate impacts and provide a viable path toward resiliency. NAP further elaborates on the climate rationale of each intervention along with its potential adaptation actions, investment need, etc. to support required financial resources arrangement, mainstreaming adaptation projects or programs into the development planning process.

In NAP, the following are described

- A total of 90 high-priority and 23 moderate-priority interventions with a total investment cost of USD 230 billion over a 27-year implementation period until the 13th Five-Year Planning cycle (2023-2050)
- 23 adaptation strategies, under 8 sectors to reinforce implementation, all towards achieving its vision and 6 goals.

The eight sectors and thematic issues that NAP focuses on are as follows.

- Water resources
- Disaster, social safety and security

- Agriculture
- Fisheries, aquaculture and livestock
- Urban areas
- Ecosystems, wetlands and biodiversity
- Policies and institutions
- Capacity development, research and innovation

NAP Investment Portfolio includes the investment plans (hereinafter referred to as "the NAP IP") alignment with CCAP, BDP2100 adaptation projects, lead and supporting implementing entities, etc. Each investment plan includes representing the thematic sectoral name, intervention name, implementation ability in one or multiple climate stress areas, tentative implementation duration, aligned NAP goal and strategies, aligned BDP2100 project code, tentative cost, context describing the climate rationale, possible adaptation actions under interventions, outcome, impact or direct/indirect benefits, lead and supporting implementing entities, etc.

NAP is one of the most concrete climate change adaptation policies and plans for implementation. Hence, the extracted effective approaches and newly proposed concept notes are compared with the NAP IP to see how the concept notes contribute to the implementation of NAP IP.

2.2.3 Nationally Determined Contribution

The primary objective of NDC is to reduce national greenhouse gas emissions and adapt to the impacts of climate change. NDC in Bangladesh was compiled and submitted to the United Nations Framework Convention on Climate Change in September 2015, for three sectors, that are Power, Industry, and Transport. It proposed 12 million tons (5%) unconditional reduction in greenhouse gas emission from the Business-as-Usual scenario by 2030 and a further 24 million tons (10%) conditional reduction in greenhouse gas emission with support from the international community taking the base year 2011. NDC was updated in August 2021 to cover four sectors, that are Energy, Industrial Processes and Product Use, Agriculture, Forestry, and other Land use and Waste. NDC update aims to further mitigation actions that Bangladesh may take to tackle its growing emissions and play its role in global efforts.

As per the updated NDC, the climate change mitigation scenario analyses and assessments were conducted. As a result, NDC proposed that the greenhouse gas emissions would be reduced by 27.56 million tons (6.73%) from the business-as-usual scenario by 2030, unconditionally. In the conditional scenario, the greenhouse gas emissions would be reduced by 61.9 million tons (15.12%) below Business-as-Usual by 2030. In both cases, the Energy sector will contribute most to such reduction and approximately 95 % and 96% of the total reductions were in the Energy sector in an unconditional and conditional scenario, respectively. The total tentative estimated costs of the mitigation actions are USD 176 billion over ten years (2021-2030).

2.2.4 Perspective Plan of Bangladesh 2021-2041

(1) Overview

The government of Bangladesh has adopted Vision 2041 which is a continuation of Digital

Bangladesh Vision 2021. It seeks to eliminate extreme poverty and reach Upper Middle-Income Country status by 2031, and High-Income Country status by 2041 with poverty approaching extinction. To convert Vision 2041 into a development strategy, policies, and programs, the 'Perspective Plan of Bangladesh 2021-2041' (hereinafter referred to as "PP2041") has been launched.

The two principal visions in PP2041 are:

- Bangladesh will be a developed country by 2041, with a per capita income of over USD 12,500 in today's prices, and fully in tune with the digital world.
- Poverty will become a thing of the past in Sonar Bangla.

The following strategic goals will be pursued as the essential components of economic policy over the long term:

- Eradication of extreme poverty by 2031; reducing poverty to less than 3 percent by 2041
- Towards upper middle-income country by FY 2031; high-income country by 2041
- Industrialization with export-oriented manufacturing will drive structural transformation into the future
- Paradigm shifts in agriculture will enhance productivity and ensure nutrition and food security for the future
- A service sector of the future will provide the bridge for the transformation of the rural agrarian economy to a primarily industrial and digital economy
- The urban transition will be an essential part of the strategy to move to a high-income economy
- Efficient energy and infrastructure will be essential components of the enabling environment that facilitates rapid, efficient, and sustainable growth
- Building a Bangladesh resilient to climate change and other environmental challenges
- Establishing Bangladesh as a knowledge hub country for promoting a skill-based society

(2) Key Strategies and Policies Related to Climate Change Adaptation

The main focus of the PP2041, described as the environmental management strategy would be to integrate environmental and climate change considerations in the growth strategy. The specific strategies, policies, and institutional reforms include the items shown in the following Table 2.2.6.

Table 2.2.6 Key Strategies, Policies, and Institutional Reform Items for Environmental Considerations and Climate Change Response in PP 2041

No.	Strategies and Policies
(i)	Integrating environmental costs into the macroeconomic framework
(ii)	Implementing the BDP2100 to build resilience and reduce vulnerability to climate change
(iii)	Reduce air and water pollution
(iv)	Ensure Sustainable Management of Forestry Resources
(v)	Strengthen Environmental Coordination and Environmental Institutions
(vi)	Strengthen Climate Change Trust Fund
(vii)	Develop a Sound Environment and Climate Change Financing Strategy

Source: PP2041, GED

The objectives for the environmental sector are shown in Table 2.2.7.

Table 2.2.7 Perspective Plan 2021-2041 Objectives for Environmental Sector

I.	Some 80 percent of the population lives in urban areas and enjoys a quality of life that is comparable to those found in the present-day high-income economies.
II.	There is a proper balance between ecology, the natural environment, and the needs of the population. In particular, the productivity of land is preserved, forest resources are conserved and enriched, biodiversity and air quality are improved, pollution level is decreased and water resources are properly managed to prevent flooding and water shortages.
III.	Cities are normally flood-free with proper drainage, modern sewerage, proper waste management, and clean air.
IV.	There is minimal incidence of absolute poverty; there are no slums and every household has a basic minimum housing quality.
V.	The country is equipped to respond fully and quickly to any incidence of natural disasters.
VI.	Environmental governance is such whereby there is a sound mix of incentives and regulatory policies including the application of the polluter pays principle and a decentralized implementation of environmental policies and programmes.

Source: PP2041, GED

(3) Policies, Strategies or Priorities in the Field of Water, Disaster Risk Reduction, and Agriculture in the Context of Climate Change Adaptation

1) Water

As part of policies, strategies, and priorities to cope with climate change, the following issues are stated;

(a) Policies

- Important policy reforms are to increase public spending on water resources from 0.8% of GDP now to 2% of GDP by FY2020; increase O&M spending from a negligible amount now to at least 0.5% of GDP by FY2020; provide incentives to encourage public-private partnerships (PPP) in water supply, water transport, river dredging, and sanitation; strengthen dialogue with India on better and more equitable sharing of upstream water including joint projects that yield multiple benefits.
- Major institutional reforms include the establishment of an institutional framework for holistic planning, budgeting, project selection, research, and monitoring and evaluation of water-related projects, as well as the establishment of water user associations at the local level that will have primary responsibility for implementing all local-level water projects including O&M.
- The government will introduce a beneficiary-pays-principle for all local water projects and O&M so that over time the water resource and related hazard management become largely beneficiary-managed and financed and therefore fully sustainable.

(b) Strategies

- Water reservoir/rainwater harvesting in rainfed/coastal/hilly areas will have to be encouraged, and small-scale water resources systems could be developed along with monitoring the maintenance of the small-scale water resources infrastructure at local levels by water management groups/cooperative associations and taking care of environmental and social issues.

- Improving water harvesting and retention (through the use of pools, dams, pits, retaining ridges, and increasing soil organic matter to heighten the water retention capacity of soils) and water-use efficiency.

(c) Priorities

- In water resources, the priority is to scale up existing good practices of water conservation and management and apply more widely integrated water management, including irrigation improvement. The perspective of 'water security' would be addressed along with food security and energy security.

2) Disaster Risk Reduction

In PP2041, while there are few specific policies and strategies mentioned in the field of disaster risk reduction, the following issues are stated.

- One of PP2041's priorities is to apply more widely integrated water management, including flood control and prevention schemes, and flood early warning systems.
- As PP2041 vision, cities will be normally flood-free with proper drainage, modern sewerage, and proper waste management.

3) Agriculture

The key priorities in the agriculture sector include strengthening local adaptive capacity by providing public goods and services, such as better climate information, innovative research for the development of heat-tolerant, salinity-tolerant crop varieties and climate-smart production technologies, and efficient water-saving irrigation practices.

2.2.5 The 8th Five-Year Plan (July 2020- June 2025)

(1) Overview

The Eighth Five-Year Plan (8FYP, July 2020 - June 2025) is a flagship document as the first in the series of Five-Year Plans to complete the agenda of achieving the social and economic transformation visualized in PP2041. 8FYP would also be instrumental in attaining SDGs, realizing BDP2100 for smooth transition following the Least Developed Country (hereinafter referred to as "LDC") graduation. 8FYP mainly centers on six core themes, which include.

I. Rapid recovery from COVID-19
II. GDP growth acceleration, employment generation, and rapid poverty reduction with a broad-based strategy of inclusiveness
III. A sustainable development pathway resilient to disaster and climate change
IV. Sustainable use of natural resources and successful management of the inevitable urbanization transition
V. Development and improvement of critical institutions, and
VI. Attaining SDG targets and coping with the impact of LDC graduation

(2) Basic Policies and Strategies Related to CCA, Water, Disaster Risk Reduction, and Agriculture

1) Environment and Climate Change

The core targets for environmental management under 8FYP are summarized in Table 2.2.8.

Table 2.2.8 Core Targets for Environmental Management

Objectives / Targets	Base year (2018)	Target (2025)
Percent of urban centers with wastewater treatment facilities	N/A	50
Core environmental spending (% of GDP)	1	1.5
Spending by environment coordinating entity (% of GDP)	0.005	0.1
Application of polluter pays principle (% of cases)	0	40
Carbon tax (% of fuel prices)	0	5
Green area for Dhaka-major cities (square meters/million people)	N/A	1-4
Disaster risk reduction and management readiness (% of population)	N/A	50
Urban water body's compliance with water quality standards (%)	0	50
Air quality (annual average, $\mu g/m^3$ PM 2.5)	86	60
Percent of cities flood-free, with proper drainage	0	45
Percent of land degraded	18	12
The area under forest cover (% of land) [base year 2015]	14.1	15.2
Protection of Habitat and Biodiversity International Ranking	Bottom 5%	Top 50%

Source: GED Projections. Base year values show the most recent available data

2) Water

The objectives and targets of the water sector for 8FYP have been set out in conformity with PP2041 and the BDP2100. The objective of the water sector in 8FYP is to scale up existing good practices of water conservation and management and apply more widely integrated water management, including flood control and prevention schemes, flood early warning systems, irrigation improvement, and demand-side management as advocated in BDP2100. The strategic objectives are explained in Attachment 3.

3) Disaster Risk Reduction

In order to address the losses and damages from natural disasters and climate change more effectively, the Government will undertake specific activities under 8FYP as summarized in the table in Attachment 3.

4) Agriculture

The development vision for the agriculture sector under 8FYP is to ensure food security and nutrition through increasing productivity, minimizing the yield gap, stabilizing the price of agricultural products, improving farmers' profitability and securities, diversifying crop products towards climate-resilient production, strengthening agricultural supply chains, increasing commercialization through uses of information and communication technology, easing credit facilities for small farmers; escalating human resource development for undertaking frontier research and delivery services; and ensuring efficient utilization of natural resources. The major focus of the Plan in the sector, therefore, is on consolidating and expanding the productivity gains through designing policies, strategies, and actions to accelerate the crop diversification and commercialization process by increasing local and export market opportunities for the farmers and other stakeholders. The major objectives of the agriculture sector for 8FYP are shown in

Attachment 3.

2.2.6 Mujib Climate Prosperity Plan

The Mujib Climate Prosperity Plan (hereinafter referred to as "MCPP") is a strategic investment framework for climate financing in Bangladesh. The objective of MCPP is to:

- Shift from vulnerability to resilience to prosperity: MCPP aims to counteract the impacts of climate change on Bangladesh's development and economy by enhancing resilience, creating jobs, and expanding opportunities. MCPP also anticipates Bangladesh's smooth graduation from the least developed country status in 2026 and seeks to diversify capital sources, improve market access, and strengthen financial protection and resilience.
- Fast-track the delivery of the Sustainable Development Goals: MCPP leverages the financing of the 8th Five Year Plan, Vision 2041, and Bangladesh Delta Plan 2100 with synergies with the Bangladesh Climate Change Strategy and Action Plan, National Adaptation Plan, and Nationally Determined Contributions.

MCPP proposes an economic transformation for prosperity with actions as follows.

- Maximizing resilience with loss and damage financing:
- Strengthen employment in a green economy
- Promote well-being and traditional living
- Secure energy independence and security, becoming a net green energy expert

MCPP estimated the total investment amount of USD 83.55 billion. In order to implement MCPP, resource mobilization, particularly from external sources and coordination with the private sector, will be crucial and the involvement of the Prime Minister's Office plays an important role. Engagement with domestic implementation partners including the PPP authority, Bangladesh Investment Development Authority, and Vulnerable Twenty declared in the Climate Vulnerable Forum is also important. MCPP considers the application of international funds like Climate Investment Funds, the Global Environment Facility, the Green Climate Fund, and the Bangladesh Climate Change Trust Fund to be essential. Attachment 4 shows the estimated level of investment in MCPP.

2.2.7 IPCC, the 6th Assessment Report

In the 6th Assessment Report of IPCC (hereinafter referred to as "AR6"), 5 scenarios were analyzed.

Table 2.2.9 Climate Change Scenarios in AR6

Scenario	Description
SSP1-1.9	Sustainability: The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries.
SSP1-2.6	Middle of the road: The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns.
SSP2-4.5	Regional rivalry: A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues.
SSP3-7.0	Inequality: Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing inequalities and stratification both across and within countries.
SSP5-8.5	Fossil-fueled development: This world places increasing faith in competitive markets, innovation, and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development. Global markets are increasingly integrated.

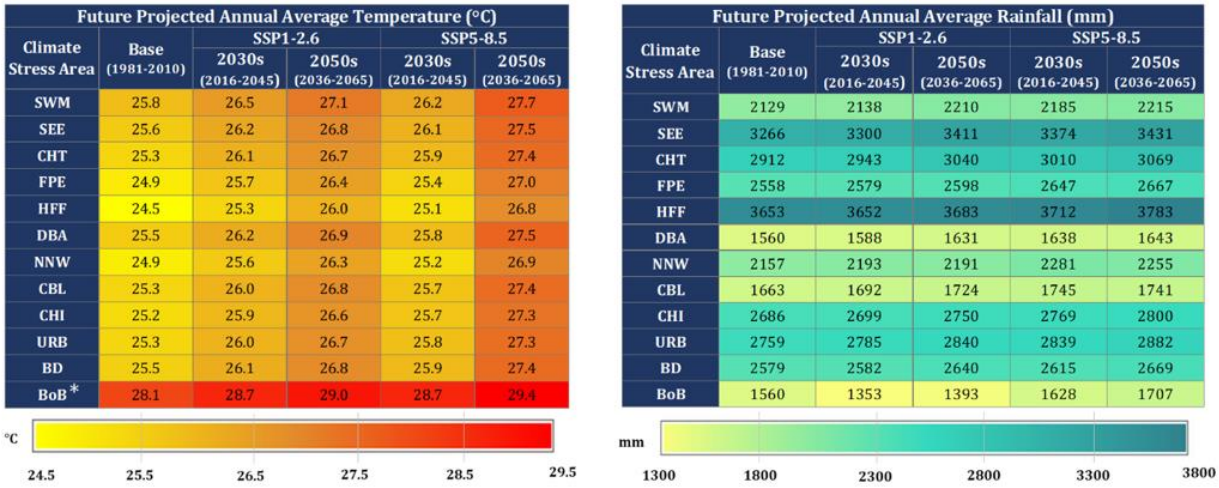
Source: AR6

(1) Temperature

AR6 projects a global temperature increase of 1.5°C to 1.6°C in the near term (the 2030s), 1.7°C to 2.4°C in the mid-term (2050s) and 1.8°C to 4.4°C in the long term (end of the century). According to NAP, Climate projections for Bangladesh indicate a warming of 0.44°C to 0.69°C in the near term (2030s) and 1.3°C to 2°C in the mid-term (2050s) for the SSP1-2.6 and SSP5-8.5 scenarios.

(2) Rainfall

Rainfall variation due to future climate change for Bangladesh ranges between 0.1-1.4 percent in the 2030s and 2.4-3.5 percent in the 2050s.

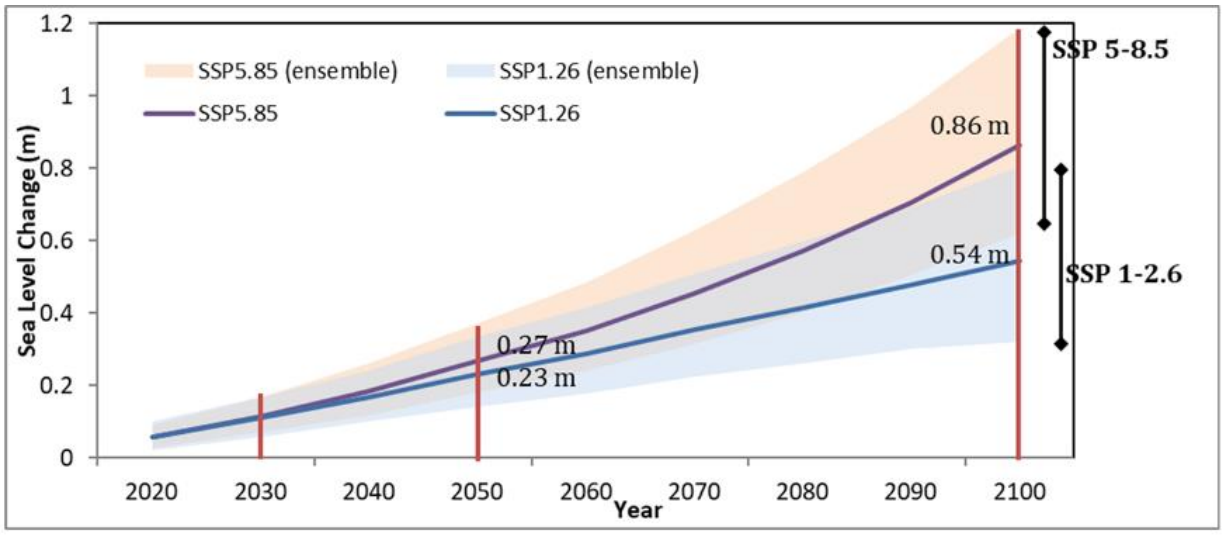


Source: NAP

Figure 2.2.1 Future Projections of Temperature and Rainfall for Bangladesh and Different Climate Stress Areas by CEGIS

(3) Sea-level Rise

Sea-level rise causes salinity intrusion, and it is one of the major hazards in low-lying coastal areas of Bangladesh. Future sea-level rise is projected to be between 0.11 - 0.12 m in the near term, 0.23 - 0.27 m in the mid-term, and 0.54 - 0.86m.



Source: NAP

Figure 2.2.2 Sea-level Rise Projections Near the Bangladesh Coast in the Bay of Bengal

2.3 Stakeholders Related to Climate Change Adaptation

Stakeholders in relation to the purposes of this study or NAP implementation in water, disaster risk reduction, and agriculture sectors are shown in Table 2.3.1.

Table 2.3.1 Related Stakeholders

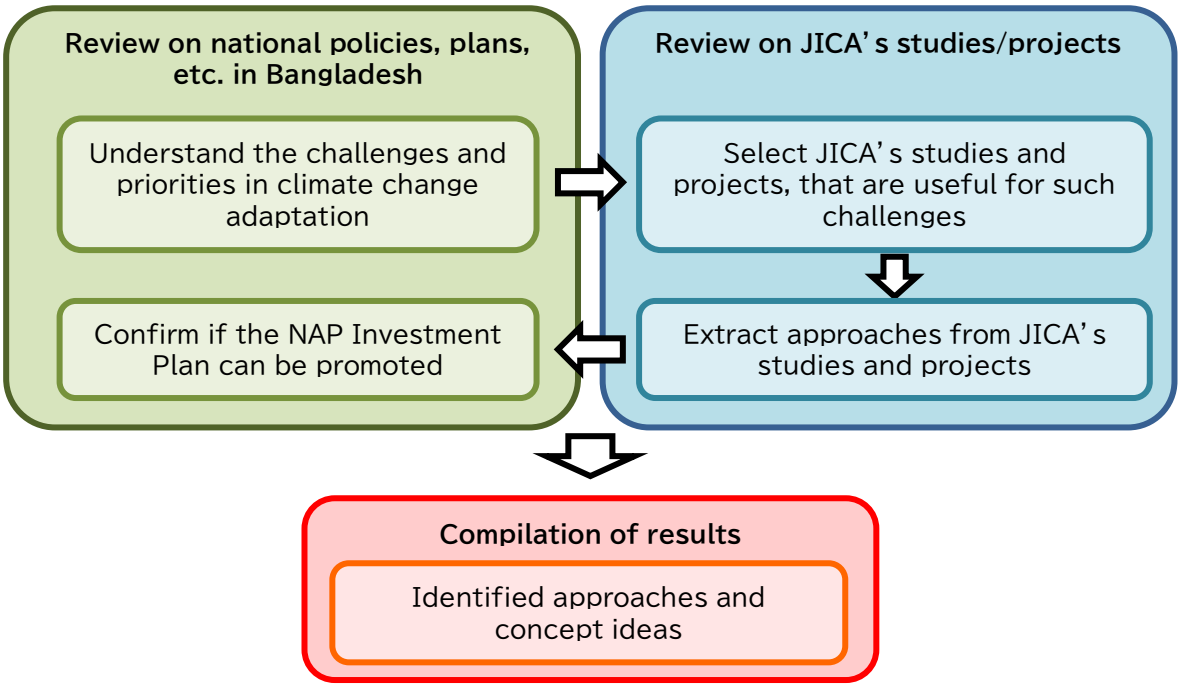
Type	Sectors		
	Water	Disaster risk reduction	Agriculture
Directly affected people	Residents in target areas, Nationals in Bangladesh	Residents in target areas, Nationals in Bangladesh	Farmers in target areas
Ministries and department	BMD, BWDB, DPE, DSHE, DPHE, DSHE, LGD	DDM, BWDB, LGED, IWM, DRRO, DMC, BHWDB, BMD, PWD, DSS, DWA, DYD, RHD, DOE, LGD, HBRI, DPHE, WARPO, SPARRSO, BUET	MoA, MoFDM, DAE, DGF, IRRI, BB, BRRI, BARI, BARC, BHWDB, DCF, RCF, other financial institution
NGO	Asia Arsenic Network	-	Share the Planet, Shapla Neer
Others	Upazila Health Complex, private companies	CEGIS	BADC private companies such as agricultural equipment companies

Where, BMD: Bangladesh Meteorological Department, BWDB: Bangladesh Water Development Board, DPE: Directorate of Primary Education, DSHE: Directorate of Secondary Higher Education, DPHE: Department of Public Health Engineering, DSHE: Directorate of Secondary and Higher Education, LGD: Local Government Division, DDM: Department of Disaster Management, LGED: Local Government Engineering Department, IWM: Institute of Water Modeling, DRRO: Disaster Risk Reduction Organization, DMC: Disaster Management Committee, BHWDB : Bangladesh Haor and Wetland Development Board, PWD: Public Works Department, DSS: Department of Social Services, DWA: Department of Women Affairs, DYD: Department of Youth Development, RHD: Roads and Highways Department, DOE: Department of Environment, LGD: Local Government Division, HBRI: Housing and Building Research Institute, WARPO: Water Resources Planning Organization, SPARRSO: Space Research and Remote Sensing Organization, BUET: Bangladesh University of Engineering and Technology, MoA: Ministry of Agriculture, MoFDM: Ministry of Food and Disaster Management, DAE: Department of Agricultural Extension, DGF: Directorate General of Food, IRRI: International Rice Research Institute, CEGIS: The Center for Environmental and Geographic Information Services, BB: Bangladesh Bank, BRRI: Bangladesh Rice Research Institute, BARI: Bangladesh Agricultural Research Institute, BARC: Bangladesh Agricultural Research Council, DCF: District Controllers of Food, RCF: Regional Controllers of Food, BADC: Bangladesh Agricultural Development Corporation
Source: JST

CHAPTER 3 SURVEY METHOD AND RESULTS

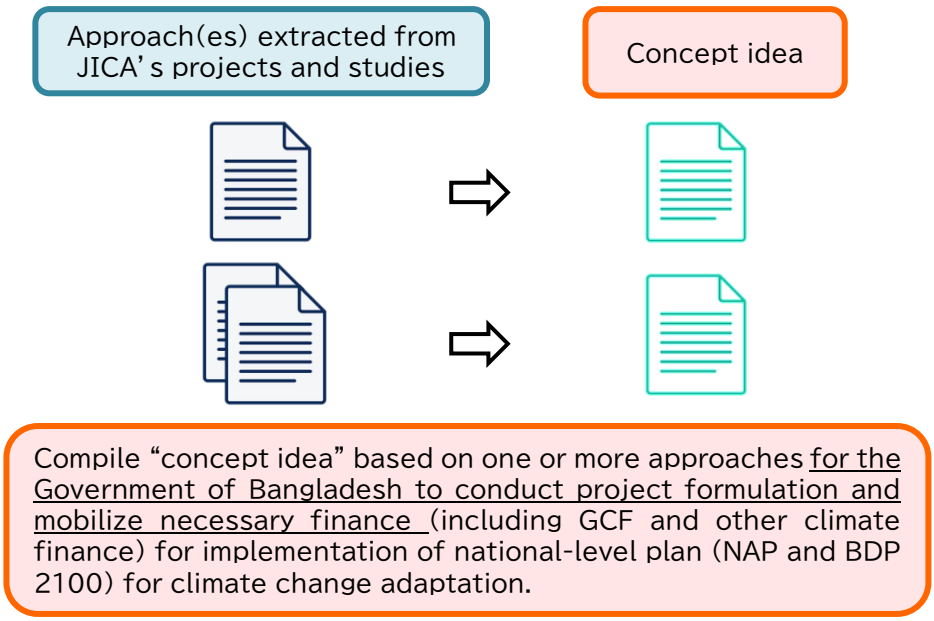
3.1 Flow of the Survey Implementation

Firstly, as described in Chapter 2, national policies, plans, etc. related to the climate change adaptation in Bangladesh are reviewed to understand the priorities and challenges of such adaptations. A review of JICA's past and ongoing studies and projects in water, disaster risk reduction, and agriculture sectors follows it and effective adaptation approaches for NAP and BDP 2100 implementation are extracted from such studies and projects. Finally, some of the approaches combined (or one approach) create "concept ideas" as new applications for climate change adaptation. With such results, this study provides policy recommendations to the Government of Bangladesh to promote a national-level plan for climate change adaptation in Bangladesh. Figure 3.1.1 shows the flow of project implementation and Figure 3.1.2 describes the relation between the approaches and the concept ideas.



Source: JST

Figure 3.1.1 Conceptual Flow of the Project Implementation



Source: JST

Figure 3.1.2 Relation between the Approaches and the Concept Ideas

3.2 Analysis Methods and Basic Compilation Policy of Effective Approach

Bangladesh and JICA have conducted many studies/projects with the schemes of technical cooperation, grant aid, ODA loan, expert(s) dispatchment, and grass-root technical cooperation for the past 50 years since the start of JICA's cooperation in Bangladesh. Firstly, all of such studies/projects in the disaster risk reduction sector in the recent approximately 50 years (since yr-1980) are listed and those in the water sector and the agriculture sector in the recent approximately 20 years (since yr-2000) are also listed (refer to the Attachment 5). Secondarily, those studies/projects are briefly reviewed to see how each study/project is related to Bangladesh's national policies and strategies for climate change adaptations. Thirdly, approximately 15 to 20 studies/projects are selected and reviewed further to extract key activities, results, lessons learned, etc., that can embody some portion of NAP IP and help promotion of the implementation of NAP and BDP 2100. The extracted key information is compiled in a format as effective approaches. The approaches describe the following items and the details are provided in Attachment 6.

1) Outline and Features of the Approach

- Summary of approach
- Keyword

2) Project delivering the Approach

- Introduction
- Key activities
- Project outcomes
- Key indicators/generated impacts
- Lessons learned
- Developed tools and guidelines

- Devices for ensuring sustainability
- Considerations for social, environmental and climate change issues
- Project information relevant to the approach

3.3 Basic Compilation Policy of Concept Idea

Based on a single or multiple approach(es) extracted in the manner described in Clause 3.2, concept ideas for future interventions are compiled. The concept ideas are compiled to provide policy recommendations and basic information for the further process (e.g., project formulation, budget request) for the Bangladesh Government to effectively implement NAP and BDP 2100.
The relation between the featured approaches and the concept ideas is described in Clause 3.4 after the explanation of the approaches and details of the concept ideas are provided in Attachment 7. The concept ideas describe the following items.

- Project title
- Keyword
- NAP sector/investment plan
- Project rationale, objectives, and approach of the project
- Project areas (expected project areas)
- Key approach, project/programme description
- Expected project results
- Engagement of key stakeholders
- Indicative cost estimate
- Remarks/acknowledgment

3.4 Selected Studies/Projects, Extracted Approaches, and Concept Ideas

As shown in Table 3.4.1, 23 JICA-funded and completed or ongoing studies/projects in Bangladesh were selected and reviewed further to extract key activities, results, lessons learned, etc., that can help promotion of the implementation of NAP and BDP 2100. The list of the extracted approaches is shown in Table 3.4.2 and the key information is compiled in the approach format in Attachment 6. Contributions of the approaches to NAP Goals and Strategies are summarized in Table 3.4.3 to Table 3.4.6.

Table 3.4.1 23 Selected Studies/projects

No.	Studies/projects name	Year
Water Sector		
1	(T/C) Feasibility Study on a Rainwater Tank Social Business with Micro Credit Loan	2010-2013
2	(T/C) The Project for Improvement of Comprehensive Management Capacity of DPHE on Water Supply	2015-present
3	(T/C) Project for Sustainable Mitigation of Arsenic Contamination under the Integrated Local Government System	2005-2008
4	(T/C) Upazila Integrated Capacity Development Project (UICDP) Phase 1 and 2	2017-present
Disaster Risk Reduction Sector		
5	(T/C) The Project for Capacity Enhancement on Formulation and Implementation of Local Disaster Risk Reduction Plan	2020-present
6	(T/C) Development of Human Capacity in Operation of Weather Analysis and Forecasting/ Project for Strengthening the Capacity of Weather and Climate Services	2009-2013, 2022-present
7	(T/C) The Project for Capacity Development of Management for Sustainable Water-Related Infrastructure	2013-2017
8	(T/C) Project for Planning Capacity Enhancement and Establishment of a Technology Adaptation Cycle on Comprehensive Nodi (River) Management	2020-present
9	(Grant) Meteorological Radar System Development in Dhaka, Rangpur, Moulvibazar, Cox's Bazar and Khepupar	2005-2008, 2007-2009, 2015-present
10	(Grant) Programme for Construction of Multipurpose Cyclone Shelters in the Area Affected by the Cyclone Sidr	2008-2010
11	(Loan) Haor Flood Management and Livelihood Improvement Project	2014-present
12	(Loan) Disaster Risk Management Enhancement Project (DRMEP)	2016-present
13	(SATREPS) Research on Disaster Mitigation Measures against Floods and Storm Surges	2014-2019
14	(Grass-root T/C) Mobilizing and Organizing Humanitarian Operations and Risk reduction activities in disaster-prone coastal Areas (MOHORA)	2017-2021
15	(Grass-root T/C) Development of Youth-led Community Disaster Preparedness System	2010-2011
16	(Grass-root T/C) Community-Based Disaster Risk Reduction in Urban Areas	2016-2019
17	(Grass-root T/C) Capacity Enhancement for Disaster Preparedness Using Community Radio	2013-2017
Agriculture Sector		
18	(T/C) Market-oriented Agriculture Promotion Project for Smallholder Horticulture Farmers Through Multi-stakeholder Partnerships	2021-present
19	(Grass-root T/C) Practice and Dissemination of Disaster-resistant Climate Change-adaptive Agriculture in Haor	2022-present
20	(Loan) Food Value Chain Improvement Project (FVCIP)	2020-present
21	(Loan) Small Scale Water Resources Development Project (Phase-1&2)	2007-2023
22	(Grant) Improvement of the Capacity of Public Food Storage in the People's Republic of Bangladesh	2012-2015
23	(Loan) Small and Marginal Sized Farmers Agricultural Productivity Improvement and Diversification Financing Project	2014-2021

Where, T/C: Technical cooperation
Source: JST

Table 3.4.2 17 Extracted Approaches

No.	Approach name
Water Sector	
1	Large scale-concrete hollow block tanks for public water supply in local communities
2	Rainwater harvesting in coastal areas through the collaboration between social businesses and communities
3	Reducing health damage caused by arsenic-contaminated drinking water with residents and hospitals
4	Securing safe water resources in rural areas based on water potential
Disaster Risk Reduction Sector	
5	Flash flood measures and livelihood improvement in Haor areas
6	Sustainable flood mitigation infrastructure development
7	Flood mitigation method and planning suitable for various/diverse-scale rivers
8	Upazila-level disaster risk reduction planning and implementation
9	Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help
10	Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment
11	Development and maintenance of meteorological radar systems
12	Improved and accurate weather observation and forecasting
13	Risk assessment, forecasting, and countermeasures for flood and storm surge risk reduction
Agriculture Sector	
14	Dissemination of new climate change-adapted paddy rice varieties in the Haor area
15	Stepwise development of small-scale irrigation and drainage system with initiative of communities (WMCAs)
16	Smallholder horticultural farmers empowerment & promotion (Bangla-SHEP)
17	Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity

Source: JST

Table 3.4.3 Contribution of the Approaches to NAP Goals and Strategies in the Water Sector

Goal	Strategy	Approach name			
		Large scale-concrete hollow block tanks for public water supply in local communities	Rainwater harvesting in coastal areas through the collaboration between social businesses and communities	Reducing health damage caused by arsenic-contaminated drinking water with residents and hospitals	Securing safe water resources in rural areas based on water potential
Goal 1: Ensure protection against climate change variability and induced natural disasters.	S 1.1: Combat cyclonic storm surges, sea level rise and salinity intrusion	✓	✓		
	S 1.2: Manage floods, erosion and drought risks				
	S 1.3: Protect life, livelihoods, infrastructures and ecosystems against slow-onset and other climate extremities				
Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation.	S. 6.1: Develop transformative capacities and management of knowledge	✓	✓	✓	✓
	S. 6.2: Introduce innovation in reducing climate change and disaster risks and consequent losses and damages	✓	✓	✓	✓
	S. 6.3: Research and innovation for agriculture, fisheries and livestock.				
	S.6.4: Advanced research on climate change impacts on ecosystems and application of ecosystem-based adaptation.				
	S. 6.5: Action research for innovation in climate-resilient infrastructure, improved health and WASH technologies				✓

Note: No matching in Goal.2, "Develop climate-resilient agriculture for food, nutrition and livelihood security.", Goal.3, "Develop climate-smart cities for an improved urban environment and well-being. ", Goal.4, "Promote nature-based solutions for the conservation of forestry, biodiversity and the well-being of communities." and Goal. 5, "Impart good governance through the integration of adaptation into the planning process."

Table 3.4.4 Contribution of the Approaches to NAP Goals and Strategies in the Disaster Risk Reduction Sector (1/2)

Goal	Strategy	Approach name				
		Flash flood measures and livelihood improvement in Haor areas	Sustainable flood mitigation infrastructure development	Flood mitigation method and planning suitable for various/diverse-scale rivers	Upazila-level disaster risk reduction planning and implementation	Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help
Goal 1: Ensure protection against climate change variability and induced natural disasters.	S 1.1: Combat cyclonic storm surges, sea level rise and salinity intrusion				✓	✓
	S 1.2: Manage floods, erosion and drought risks	✓	✓	✓	✓	
	S 1.3: Protect life, livelihoods, infrastructures and ecosystems against slow-onset and other climate extremities	✓				
Goal 2: Develop climate-resilient agriculture for food, nutrition and livelihood security.	S 2.1: Promote extension of climate-smart agriculture	✓				
	S 2.2: Develop climate-resilient fisheries, aquaculture, and livestock					
	S 2.3: Manage sustainable agro-inputs and transformative value chains					
	S 2.4: Strengthen extension services for agriculture, fisheries and livestock					
Goal.3: Develop climate-smart cities for an improved urban environment and well-being	S 3.1: Promote green and blue infrastructure for urban environmental management and conservation					

Goal	Strategy	Approach name				
		Flash flood measures and livelihood improvement in Haor areas	Sustainable flood mitigation infrastructure development	Flood mitigation method and planning suitable for various/diverse-scale rivers	Upazila-level disaster risk reduction planning and implementation	Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help
Goal.3: Develop climate-smart cities for an improved urban environment and well-being (continued)	S 3.2: Develop climate-smart cities to increase urban resilience			✓		
	S 3.3: Develop climate-resilient health care and WASH facilities for improved human well-being and livability in cities					
Goal 5: Impart good governance through the integration of adaptation into the planning process.	S 5.1: Reform policies for mainstreaming adaptation				✓	✓
	S 5.2: Develop a framework for adaptation monitoring, evaluation and learning					
	S 5.3: Engage the private sector in adaptation implementation					
	S 5.4: Empower local government institutes, community-based organizations, women, people with disabilities, and youth for locally-led adaptation				✓	✓
	S 5.5: Enhance climate financing for adaptation					
Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation.	S. 6.1: Develop transformative capacities and management of knowledge		✓	✓		✓
	S. 6.2: Introduce innovation in reducing climate change and disaster risks and consequent losses and damages		✓	✓		
	S. 6.3: Research and innovation for agriculture, fisheries and livestock.					
	S.6.4: Advanced research on climate change impacts on ecosystems and application of ecosystem-based adaptation.					
	S. 6.5: Action research for innovation in climate-resilient infrastructure, improved health and WASH technologies		✓	✓		

Note: No matching in Goal 4, “Promote nature-based solutions for the conservation of forestry, biodiversity and the well-being of communities.”

Table 3.4.5 Contribution of the Approaches to NAP Goals and Strategies in the Disaster Risk Reduction Sector (2/2)

Goal	Strategy	Approach name			
		Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment	Development and maintenance of meteorological radar systems	Improved and accurate weather observation and forecasting	Risk assessment, forecasting, and countermeasures for flood and storm surge risk reduction
Goal 1: Ensure protection against climate change variability and induced natural disasters.	S 1.1: Combat cyclonic storm surges, sea level rise and salinity intrusion	✓	✓	✓	✓
	S 1.2: Manage floods, erosion and drought risks		✓	✓	✓
	S 1.3: Protect life, livelihoods, infrastructures and ecosystems against slow-onset and other climate extremities	✓	✓	✓	✓
Goal.3: Develop climate-smart cities for an improved urban environment and well-being	S 3.1: Promote green and blue infrastructure for urban environmental management and conservation				
	S 3.2: Develop climate-smart cities to increase urban resilience				
	S 3.3: Develop climate-resilient health care and WASH facilities for improved human well-being and livability in cities	✓			
Goal 5: Impart good governance through the integration of adaptation into the planning process.	S 5.1: Reform policies for mainstreaming adaptation			✓	
	S 5.2: Develop a framework for adaptation monitoring, evaluation and learning				
	S 5.3: Engage the private sector in adaptation implementation				
	S 5.4: Empower local government institutes, community-based organizations, women, people with disabilities and youth for locally led adaptation				
	S 5.5: Enhance climate financing for adaptation				
Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation.	S. 6.1: Develop transformative capacities and management of knowledge				
	S. 6.2: Introduce innovation in reducing climate change and disaster risks and consequent losses and damages		✓	✓	✓
	S. 6.3: Research and innovation for agriculture, fisheries and livestock.				
	S.6.4: Advanced research on climate change impacts on ecosystems and application of ecosystem-based adaptation.				✓
	S. 6.5: Action research for innovation in climate-resilient infrastructure, improved health and WASH technologies		✓	✓	

Note: No matching in Goal.2, “Develop climate-resilient agriculture for food, nutrition and livelihood security.”, Goal 4, “Promote nature-based solutions for the conservation of forestry, biodiversity and the well-being of communities.”

Table 3.4.6 Contribution of the Approaches to NAP Goals and Strategies in the Agriculture Sector

Goal	Strategy	Approach name			
		Dissemination of new climate change-adapted paddy rice varieties in the Haor area	Stepwise development of small-scale irrigation and drainage system with initiative of communities (WMCAS)	Smallholder horticultural farmers' empowerment & promotion (Bangla-SHEP)	Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity
Goal 2: Develop climate-resilient agriculture for food, nutrition and livelihood security.	S 2.1: Promote extension of climate-smart agriculture	✓			✓
	S 2.2: Develop climate-resilient fisheries, aquaculture and livestock				
	S 2.3: Manage sustainable agro-inputs and transformative value chains			✓	
	S 2.4: Strengthen extension services for agriculture, fisheries and livestock		✓	✓	
Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation.	S. 6.1: Develop transformative capacities and management of knowledge	✓	✓	✓	✓
	S. 6.2: Introduce innovation in reducing climate change and disaster risks and consequent losses and damages	✓	✓	✓	✓
	S. 6.3: Research and innovation for agriculture, fisheries and livestock.	✓	✓	✓	✓
	S.6.4: Advanced research on climate change impacts on ecosystems and application of ecosystem-based adaptation.				
	S. 6.5: Action research for innovation in climate-resilient infrastructure, improved health and WASH technologies		✓		

Note: No matching in Goal 1, “Ensure protection against climate change variability and induced natural disasters.”, Goal.3, “Develop climate-smart cities for an improved urban environment and well-being.”, Goal.4, “Promote nature-based solutions for the conservation of forestry, biodiversity and the well-being of communities.”, and Goal.5, “Impart good governance through the integration of adaptation into the planning process.”

3.4.1 Water Sector

(1) Issues and Status of Countermeasures

1) Water Quality

Bangladesh has an extensive coastline where the adverse impact of saltwater intrusion is significant and natural hazards caused by climate change in this region occur more frequently than before with greater intensity. Bangladesh's land area impacted by salinity increased by roughly 26.7% from 1973 to 2009, or 0.223 million hectares, with about 35,440 hectares of the land becoming saline only between 2000 and 2009[1]. According to another study, future sea level rise will drive the salinity further inward in the short- and medium-term. In the mid-term, the areas affected by 1 ppt salinity will grow by 7.5%, whereas the regions affected by 5 ppt salinity will grow by 9%[2].

Most of Bangladesh's groundwater is also contaminated with arsenic. Since arsenic contamination of groundwater was discovered in 1993, a nationwide survey was conducted and found that arsenic exceeding standard values was detected in approximately 30% of wells. Construction of alternative

[1] Saline Soils of Bangladesh, Soil Resource Development Institute, SRMAF Project, Ministry of Agriculture, 2010

[2] Technical Note: Impacts of projected Sea Level Rise on coastal embankments, CEGIS, 2021

water sources later progressed, and by 2009 approximately 970,000 shared alternative water sources had been installed, but only about 690,000 of these were in operation. It is estimated that approximately 20 million people still do not have access to safe water due to arsenic contamination[3].

2) Water Resource Management by the Government

The Department of Public Health Engineering (hereinafter referred to as "DPHE") is the leading agency for safe water distribution in rural areas. The main drinking water sources were tube wells, pond sand filters, and rainwater harvesting in the rural area. The development of large-scale safe water distribution such as pipe water distribution is proceeding by DPHE, yet it is expected to take several more years to fully cover the entire country. In addition to salinity and arsenic problems, these water sources have been generally affected by several issues, such as inundation of water sources by contaminated flood water, disruption of access of fetching safe water, and disruption of the infrastructures of the water supply system. Presently, DPHE is working on safe water distribution in the entire Bangladesh based on the scientific approach for the selection of alternative water sources.

3) Awareness of Residents on Safe Water

Through the continuous awareness raising on arsenic poisoning issues, people in Bangladesh know how dangerous arsenic-contaminated water is. However, residents may not be able to avoid such dangerous water because there are no alternative water sources, or, some of them may not be fully aware of the serious health implications. The Government of Bangladesh is trying to shift the water source from underground water to surface water to avoid lowering groundwater levels. However, residents prefer deep tube wells for their water and continuously use them because underground water has stabler and relatively larger discharge than surface water.

Since climate change has made the available water source dramatically changing, the residents should be informed about their choices of water sources. To do so, along with the scientific approach for finding suitable water sources by the government, awareness raising targeting residents is highly expected.

(2) Effective Approach

In the water sector, the following 4 approaches are extracted.

1) Large scale-concrete hollow block tanks for public water supply in local communities
2) Rainwater harvesting in coastal areas through the collaboration between social businesses and communities
3) Reducing health damage caused by arsenic-contaminated drinking water with residents and hospitals
4) Securing safe water resources in rural areas based on water potential

[3] Situation Analysis of Arsenic Mitigation 2009, JICA-DPHE, 2010

The overview of the approaches for application to future interventions is provided here and details of the approach are provided in Attachment 6.

1) Large Scale-Concrete Hollow Block Tanks for Public Water Supply in Local Communities

(a) Summary

In rural areas where there has been an issue of a chronic shortage of drinking water, concrete hollow block tanks storing rainwater at public facilities (e.g., schools) are planned and constructed for drinking water supply to facility users (e.g., students, teachers, school staff, etc.) and neighboring residents. This approach mainly consists of the following.

- Basic survey for rainwater tank installation
- Rainwater tank construction
- Establishment of a management committee
- Compilation of the maintenance manual of the rainwater harvesting system

Keyword:

Rainwater harvesting, safe water distribution, reduction of labor and cost for safe water access, ownership, sustainable business, local corporation, NGO, Sky Water Harvesting System

(b) Lessons learned from the past projects

- These concrete hollow block-made tanks can be installed anywhere in Bangladesh as long as there is enough open space.

(c) Ensuring sustainability

- Prompt and continuous maintenance by maintenance committees
- Raising awareness on maintenance of the tanks by signage, etc.

Source: JICA

Photo 3.4.1 CHB-made Large-scale Rainwater Tank at a Highschool

Source: JICA

Photo 3.4.2 Students Pouring Rainwater

2) Rainwater Harvesting in Coastal Areas Through the Collaboration between Social Businesses and Communities

(a) Summary

In rural coastal areas where salinity issues are seen in drinking water, this approach, collaborating with a private company and local NGOs installs rainwater tanks, grows awareness about rainwater harvesting, and develops a social business model that achieves sustainable and affordable safe water access, primarily targeting the BOP. This approach mainly consists of the following.

- Market survey regarding drinking water
- Mason training to learn rainwater tank manufacturing methods
- Production and installation of rainwater tanks
- Awareness raising and monitoring of rainwater use

Keyword:

Rainwater harvesting, safe drinking water supply, AMAMIZU (which means "water from the sky" in Japanese) tank, reduction of labor and costs on water fetching, residents' ownership of their tanks, local corporations, NGOs

(b) Lessons learned from the past projects

- Product payment allocation which requires a partial payment to owners (residents) with the involvement of a local company raises awareness of the ownership of the tank.
- Transportation for delivering the tank is the key. The road that is flat and durable should be chosen where available. Boat transportation is also applicable.

(c) Ensuring sustainability

- Sustainable social business, sales at low prices rather than donations, aiming to have the beneficiaries realize ownership of their tanks
- Small-scale rainwater tanks for low-income people and large tanks for wealthy people or public usage (introduced in another approach).

Source: Institute for Skywater Harvesting, Co., Ltd

Photo 3.4.3 Production of AMAMIZU Tank

Source: Institute for Skywater Harvesting, Co., Ltd

Photo 3.4.4 AMAMIZU Tank and Residents

3) Reducing Health Damage Caused by Arsenic-Contaminated Drinking Water with Residents and Hospitals

(a) Summary

Intending to install sustainable arsenic contamination control measures, this approach raises awareness of residents on arsenic water problems and provides a fund collection system among residents. This approach also strengthens the planning capacity of the residents' committee for alternative water sources and assists arsenic poisoning patience management at hospitals in Upazilas where arsenic contamination is serious. This approach mainly consists of the following.

- Enhancing the ability of water source management of residents
- Formulation and enhancing the coordination ability of the arsenic countermeasures committee
- Technical support for the installation of alternative water sources such as piped water
- Support for arsenic poisoning patients

Keyword:
Arsenic contamination, participatory mitigation, fund collection system, arsenic mitigation committee, alternative water source, hospital, handbook

(b) Lessons learned from the past projects

- To shift water sources from underground to surface water, stable discharge through a year will be a challenge.

Source: JST

Photo 3.4.5 Well-maintained Arsenic Iron Removal Plant

(c) Ensuring sustainability

- Collection of maintenance costs from the user for the small-scale facilities such as the arsenic iron removal plant.
- Utilization of the technical handbook among staff to avoid discontinuation of knowledge caused by transfer of personnel
- Technical assistance from mechanics of DPHE for the maintenance of the water sources and assistance on enlightenment activities.

Source: JST

Photo 3.4.6 Pipe Water Supply System

4) Securing Safe Water Resources in Rural Areas Based on Water Potential

(a) Summary

To increase the number of safe water resources and provision in rural areas where the rate of safe drinking water coverage ratio is relatively low, the water resource management system, water development planning, and operation and maintenance capacity are strengthened. This approach mainly consists of the following.

- Improving planning, construction, and management methods of water supply facilities in rural areas
- Delivering a strategic action plan for drinking water supply in line with the sector risk development plan
- Demonstration of selection of water sources and improvement of construction skills
- Improving skills and organization structures in monitoring and surveillance

Keyword:

Rural village, rural city, Pourashava, water supply, DPHE, medium-term plan, long-term plan, water resource potential map (surface water, groundwater, rainwater, Division, Upazila), pipe water supply facilities, planning, organizational structure, financial planning, monitoring, training

(b) Lessons learned from the past projects

- Regular data acquisition in DPHE and from related organizations, e.g., meteorological data, socio-economic data, and data from monitoring and surveillance is the basis of planning, designing, construction, and management.

(c) Ensuring sustainability

- Continuous use of information management system and clarification of management responsibilities
- Organizational reorganization from the Groundwater Circle to the Water Resources Circle, about the shift from the use of groundwater to surface water.

Source: Earth Science System Co., Ltd.

Photo 3.4.7 Water Pollution Risk Surveillance

Source: Earth Science System Co., Ltd.

Photo 3.4.8 Monitoring of Water Qualities

(3) Stakeholder Analysis in the Water Sector

1) Methodology of Stakeholder Analysis on This Survey

Stakeholder analysis is conducted to identify key stakeholders of a project and assess their interests and influence. This method is generally taken to clarify the beneficiaries, interests, and conflicts between stakeholders, influential bodies, and risks of the project implementation so that the project planning and implementation will be smoother.

In general, the stakeholder analysis is conducted with the following steps.

i. draw up a "stakeholder table";
ii. assess each stakeholder's importance to project success and their relative power/influence;
iii. identify risks and assumptions that will affect project design and success.

To produce the stakeholder table, the following steps can be taken;

i. identify and list all potential stakeholders.
ii. identify their interests (overt and hidden) in relation to the problems being addressed by a project and its objectives.
iii. briefly assess the likely impact of the project on each of these interests (positive, negative, or unknown), and
iv. indicate the relative priority that the project should give to each stakeholder in meeting their interests.

However, since the purpose of the survey is to review existing and ongoing studies/projects, extract effective approaches, and compile several concept ideas for future projects, only the key stakeholders in each approach are focused. Further analysis should be conducted as the project design develops, interests change, and more information becomes available.

2) Key Stakeholders in the Water Sector

Agencies which may utilize the above-mentioned approaches in the water sector are considered key stakeholders and listed in Table 3.4.7.

Table 3.4.7 Key Stakeholders in the Water Sector

No.	Name of approach	Key stakeholders
1	Large scale-concrete hollow block tanks for public water supply in local communities	Teknaf Upaila Perishad, DSHE, DPE, DPHE, Skywater Bangladesh Ltd.
2	Rainwater harvesting in coastal areas through the collaboration between social businesses and communities	DPHE, Skywater Bangladesh Ltd., Skywater Harvesting Ltd., PR Bangladesh (NGO)
3	Reducing health damage caused by arsenic-contaminated drinking water with residents and hospitals	LGD, DPHE, UHC, Asia Arsenic Network (NGO)
4	Securing safe water resources in rural areas based on water potential	DPHE

Source: JST

(4) Concept Idea

Referring to the approaches described in the previous Clause, the concept ideas of interventions for the practical applications are proposed in this Clause. In the water sector, 2 concept ideas are compiled in the manner shown in Figure 3.4.1. As shown in the figure, the features from two approaches are combined to create each concept idea.

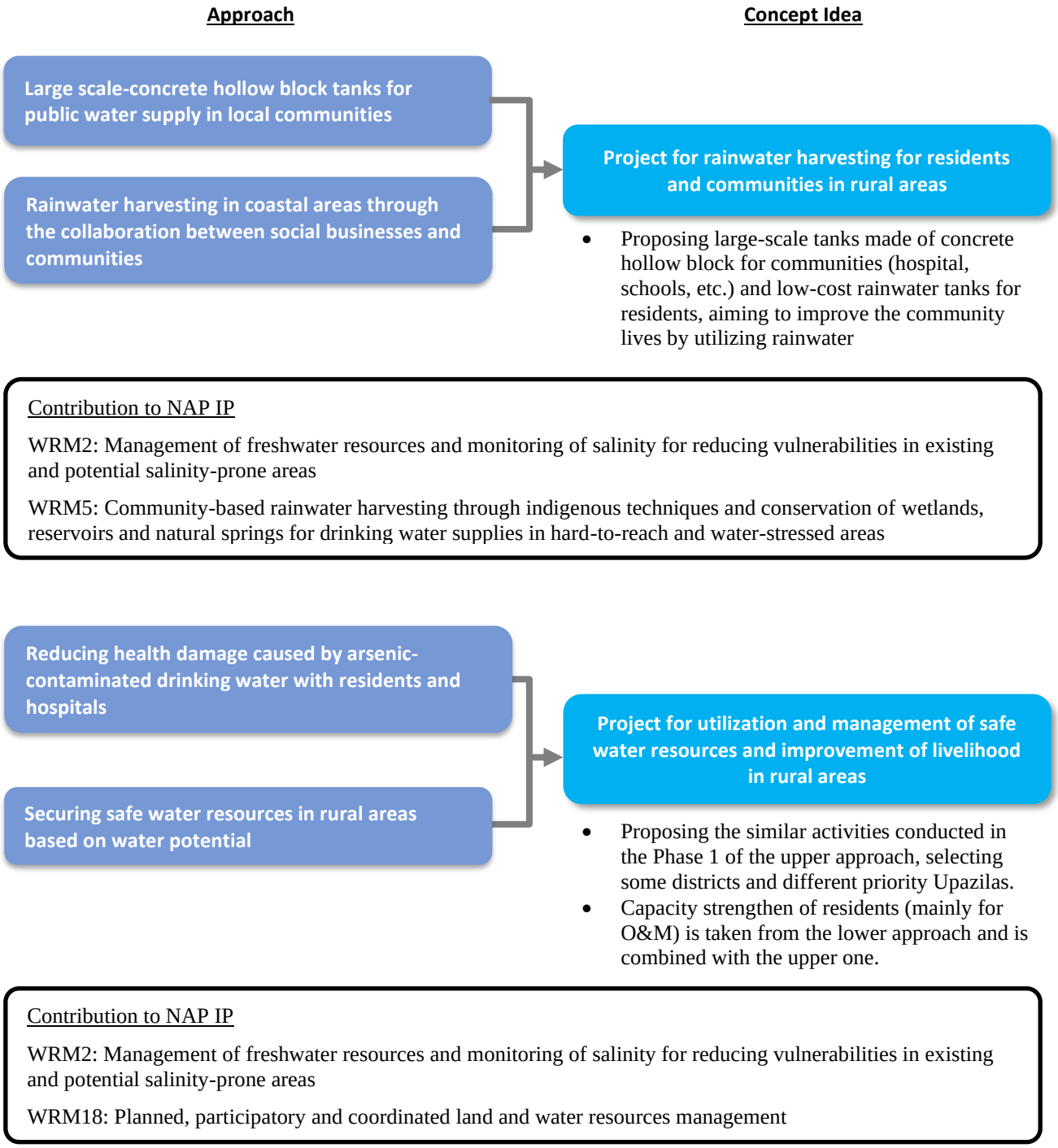


Figure 3.4.1 Relation between the Approaches and the Concept Ideas in the Water Sector

3.4.2 Disaster Risk Reduction Sector

(1) Issues and Status of Countermeasures

1) Understanding of Hazard and Risk

When planning disaster risk reduction interventions, it is common to use hazard maps to identify the disaster characteristics of the target area and to consider necessary structural and non-structural measures. In Bangladesh, however, although hazard maps covering the entire country or a part of the country have been developed, detailed hazard maps that can identify the characteristics of disaster-prone areas at a local level have not been sufficiently developed. In developing disaster risk reduction interventions at the local level, it is important to understand disaster risks based on the natural and social characteristics of the respective areas and to develop project implementation plans based on this understanding.

2) Large-scale and Widespread Needs for DRR Infrastructure Development

The development of water-related infrastructures such as embankments and polders has not yet been sufficient in Bangladesh. One of the reasons for insufficient development is that there are many vulnerable points/sections of facilities, and they are scattered over a wide area, resulting in patchwork repairment for each facility. Even if the weakest sections of each facility are improved, damage occurs from other vulnerable sections, and consequently, the overall strength of the facility cannot be ensured. The lack of overall strength of the facility creates a vicious cycle of damage after a disaster, followed by large-budgeted repairs, and inadequate reinforcement leads to further repeated damage.

3) Inter-agency Coordination for Disaster Risk Reduction Interventions

There is insufficient information sharing and coordination on planning and implementation status by various government agencies. In order to improve the effectiveness and efficiency of disaster risk reduction activities, there is a need to strengthen coordination and establish a cooperative system among the implementing agencies. Even in the implementation of disaster risk reduction interventions in local areas, the involvement of central-level agencies is important in coordinating the collaboration among projects at the District and Upazila levels.

4) Maintenance and Renewal of Facilities and Equipment

There is a lack of proper maintenance of constructed facilities including cyclone shelters. It is reported that the reasons for insufficient maintenance are that skills related to maintenance and management are not fully shared among the relevant stakeholders and that sufficient funds are not provided for this purpose. In the case of cyclone shelters, cyclones do not occur regularly, and the importance of maintenance and management tends to be a low priority in responsible public or related organizations.

5) Disaster Risk Reduction at the Community Level

While various efforts are being made at community levels to adapt to climate change impacts,

addressing climate change will require further behavioral change among local communities. In the community, it is necessary to strengthen its capacity and sustainably maintain its functions by cultivating people who will be responsible for the development of the community in the long term and by preparing each resident for disaster risk reduction on their initiative.

The knowledge and capacity of residents to evacuate have been steadily improved. However, there are challenges in providing residents with easy-to-understand information in light of the changes in meteorological and hydrological phenomena expected in the future due to the effects of climate change. In addition to providing information on expected natural phenomena, it is also necessary to provide convincing information on the potential damage caused by such natural phenomena so that residents are encouraged to prepare for disasters and take evacuation actions.

(2) Effective Approach

In the disaster risk reduction sector, from the reviewed past 13 JICA-funded studies and projects, the following 9 approaches are extracted.

1) Flash flood measures and livelihood improvement in Haor areas
2) Sustainable flood mitigation infrastructure development
3) Flood mitigation method and planning suitable for various/diverse-scale rivers
4) Upazila-level disaster risk reduction planning and implementation
5) Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help
6) Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment
7) Development and maintenance of meteorological radar systems
8) Improved and accurate weather observation and forecasting
9) Risk assessment, forecasting, and countermeasures for flood and storm surge damage reduction

The overview of the approaches for application to future interventions is provided here and details of the approach are provided in Attachment 6.

1) Flash flood measures and livelihood improvement in Haor areas

(a) Summary

This approach develops submersible embankments and roads and provides agriculture and fishery support to protect Boro rice cultivation from flash flood damage and improve the quality of life and livelihood of local communities in the Haor area. This approach involves communities from the planning stage to the O&M stage and also motivates them by providing livelihood support so that the ownership of the communities is strengthened for better stricture maintenance and sustainability. This approach mainly consists of the following.

- Developing and periodical updating a river management plan for the entire Haor area (scientific and fair investment for mitigation and ensuring effectiveness)
- Design and construction of strong and economical flood mitigation structures
- Strengthening agricultural and fishery promotion activities for sustainable infrastructure operation, poverty reduction, and climate resilience

Keyword:

Haor area, monsoon season, pre-monsoon season, river embankment, submersible embankment, river management plan, hazard assessment, risk assessment, qualities of design and construction, rural infrastructure, agriculture, and fishery prom

(b) Lessons learned from the past projects

- The period for land acquisition is unpredictable since it is conducted by a district authority, which is independent of the project implementing agencies.
- Close communication with residents is important not only for the maintenance activities of the structures but also for the design of the river structures such as the causeway.

(c) Ensuring sustainability

- Close communication with residents is important not only for the maintenance activities of the structures but also for the design of the river structures such as the causeway.

Source: JICA

Photo 3.4.9 Submergible Embankment Before the Improvement

Source: JICA

Photo 3.4.10 Submergible Embankment After the Improvement

2) Sustainable water-related infrastructure development

(a) Summary

This approach aims to ensure the flood control function, improve the efficiency of maintenance and management, and reduce life cycle costs. To support this, various manuals are prepared and a pilot project for embankment rehabilitation is conducted. With such implementation of the pilot project, a suitable design for sustainable water-related structures is verified. An action plan was also created to disseminate and efficiently use various manuals.

This approach mainly consists of the following:

- Preparation and dissemination of river embankment design manuals
- Preparation and dissemination of river embankment construction manuals
- Preparation and dissemination of river structure maintenance and management manuals

Keyword:

Embankment, riverbank erosion, flash flood, local scouring, piping, design manual, construction manual, maintenance manual, action plan, embankment rehabilitation, pilot project, GIS database

(b) Lessons learned from the past projects

- Traditional design methods in civil engineering are more practical than the ones with the latest numerical analyses.
- Accumulation of data on damaged structures by flood is essential to designing resilient river structures reflecting the features of the rivers.
- Most of the embankment damage was caused by the damage on the high riverbed in the rivers on a similar scale.

(c) Ensuring sustainability

- Securing maintenance costs and regular maintenance activities.

Source: JICA

Photo 3.4.11 Slope Protection Right After the Improvement

Source: JST

Photo 3.4.12 Slope Protection in Good Condition (Present)

3) Flood Mitigation Method and Planning Suitable for Large, Middle, and Small-Scale Rivers

(a) Summary

This approach establishes tools for systematic and diverse river control and planning for large-scale rivers and flood mitigation planning methods for middle and small-scale rivers. This approach mainly consists of the following.

- Selection of river channel control methods for large low-lying rivers (e.g., Jamuna River), development of river training tools for selection and maintenance of river structures
- River shape monitoring works for large low-lying rivers
- River flood mitigation planning for relatively small rivers (e.g., Karnafuri, Sang, and Matamufuri river scale)

Keyword:

Major rivers, small rivers, river management planning, master plan, river channel planning, structure design, maintenance management, knowledge tools, River Training Methodology (RTM), training

(b) Lessons learned from the past projects

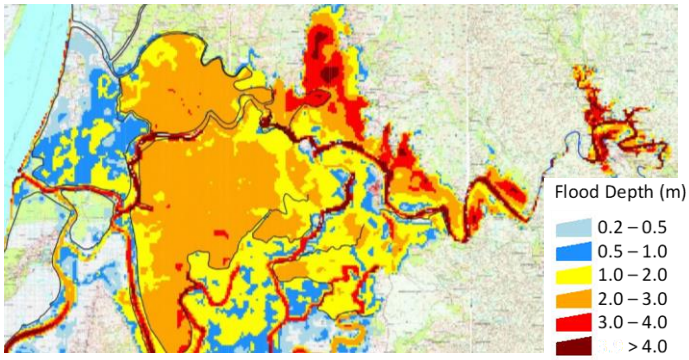
- The technical evaluation of the river channel management in a large-scale river requires a large amount of budget. Even in a pilot project, the size of the structure becomes fairly large, so as does the budget.
- The related organizations and stakeholders should communicate with each other to align their strategies and plans for the improvement and development of the target areas in a formal way, e.g., in a river management committee.

(c) Ensuring sustainability

- Approval of knowledge tools and RTM operations within Bangladesh Water Development Board (hereinafter referred to as "BWDB)
- Arrangement for data collection among relevant partners is continuously conducted.
- Handbooks, knowledge tools, etc. will be utilized for a succession of technology that is not affected by personnel transfers or low budget allocation.

Source: JICA

Photo 3.4.13 Embankment of Sangu River



Source: JICA

Figure 3.4.2 Inundation Analysis Result for Matamuhuri River

4) Upazila-level Disaster Risk Reduction Planning and Implementation

(a) Summary

The formulation of disaster risk reduction plans that reflect local disaster characteristics and their implementation based on smooth coordination among relevant agencies are useful in managing disaster risks effectively at the local level. In particular, it is important to understand local disaster risks properly by sharing knowledge among local-level stakeholders such as Upazilas and Unions, to plan pre/post-disaster activities based on the understanding, and to monitor their implementation. The approach primarily consists of the following.

- Upazila-level disaster hazard and risk assessment;
- Enhancement of Upazila-level project coordination system involving the Department of Disaster Management (hereinafter referred to as "DDM") and its local offices, District/Upazila Disaster Management Committees (hereinafter referred to as "DMCs"), and other relevant organizations;
- Formulation of practical Upazila-level disaster risk reduction plans in collaboration with relevant ministries, agencies, and local governments.

Keyword:
Local disaster risk reduction plan, hazard and risk assessment, disaster management committee, central and local cooperation, inter-agency collaboration

(b) Lessons learned from the past projects

- Continuous involvement of central government agencies from the early stage of activities to ensure smooth coordination between local disaster risk reduction plans and ongoing/future projects by central government agencies.
- Facilitation of Upazila-level project coordination meetings (UzSC) is also important for smooth consensus building with communities on the selection of priority projects based on an understanding of disaster risk.

(c) Ensuring sustainability

- The experience and knowledge in disaster risk assessment and planning should be accumulated in the Department of Disaster Management to strengthen the institutional capacity. That is vital for the nationwide roll-out and continuous updating of local disaster risk reduction plans.
- It is also important to involve local consultants and NGOs who know well about the local situation in the facilitation of local-level coordination meetings and promote their capacity enhancement for the further dissemination and elaboration of local disaster risk reduction planning.

5) Disaster Risk Reduction Based on Collaboration among Residents' Self-help, Community Mutual-help, and Public-help

(a) Summary

This approach is to promote disaster risk reduction based on the spirit of "self-help", "mutual-help", and "public-help", which intend to raise the awareness of residents through disaster-related education in schools, to enhance the capacity of DMCs established in local administrations, and to strengthen relationships among relevant stakeholders. The approach also provides opportunities to share disaster-related knowledge between residents and local government and to think about future disaster risk reduction to enhance the disaster preparedness of the community as a whole. The approach mainly consists of the following contents.

- School-based disaster education and awareness-raising
- Strengthening the functions of Union-level disaster risk reduction
- Strengthening the functions of Upazila-level disaster risk reduction
- Strengthening the cooperation between the District-, Upazila-, and Union-level DMCs

Keyword:

Disaster management committee, disaster education, cooperation between residents and government, DRR Olympic

(b) Lessons learned from the past projects

- Disaster education for students is significantly important. As they acquire knowledge about disaster preparedness, this knowledge can be transferred to their families and communities. In addition, holding events that motivate stakeholders, such as the local DRR Olympics (performance events by students on the theme of DRR), is also effective in strengthening stakeholder involvement.

(c) Ensuring sustainability

- By involving young generations in the activities, the community's disaster risk reduction capacity can be enhanced in a sustainable way as they will take initiatives in disaster risk reduction in the future when they grow up.

Source: Jagrata Juba Sangha

Photo 3.4.14 Disaster Awareness Activities for Local Residents

Source: Shapla Neer

Photo 3.4.15 Students Performing a Play on the Theme of Disaster Risk Reduction at the DRR Olympic

6) Construction and Maintenance of Multi-purpose Shelters with Considerations for Gender and Educational Environment

(a) Summary

This approach aims to increase the number of people who can be evacuated during a cyclone by installing evacuation shelters in areas at high risk of cyclone damage. On the other hand, the shelters will be used as elementary schools during normal times, thereby contributing to improving the learning environment for primary education. The shelters need to be designed in a gender-sensitive and evacuation-friendly manner. In addition, the shelters should be equipped with stable electricity and water supply.

- Development of gender-sensitive multi-purpose cyclone shelters
- Development of educational facilities that can function as schools by neighboring children in normal times
- Installation of solar panels and water utilization equipment to improve living conditions in shelters
- Appropriate maintenance of multi-purpose cyclone shelters with close collaboration and clear demarcation among public and community organizations

Keyword:

Cyclone shelter, multi-purpose, O&M, school education, gender-responsive

(b) Lessons Learned from the past projects

- The installation of solar panels and rainwater harvesting will make shelter life more comfortable and motivate residents to evacuate. Additionally, for rapid and safe evacuation, site selection for shelters should be evaluated based on road network conditions. If necessary, pavement conditions leading to shelters should be improved.

(c) Ensuring Sustainability

- In addition to major repair works by government agencies, daily maintenance by the School Management Committee (hereinafter referred to as “SMC”) is also important to ensure its functionality during emergencies.

Source: JICA

Photo 3.4.16 Cyclone Shelter at Debpur, Kalapara Upazila, Patuakhali (2008)

Source: JST

Photo 3.4.17 School-cum Cyclone at Debpur, Kalapara Upazila, Patuakhali (2024)

7) Development and Maintenance of Meteorological Radar Systems

(a) Summary

An extensive and detailed understanding of weather information in and around Bangladesh is critical for the prevention and mitigation of weather-related disasters. The approach is to develop, update, and maintain multiple meteorological doppler radar systems that cover the entire country of Bangladesh, which aim to contribute to the mitigation of damage caused by weather disasters such as floods and tropical cyclones through the enhancement of the meteorological observation network.

- Development and renewal of meteorological doppler radar systems
- Maintenance and management of meteorological doppler radar systems

Keyword:
Meteorological radar, weather forecasting, equipment upgrades, maintenance

(b) Lessons learned from the past projects

- Since past equipment failures have been caused by the unstable power supply, the radar systems need to be designed to be able to be operated by in-house power generation instead of private power generation as a measure to prevent similar problems.

(c) Ensuring sustainability

- The equipment and facilities were designed to minimize replacement parts and consumables to reduce operation and maintenance costs. However, during long-term operation, there are cases where spare parts have already stopped being manufactured and need to be replaced. Aging facilities are inevitable, thus spare parts must be available for procurement and replacement at the appropriate time.
- The Bangladesh Meteorological Department (hereinafter referred to as "BMD") has been facing a shortage of young technical engineers, while senior technicians are retiring. To establish a reliable maintenance system, it is very important to maintain proper staff and technician allocation by acquiring and training new technicians.

Source: JICA

Photo 3.4.18 Radar Towers in Cox's Bazar (Left) and Khepupara (Right)

8) Improved and Accurate Weather Observation and Forecasting

(a) Summary

In order to mitigate weather-related disasters, it is important to provide accurate weather forecast information and communicate it to relevant organizations and residents in a reliable and easy-to-understand manner. This approach aims to improve systems and mechanisms for weather information collection, analysis, forecasting, and dissemination. This will be achieved through the following components:

- Improvement of weather observation system, which is the basis for weather analysis and forecasting operations.
- Establishment of medium- to long-term forecasts through the introduction of numerical forecasting technology.
- Analysis of climate change trends by utilizing accumulated data.
- Enhancement of the function to disseminate accurate information.

Keyword:

Weather observations, calibration, data archive, numerical forecasting, climate change trends

(b) Lessons learned from the past projects

- It is important to increase the operating hours of meteorological radars in order to obtain sufficient data for the analysis of the correlation between ground observations and weather radar data.

(c) Ensuring sustainability

- The BMD has been facing a shortage of young technical engineers, while senior technicians are retiring. It is extremely important to acquire and train new technicians based on human resource development plans in order to establish a reliable weather data management and forecasting system. The technical personnel should be trained through continued pilot numerical forecasting and hands-on training in data management.

Source: JICA

Photo 3.4.19 Operation and Maintenance Training at Khepupara Weather Radar Station

Source: JICA

Photo 3.4.20 Rain Gauge Repair and Operation Check

9) Risk Assessment, Forecasting, and Countermeasures for Flood and Storm Surge Risk Reduction

(a) Summary

This approach involves research aimed at establishing analysis and forecasting methods for flood and storm surge damage, and riverbank erosion prevention measures. By proposing and testing measures to prevent and mitigate water-related disasters, this approach will contribute to building a society with disaster resilience. This effort will be accomplished through the realization of the following components:

- Research and development of risk assessment methodology for riverine flood
- Development of improved storm surge forecasting and warning systems for coastal areas
- Mechanistic analysis of riverbank erosion and levee failure, and study of mitigation measures

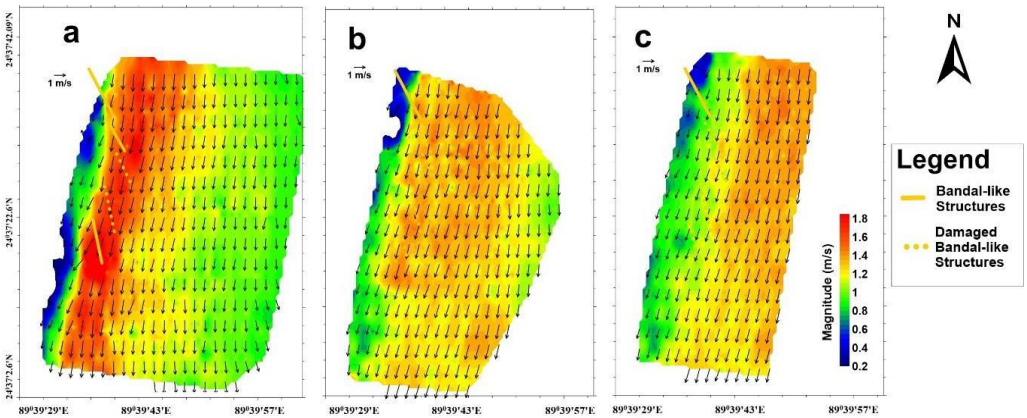
Keyword:
Hydraulic simulation, risk assessment, hydraulic experiment, comparative verification

(b) Lessons learned from the past projects

- In flood and storm surge damage forecasting, it is important to continuously collect information from the community, since incorporating social attributes such as age composition, gender composition, and proportion of vulnerable groups in each Upazila into risk assessment will lead to more practical risk assessment.

(c) Ensuring sustainability

- To promote the practical application of research achievements by relevant stakeholders, it is necessary to convince government organizations and communities by visualizing the outputs obtained from the tools in an easy-to-understand way and showing that they reflect actual situations. In addition, it is important to deepen public-academic collaboration through further involvement of government agencies in research activities. It is also important to continuously validate the system against actual phenomena and share the results.



Source: BUET

Figure 3.4.3 Analysis of Flow Velocity around the Experimental Reach and Bandal-like Structure during Wet Monsoon

In addition to the above-mentioned 9 approaches in the disaster risk reduction sector, the following knowledge was extracted from the existing project. Although the methodology was not well composed enough to be a single approach, the knowledge is still useful for future interventions.

10) Enhancement of Infrastructure Rehabilitation and Reconstruction Systems

(a) Summary

The approach will strengthen comprehensive disaster risk reduction capacity by establishing and implementing mechanisms for the rehabilitation and reconstruction of vulnerable infrastructure damaged by natural disasters. This effort will be accomplished through the realization of the following components:

- Rehabilitation and reconstruction of levees, bridges, roads, and other critical infrastructure
- Strengthening the system for rapid and effective post-disaster recovery and reconstruction

Keyword:
Infrastructure rehabilitation and reconstruction, Inter-agency collaboration

(b) Lessons learned from the past projects

- In some cases, investment should be focused on each polder in a more comprehensive manner rather than spreading the investment across multiple polders. In the selection of a focused investment polder, priorities should be strategically considered in accordance with scientific knowledge-based hazard and risk analysis.

(c) Ensuring sustainability

- In the ongoing disaster rehabilitation project named “Disaster Risk Management Enhancement Project (DRMEP), a fund management and project approval/implementation process that supports rapid implementation of rehabilitation projects has been introduced and applied. It is recommended that the operational process be tested in future projects and updated as necessary.

(3) Stakeholder Analysis in the Disaster Risk Reduction Sector

Agencies which may utilize the above-mentioned approaches in the disaster risk reduction sector are considered key stakeholders and listed in Table 3.4.8.

Table 3.4.8 Key Stakeholders in the Disaster Risk Reduction Sector

No.	Name of approach	Key stakeholders
1	Flash flood measures and livelihood improvement in Haor areas	BWDB, LGED
2	Sustainable flood mitigation infrastructure development	BWDB
3	Flood mitigation method and planning suitable for various/diverse-scale rivers	BWDB
4	Upazila-level disaster risk reduction planning and implementation	DDM, DRRO, PIO, Upazila DMC, District DMC
5	Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help	Union DMC, Upazila DMC, District DMC, Shapla Neer Bangladesh, Jagrata Juba Shangh
6	Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment	LGED, DDM, DPE, SMC
7	Development and maintenance of meteorological radar systems	BMD
8	Improved and accurate weather observation and forecasting	BMD
9	Risk assessment, forecasting, and countermeasures for flood and storm surge risk reduction	BUET, Kyoto University

Source: JST

(4) Concept Idea

Referring to the approaches described in the previous Clause, the concept ideas of interventions for the practical applications are proposed in this Clause. In the disaster risk reduction sector, 6 concept ideas are compiled in the manner shown in Figure 3.4.4 to Figure 3.4.6. As shown in the figures, the features from a single approach or multiple approaches created each concept idea.

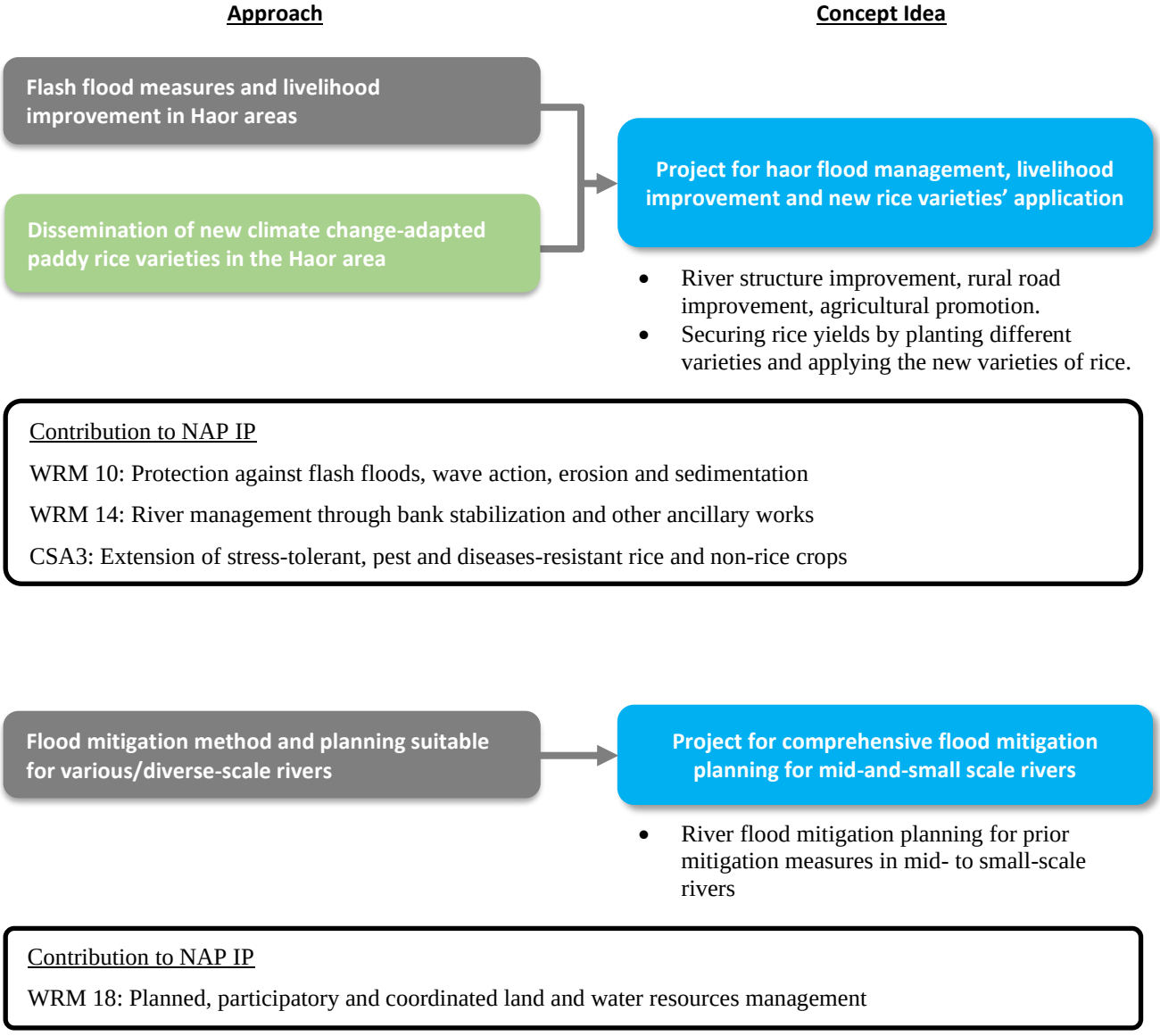


Figure 3.4.4 Relation between the Approaches and the Concept Ideas in the Disaster Risk Reduction Sector (1/3)

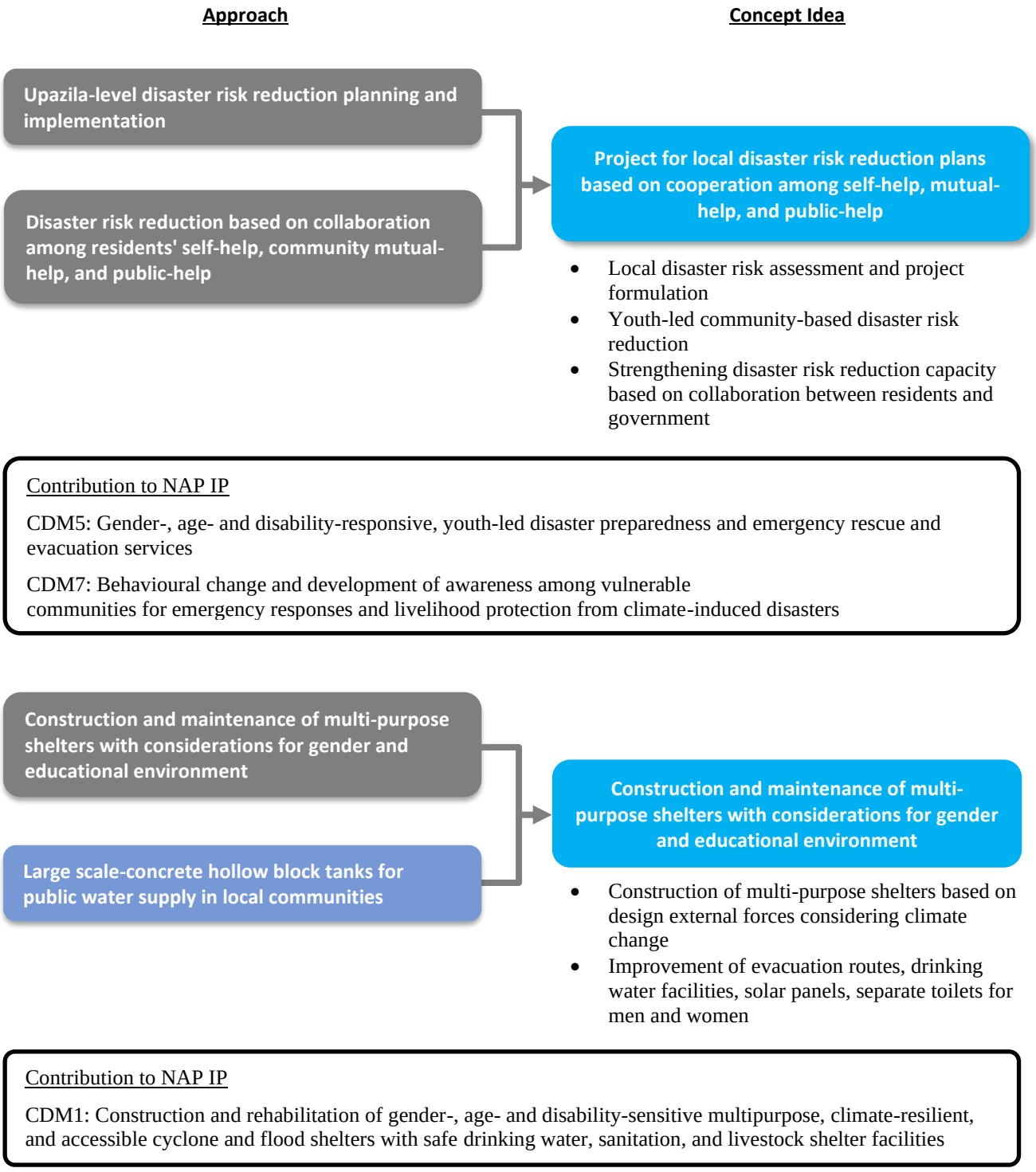


Figure 3.4.5 Relation between the Approaches and the Concept Ideas in the Disaster Risk Reduction Sector (2/3)

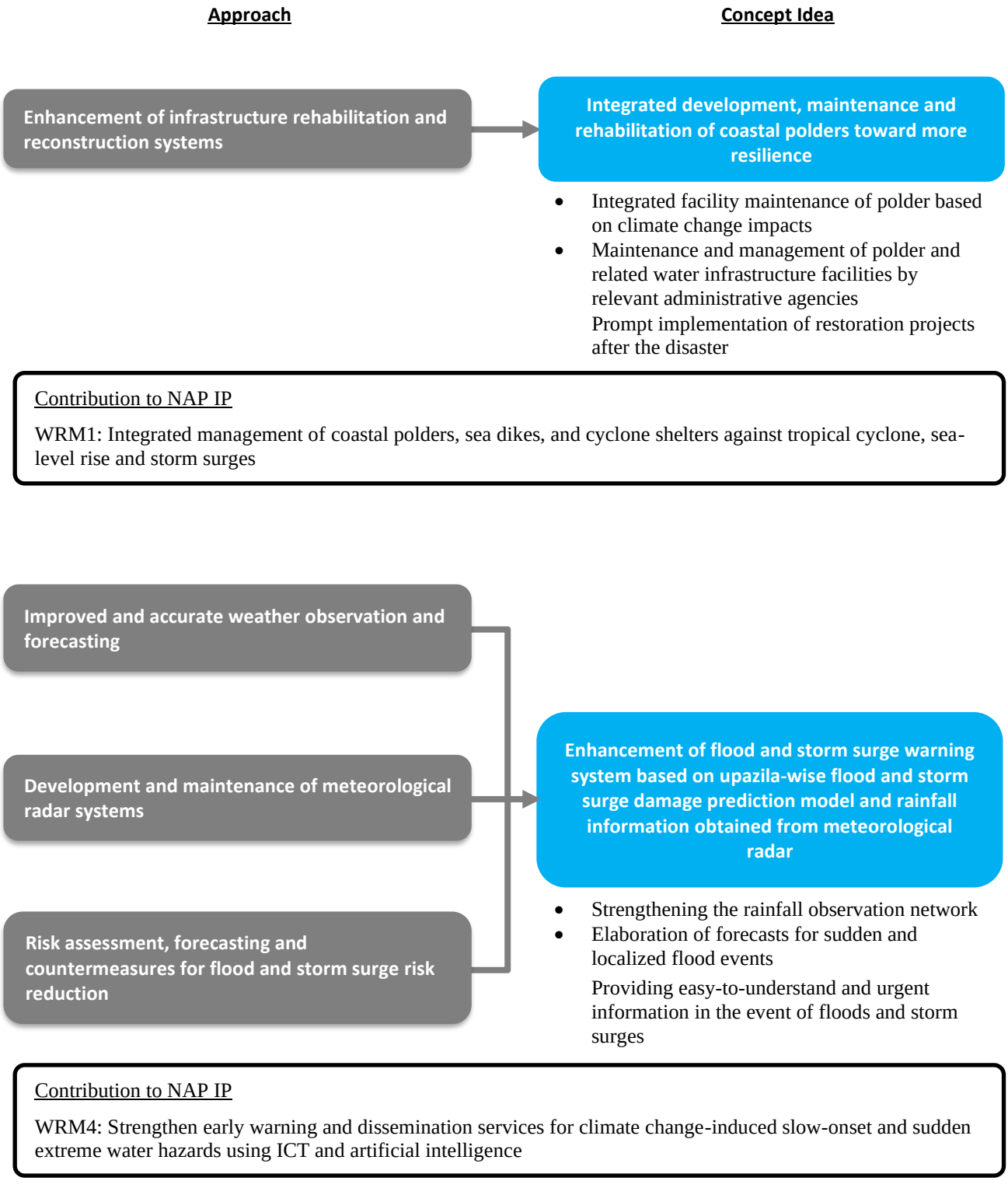


Figure 3.4.6 Relation between the Approaches and the Concept Ideas in the Disaster Risk Reduction Sector (3/3)

3.4.3 Agriculture Sector

(1) Issues and status of countermeasures

1) Flash floods in the Haor area

Flash floods often occur in the pre-monsoon season in the Haor area, but they can occur earlier or later depending on the year. If a flash flood occurs early, it will coincide with the harvest season of Boro rice in the Haor area, which will significantly reduce the yield. As a result, the livelihoods of farmers in the Haor area may deteriorate and the rice self-sufficiency rate in Bangladesh may decrease. In addition to the flash flood threat, the region may also be affected by cold snaps, blast sickness, etc.

2) Lack of Agricultural Water Management Facilities

Many farmers do not have irrigation and drainage facilities. Hence, their yields are easily affected by the weather, and their livelihoods are not stable. In areas where drainage and irrigation canals are underdeveloped or deteriorate over time, agricultural productivity is low because irrigation and drainage cannot be practiced in a planned manner.

3) Loss of income opportunities for small-scale horticultural farmers due to lack of market information

Small-scale horticultural farmers can only ship small quantities of their crops in a short time, so the unit price is dominated by middlemen. In addition, if the same crop that the farmer shipped is oversupplied to the market by other farmers, the price will collapse. The inability to sell at a reasonable unit price and planting without considering marketability are the causes of poor management of small-scale horticultural farmers. The production of high-value-added crops requires high-quality seeds, fertilizers, and pesticides. However, it is more expensive because the purchase volume is small. In addition, small-scale horticultural farmers do not have enough money to purchase and do not know how to grow it properly.

4) Insufficient capacity of food storage warehouses

Since rice production is increasing, it is also necessary to improve the storage capacity of rice. In addition, since the yield of rice fluctuates depending on the weather, it is necessary to store rice in good harvest years in case of a bad harvest year. Currently, about 600 warehouses have been constructed, many of which are manually operated. Therefore, if the workforce cannot be secured in the event of a disaster, it will be difficult to ship quickly to the places where it is needed. In addition, most of the warehouses do not have air conditioning, so long-term storage is not appropriate from the viewpoint of maintaining quality.

(2) Effective Approach

In the agriculture sector, from the reviewed past 5 JICA-funded projects and studies, the following 4 approaches are extracted.

1) Dissemination of new climate change-adapted paddy rice varieties in the Haor area

2) Stepwise development of small-scale irrigation and drainage system with initiative of communities (WMCAs)
3) Smallholder horticultural farmers empowerment & promotion (Bangla-SHEP)
4) Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity

The overview of the approaches for application to future interventions is provided here and details of the approach are provided in Attachment 6.

1) Dissemination of new Climate Change-Adapted paddy rice varieties in the Haor area

(a) Summary

In the Haor area, the production of Boro rice and inland fisheries are the major sources of income. However, flash floods that come from the neighboring India, and threatened Boro rice almost every year. By introducing a new variety of Boro rice that can be harvested earlier than flash floods occur, farmers can reduce the impact of flash floods on their rice yields. In addition, new varieties that are resistant to cold damage, that are resistant to blast disease, bring high yields or are of good taste, have already been developed. By planting a mix of new varieties with different strengths, farmers can reduce the risk of reduced rice yields due to the weather.

Keyword

Climate change-adaptive agriculture, new varieties of paddy rice, cropping pattern, flash floods, Haor area

(b) Lessons learned from the past projects

- In 2017, a flash flood hit earlier than usual, and the amount of Boro rice in Habiganj district dropped sharply. As long as the memory of flash flood damage is vivid, it is relatively easy to promote the spread of new varieties. When disseminating new varieties to areas that have not been affected in recent years, it is useful to have people who have experienced disasters explain the damage so that they can imagine the effects of the new varieties.

(c) Ensuring sustainability

- It is important that climate change-adaptive rice varieties are readily available. Seed farmers need to improve the storage facilities for seeds and learn how to store them.
- It is important to engage technical extension officers who can advise the farmers on cultivation methods and planting timings for new varieties.

Source: share the planet

Photo 3.4.21 Preparatory Work for Paddy Fields

2) Stepwise Development of Small-scale Irrigation and Drainage Systems with Initiative of Communities (WMCAs)

(a) Summary

Facilities for small-scale irrigation and drainage are effective in stabilizing the profits of beneficiary farmers. This approach builds facilities for small-scale irrigation and drainage. In addition, it fosters the Water Management Co-operative Associations (hereinafter referred to as WMCAs) to manage the facilities. In this approach, sub-projects are implemented in the target area. The sub-projects consist of four components 1) Flood Management, 2) Drainage Improvement, 3) Water Conservation, and 4) Command Area Development.

Keyword

Small-scale water resource development, WMCA, improving water facilities, agribusiness, farming equipment and facility

(b) Lessons learned from the past projects

- The WMCA can identify the knowledge and facilities that are lacking from the actual operational results. Good interpersonal relationships within the sub-project area are often a prerequisite for sound project management.
- Setting easy-to-understand indicators (e.g., irrigated areas or flood areas) and knowing the impact of other districts can help WMCA determine whether facilities are needed for additional development.

(c) Ensuring sustainability

- The WMCA Independence and Continuity Plan must be feasible and specific as it will be the WMCA's action plan after the project is completed. It is important to clearly state the responsible person, the implementer, the work period, the necessary materials and equipment, and the person in charge of the progress monitoring for each task in the document.

Source: JST

Photo 3.4.22 Irrigation Area (Dry Season)

Source: JST

Photo 3.4.23 WMCA Village Meeting

3) Smallholder Horticultural Farmers Empowerment & Promotion (Bangla-SHEP)

(a) Summary

Price crashes due to crop oversupply and middlemen setting low prices worsen the livelihoods of smallholder horticultural farmers. This approach, called “Bangla-SHEP” in this survey, is an innovative agricultural extension method that changes the mindset of farmers from "selling what farmers grow" to "growing what the market needs". Bangla-SHEP is based on stakeholder collaboration. In other words, smallholder horticultural farmers decide which crops to grow through their own market research, DAE provides guidance on the cultivation techniques of the crops of their choice, private companies sell the necessary agricultural inputs at fair prices, and microfinance loans if the farmer's budget is insufficient. By introducing Bangla-SHEP, farmers will be able to produce crops that meet market needs and stabilize their gross income.

Keyword

Bangla-SHEP, market-oriented agricultural expansion, smallholder horticultural farmer, microfinance

(b) Lessons learned from the past projects

- This approach achieves the goal of market-oriented agriculture through the collaborative work of multiple organizations (e.g., farmer groups, DAEs, agricultural material companies, microfinance, etc.) During the work, officers in each organization responsible for this approach will have a good understanding of each other's organizational responsibilities. This collaboration is expected to make it easier to carry out joint work in an emergency.

(c) Ensuring sustainability

- It is desirable to continue to provide guidance on cultivation techniques for new products that adapt to changing consumer needs.
- Farmers' meetings are attended by men and women in the household together so that the discussion is not biased towards one gender's opinion.

Source: JICA

Photo 3.4.24 Farmers’ Association Survey

4) Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity

(a) Summary

This approach involves building food storage facilities equipped with air conditioning that can maintain the quality of stockpiled food and machines that can load pallets full of rice bags into or out of a warehouse quickly. This is important in terms of national food security and food distribution to the poor. Although self-sufficiency is increasing year by year, there are still significant challenges in terms of food security due to the sensitivity of rice yields to climatic conditions. Strengthening the capacity of rice stockpiles will mitigate fluctuations in supply to the market due to good or bad harvests caused by weather conditions.

Keyword

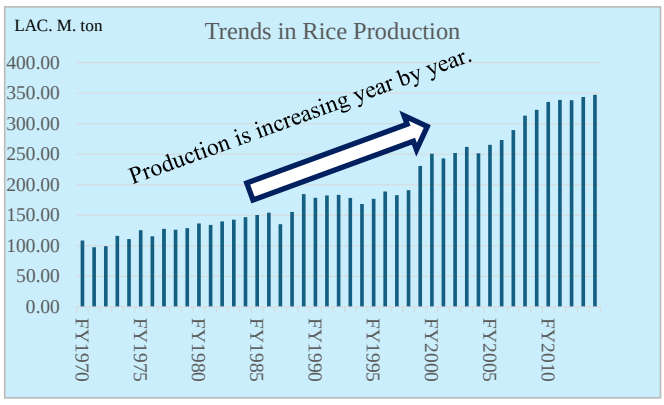
Food security, rice self-sufficiency, food stockpiling facilities, public food rationing, access to food, stockpiling methods, transportation methods, parboiling

(b) Lessons learned from the past projects

- Currently, 85 kg or 50 kg of jute bags are used. Jute bags full of rice will have a cylindrical shape, so they will become unstable when stacked on pallets. If the rice bag is a 30 kg paper bag, like a cement bag, it can be stacked stably, so that more than 1 ton of rice bags can be stacked on one pallet.
- In order to train instructors rather than operators, the training period for inventory management using machines should have been longer.

(c) Ensuring sustainability

- As the number of mechanical warehouses increases, there will be a need for instructors in mechanical inventory management.
- It is necessary to look for ways to reduce management costs. For example, the rooftop of the facility is unused, so solar panels can be installed. This will reduce the electricity costs required by the facility.



Source: JICA

Source: JICA

Figure 3.4.7 Increasing Annual Rice Production and Rice Storage Facility

(3) Stakeholder Analysis in the Agriculture Sector

Agencies which may utilize the above-mentioned approaches in the agriculture sector are considered key stakeholders and listed in Table 3.4.9.

Table 3.4.9 Key Stakeholders in the Agriculture Sector

No.	Name of approach	Key stakeholders
1	Dissemination of new Climate Change-Adapted paddy rice varieties in the Haor area	BRRI, DAE, NGO (Share the Planet, ASED HABIGANJ)
2	Stepwise development of small-scale irrigation and drainage systems with initiative of communities (WMCAs)	LGED, DAE
3	Smallholder Horticultural Farmers Empowerment & Promotion (Bangla-SHEP)	MoA, DAE, Bangladesh Bank, microfinance institutions, agricultural equipment companies
4	Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity	MoDMR, MoFDM, DGF, DCF, RCF

Where, MoA: Ministry of Agriculture, MoFDM: Ministry of Food and Disaster Management, DAE: Department of Agricultural Extension, DGF: Directorate General of Food, BRRI: Bangladesh Rice Research Institute, BARI: DCF: District Controllers of Food, RCF: Regional Controllers of Food
Source: JST

(4) Concept Idea

Referring to the approaches described in the previous Clause, the concept ideas of interventions for the practical applications are proposed in this Clause. In the agriculture sector, 4 concept ideas are compiled in the manner shown in Figure 3.4.8 to Figure 3.4.9. As shown in the figures, the features from a single approach created a single concept idea.

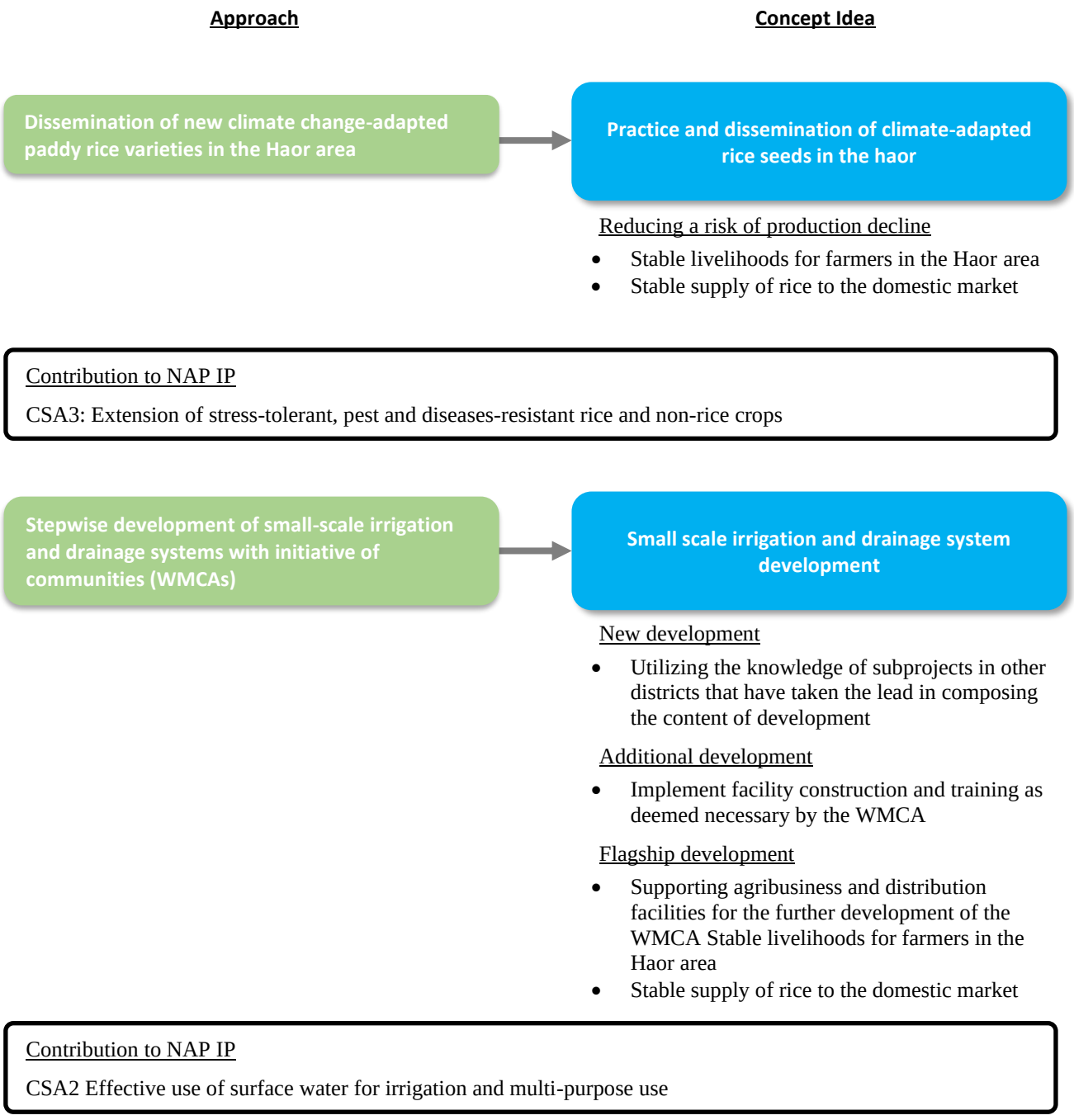


Figure 3.4.8 Relation between the Approaches and the Concept Ideas in the Agriculture Sector (1/2)

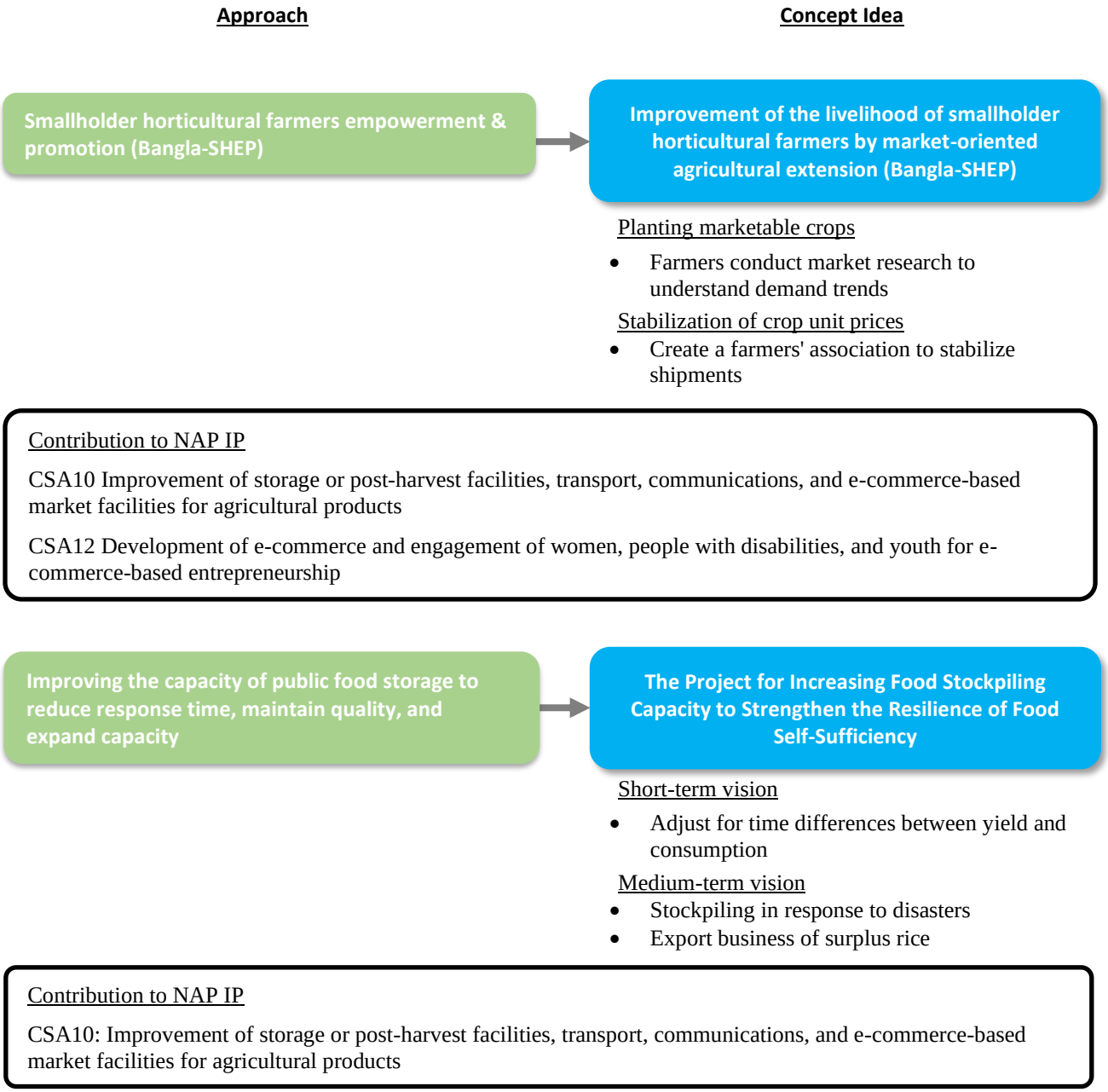


Figure 3.4.9 Relation between the Approaches and the Concept Ideas in the Agriculture Sector (2/2)

CHAPTER 4 RECOMMENDATION

This chapter presents policy recommendations for the Government of Bangladesh to implement the approaches and concept ideas identified in this survey.

4.1 Recommendations for the Application of Approaches and Concept Ideas in the Water Sector

(1) Capacity Enhancement of Key Implementation Agencies

For securing safe water, JICA has cooperated with DPHE since the 1980s and DPHE is expected to lead the development continuously and guide City Cooperations and rural local governments. DPHE has developed mid and long-term water development plans at the upazila level with their water potential maps and technical guidelines. This information should be institutionalized and applied for technical support by DPHE for those related agencies. In addition, to update river-related and meteorological information, cooperation with line government organizations such as BWDB and BMD is required.

(2) Regular Maintenance Activities by the Maintenance Committee

For sustainable utilization of the water source facilities, daily or regular maintenance is effective and necessary. To conduct such maintenance, the establishment and involvement of users' maintenance committees are essential at the beginning stage of the project implementation. Such involvement and livelihood improvement activities for the communities from the planning stage bring their ownership to the facilities, promote their understanding of saving money for maintenance by themselves, and result in the sustainability of the utilization of the facilities.

(3) Consideration for Gender and Vulnerable People

In the water sector, the roles that women and children play are significant. This is because they tend to be in charge of housework at home and fetching water from water sources and it affects their life and education significantly. Therefore when water management interventions are planned, their social conditions should be carefully studied and reflected in designs. In addition, capacity building and raising awareness of them should be considered.

(4) Raising Awareness of Safe Water Use

According to the residents and local NGOs that were interviewed in the study, it was found that most of the residents knew the risks of arsenic poisoning. However, most of them do not know the actual water quality of the water they usually use. In addition, even though they know that the quality of their water is not suitable for drinking, they drink it no matter what the water quality is because there is no other means to access the drinking water. The safe water acquisition seems to be hindered by undeveloped safe surface water and/or insufficient understanding of the water quality. Hence, along with the government-led activities, local awareness-raising activities are still required. In order to raise awareness, education for children works effectively and brochures as educational material on safe water should be shared at schools and home.

4.2 Recommendations for the Application of Approaches and Concept Ideas in the Disaster Risk Reduction Sector

(1) Capacity Enhancement of Key Implementation Agencies in Local Disaster Risk Reduction

In local disaster risk reduction, the DDM is required to continuously lead the development and update of local disaster risk reduction plans at the upazila level. To this end, it is important to further strengthen the coordination and management capacity of DDM toward project identification and formulation in coordination with relevant organizations at central and local levels. In addition, the accumulation of knowledge on hazard and disaster risk assessment should be promoted. It is also important to promote the human resource development of local consultants and NGO personnel, as well as local DDM offices, local governments, and local communities, through the accumulation of practical experiences in hazard and risk analysis and the operation of local-level committees. Through the accumulation of these experiences, they will acquire the knowledge necessary to facilitate consensus-building among stakeholders.

(2) Scientific-Based Risk Analysis and Its Continuous Improvement

It is important to understand the complexity of the climate change phenomenon from a scientific perspective and to advance policies and projects based on this understanding. On the other hand, it is difficult to completely simulate and explain actual complex phenomena by scientific models. In order to improve the validity and reliability of damage prediction models based on scientific knowledge, it is important to continuously update the models through comparative verification between actual phenomena and prediction results. Additionally, to ensure the accuracy of impact-based disaster prediction, it is also important to continuously collect local-level socio-demographic information and reflect it in the risk assessment system.

(3) Consideration for Gender and Vulnerable People

In order to ensure the smooth evacuation of people to cyclone and flood shelters, it is necessary to improve accessibility by improving road conditions around shelters and increasing transport facilities. In addition, there are still factors that prevent people, particularly women, from seeking shelter in the event of a disaster, such as the lack of sanitation facilities and poor maintenance. Improving the living conditions of shelters is necessary to reduce sanitation, nutrition, and gender safety issues. To ensure a gender-sensitive design, for example, the first floor should be designed for women and children only and the second floor for men only, and consideration should be given to providing toilets on each floor. Ensuring such living conditions above a certain level will also encourage residents to actively evacuate.

With regard to evacuation information, such as early warning, in order to encourage quicker evacuation of residents, it is important not only to provide them with easy-to-understand information but also to provide scientific-based analysis and forecast information with geographic information to help residents visualize the situation and disaster damage risk.

4.3 Recommendations for the Application of Approaches and Concept Ideas in the Agriculture Sector

(1) Dissemination of New Varieties Led by the Government

Many of the new varieties that farmers are demanding to mitigate climate change impacts (e.g., resistance to cold damage, early harvesting, resistance to blast disease) have already been developed by the Bangladesh Rice Research Institute (hereinafter referred to as "BRRI"). In addition, a seed supply system (according to Bangladesh Agricultural Development Corporation, hereinafter referred to as "BADC") and a cultivation technology guidance system (by DAE) are also in place. Despite these favorable conditions, the use of new varieties has not expanded.

On the other hand, many farmers seem to choose varieties based on the recommendation of seed companies who advise on cultivation. Considering this, it seems that the accompaniment type of assistance is suitable for the dissemination of new varieties in the Haor area. In other words, in order to alleviate the anxiety that farmers feel about cultivating inexperienced varieties, NGOs should visit and instruct farmers who have introduced new varieties. The activities of the NGO are premised on cooperation with BRRI, DAE, and BADC.

(2) Feedback on Cultivation Records to Researchers

The important thing in agriculture is the observation and recording of crop growth. Notifying DAE and BRRI of disease or pest outbreaks is necessary for farmers to know how to deal with them. It also helps DAE to disseminate information about diseases and pests to other farmers.

(3) Maintaining Equity for Good Organizational Management

Farmers' Cooperatives such as the WMCA are organized by people who share the benefits of the same facilities (flood protection dike, irrigation canals, etc.). Each member will have different economic power and influence, but for a successful organization, it is important to maintain equity in the division of the administrative tasks of the facility and in the distribution of the benefits which the facility brings. Rather than enforcing strict rules, it is important to foster an awareness that everyone owns the facility. One WMCA uses membership fees to purchase work tools (sewing machines and livestock) for members in need. This is an effective way to show that the WMCA aims to improve everyone's lives.

(4) Evaluation for Sub-project Improvements

In SSWRDP (Phase 2), some WMCAs have applied for additional development based on the success cases of other areas. Since the natural and social conditions are different in each area, the same benefits cannot be obtained by introducing successful examples as they are. In order to arrange and introduce successful examples, it would be useful to conduct an evaluation that analyzes the success factors of each sub-project.

(5) The Adequate Degree of Achievement During the Project Period

In the Bangla-SHEP approach, farmers predict demand based on market research to determine which crops to plant. In the concept idea using this approach, the project's purpose is to improve the

livelihoods of farmers. This project will gradually improve the accuracy of the farmer's forecast, and the livelihood of farmers will be improved accordingly. Hence, the indicators (degree of achievement) should be set assuming the degree of improvement in livelihood at the end of the project.

ATTACHMENT 1 Bangladesh Delta Plan 2100 Investment Projects

Table 1.1 BDP2100 Investment Projects (Coastal Zone)

No.	Code	Project Name	Assumed Project Cost (Million BDT)
1	CZ1.1	Construction of Padma Barrage and Ancillary Works	408,713
2	CZ1.11/1.3	Improved Drainage in the Bhabadha Area	1,557
3	CZ1.26	Development of Water Management Infrastructure in Bhola Island	14,651
4	CZ1.3	Char Development and Settlement Project- V	1,138
5	CZ1.4	Study on Integrated Management of Drainage Congestion for Greater Noakhali	16
6	CZ1.5	Study on Tidal River Management	1,250
7	CZ1.6	Integrated Land Reclamation Project of Hatiya-Dhamar Char-Nijhum Dwip	550
8	CZ1.8/1.21	West Gopalganj Integrated Water Management Project	2,735
9	CZ1.30	Rehabilitation of Water Management Infrastructure in Bhola District	23,419
10	CZ1.39	Morphological Dynamics of Meghna Estuary for Sustainable Char Development	72
11	CZ1.40	Rationalization of Polders in Gorai-Passur Basin	106,604
12	CZ1.41	Program for Implementation of Rationalized Water-Related Interventions in Gorai-Passur Basin	14,570
13	CZ1.44	Rationalization of Polders in Baleswar - Tentulia Basin	158,502
14	CZ1.45	Program for Implementation of Rationalized Water-Related Interventions in Baleswar-Tentulia Basin	8,800
15	CZ1.47	Rationalization of Polders in Gumti - Muhuri Basin	64,328
16	CZ1.48	Program for Implementation of Rationalized Water-Related Interventions in Gumti - Muhuri Basin	13,988
17	CZ1.52	Land beyond Land, Efforts to Reclaim lands near Coast; Preparatory Surveys and Studies	927
18	CZ1.53	Structural interventions for managing sea level rise: preparatory surveys & studies	1,024
19	CZ1.7	Urirchar-Noakhali Cross Dam Project	4,353
20	CZ12.6	Integrated Coastal Zone Land Use Planning in Bangladesh using GIS and RS Technology	899
21	CZ12.8	Southern Agricultural Improvement Project (SAIP)	39,184
22	CZ17.1	Exploration of the Production Potential of Coastal Saline Soils of Bangladesh	98
23	CZ4.1	Development of Climate Smart Integrated Coastal Resources Database (CSICRD)	122
Total Project Cost			867,500

Source: Summarized by the Survey Team based on BDP2100

Table 1.2 BDP2100 Investment Projects (Barind and Drought-Prone)

No.	Code	Project Name	Assumed Project Cost (Million BDT)
1	DP1.1	North Rajshahi Irrigation Project	19,910
2	DP1.2	Revitalization and Restoration of Beel Halti	4,762
3	DP1.21	Rationalized Water-Related Interventions in Hurasagar Basin	15,934
4	DP1.3	Revitalization and Restoration of Hurasagar and Atrai Rivers	89,522
5	DP1.4/1.5	Kurigram Irrigation Project	26,992
6	DP15.3	Barind Area Fisheries Development Project	3,580
7	DP25.1	WMOs and Participatory Management Model, North Rajshahi Irrigation with Padma Barrage	101
8	DP25.2	Development of WMOs for Cost Recovery for O&M for the Mahananda Irrigation Scheme	61
9	DP25.3	WMOs and Participatory Management Model, for O&M for the Kurigram Irrigation Schemes (I & II)	102
Total Project Cost			160,964

Source: Summarized by the Survey Team based on BDP2100

Table 1.3 BDP2100 Investment Projects (Haor and Flash Flood)

No.	Code	Project Name	Assumed Project Cost (Million BDT)
1	HR1.1	Program for Implementation of Rationalized Water-Related Interventions in Upper Meghna Basin	5,780
2	HR14.1	Ecosystem habitat preservation program for plants, wildlife, fisheries, and migratory birds	386
3	HR14.3	Management of Commercially Important Wetland Ecosystem	417
4	HR15.4/5	Sustainable Haor Wetland/Rivers and Fish Habitat Management	9,700
5	HR2.1/2.2	Village Protection against Wave Action in Haor Area and Improved Water Management in Haor Basins	7,286
6	HR2.4	Elevated Village Platforms for the Haor Areas	3,942
Total Project Cost			27,511

Source: Summarized by the Survey Team based on BDP2100

Table 1.4 BDP2100 Investment Projects (Chattogram Hill Tracts)

No.	Code	Project Name	Assumed Project Cost (Million BDT)
1	CH1.1	Prospects for Promoting Soil Conservation and Watershed Protection in Chattogram Hill Tracts	8
2	CH1.10	Rationalization of Polders in Chittagong Coastal Plain	42,376
3	CH1.11	Program for Implementation of Rationalized Water-Related Interventions in Chattogram Coastal Plain Basin	811
4	CH12.4	Enhancement of Livelihood in the Chattogram Hill Tracts through good agricultural practice	9,519
5	CH26.1	Kaptai Lake Rehabilitation Study and Pilot Project	10
6	CH26.2	Development Catchment and Sub-Catchment Management Plans	16
7	CH26.5	Flow control and water storage structures for water availability in the dry season	625
8	CH9.2	Water Supply and Environmental Sanitation in Pourashavas Under CHTs	5,433
Total Project Cost			58,798

Source: Summarized by the Survey Team based on BDP2100

Table 1.5 BDP2100 Investment Projects (River System & Estuaries)

No.	Code	Project Name	Assumed Project Cost (Million BDT)
1	MR1.1	River Bank Improvement Program	140,694
2	MR1.46	Integrated Jamuna-Padma Rivers Stabilization and Land Reclamation Project	289,800
3	MR 1.5	Study for harnessing the waters of the Brahmaputra River	435
4	MR1.6	Development of the Chandona-Barasia River Basin System	461
5	MR3.1	Sustainable Restoration of Connectivity of Major Navigation Routes	22,948
6	MR1.2	Study of Integrated River System Management and Protection of Accreted Land	3,854
7	MR12.1	Enhancement of Agricultural Productivity Towards Food Security in Char Lands	15,039
Total Project Cost			473,231

Source: Summarized by the Survey Team based on BDP2100

Table 1.6 BDP2100 Investment Projects (Urban Areas)

No.	Code	Project Name	Assumed Project Cost (Million BDT)
1	UA1.1	Protection of Rivers System around Dhaka City with Their Ecological Restoration	14,788
2	UA1.2	Dhaka Integrated Flood Control Embankment cum Eastern Bypass Road Multipurpose Project	58,060
3	UA1.3	Drainage Improvement of Dhaka-Narayanganj-Demra Project (Phase 2)	5,711
4	UA10.1	Improvement of Drainage Congestion and Flood Control for Chattogram City Corporation Area	30,805

5	UA11.1	Improvement of Drainage Congestion, Canal Dredging, and Flood Control for Barisal CC area	4,522
6	UA23.1	Khulna Water Supply Project Phase II	26,662
7	UA23.2	Financial performance improvement of a Water Utility in a medium-sized city	383
8	UA3.1	Improvement of drainage network, flood control, and solid waste management for Khulna City	73,226
9	UA9.1	Water Supply project for the city corporation areas in Bangladesh (Phase I & II)	31,255
10	UA9.1(20.1)	Greater Dhaka Integrated Water and Sewage Improvement Project	378,000
11	UA9.2	Improvement of sanitation system in city corporation areas of Bangladesh	23,400
12	UA9.3	Project for improvement of storm water drainage facilities in city corporation areas	11,545
Total Project Cost			658,357

Source: Summarized by the Survey Team based on BDP2100

Table 1.7 BDP2100 Investment Projects (Cross-Cutting Field)

No.	Code	Project Name	Assumed Project Cost (Million BDT)
1	CC1.3	Dynamic Climate Smart Knowledge Portal and Hydro-geological Database for MoWR and BWDB	191
2	CC1.4	Development/Improvement of Multi-Purpose Disaster Shelters and its Management Information System (MDS&MIS)	307,624
3	CC1.41	Program for Implementation of Rationalized Water-Related Interventions in Dhaleswari Basin	1,838
4	CC1.43	Revitalization of Khals all Over the Country	4,577
5	CC1.45	Expansion and Modernization of Network and Tools for Groundwater Monitoring Including the Establishment of a National Coordination Mechanism	4,033
6	CC1.46	Managed Aquifer Recharge for Artificial Storage (MARAS) of Water to Improve Groundwater Table and Quality Conditions in Vulnerable Areas	1,334
7	CC12.37	Integrated Agricultural Development in Moderately Cyclone affected areas	16,398
8	CC16.19	Climate Resilient Livestock Production	
9	CC18.5	Improvement of Urban Drainage in District and Upazila level municipalities of Bangladesh	157,650
10	CC9.10	Piped Water Supply project in 100 Pourashavas	25,031
11	CC9.11	Water Supply project in the Urban areas of Bangladesh (secondary towns)	46,688
12	CC9.12	Improvement of sanitation system in urban areas of Bangladesh	22,173
13	CC9.13	Village Piped water supply system project (Phase I & II)	53,376
14	CC9.17	Project for improvement of water supply and sanitation facilities in char area	9,720
15	CC9.18	Project for improvement of storm water drainage facilities in Pourashava (Phase I)	23,485
Total Project Cost			674,118

Source: Summarized by the Survey Team based on BDP2100

ATTACHMENT 2 National Adaptation Plan Investment Plan Codes and Descriptions

Water Resource Management Sector
Disaster Management, Social Safety and Security Sector
Climate -Smart Agriculture Sectors
Governance and Organization Sectors
Capacity Development and Research Sectors

Table 2.1 NAP IP in the Water Resource Management Sector

Code	NAP Investment Plan
WRM1	Integrated management of coastal polders, sea dikes, and cyclone shelters against tropical cyclone, sea-level rise and storm surges
WRM2	Management of freshwater resources and monitoring of salinity for reducing vulnerabilities in existing and potential salinity-prone areas
WRM3	Protection and management of potentially vulnerable areas due to tropical cyclone, sea-level rise, extreme storm surges and flooding
WRM4	Strengthen early warning and dissemination services for climate change-induced slow-onset and sudden extreme water hazards using ICT and artificial intelligence
WRM5	Community-based rainwater harvesting through indigenous techniques and conservation of wetlands, reservoirs and natural springs for drinking water supplies in hard-to-reach and water-stressed areas
WRM6	Dredging of all major and medium rivers for accommodating the smooth drainage of excess floods during climate-induced extreme events
WRM7	Construction and rehabilitation of flood and drainage management measures with eco-engineering solutions
WRM8	Drainage management of economic/industrial zones and critical infrastructure, and reinforced climate resilience through risk assessment
WRM9	Internal drainage management and climate-resilient development of the Char and islands areas
WRM10	Protection against flash floods, wave action, erosion and sedimentation
WRM11	Erosion risk management through erosion prediction, improved early warning and its dissemination
WRM12	Sustainable shoreline erosion management based on eco or bio-engineering measures
WRM13	Reclamation and development of lands for the expansion of afforestation, agriculture, shrimp cultivation, and settlements
WRM14	River management through bank stabilization and other ancillary works
WRM15	Ecosystem-based sediment management along coasts and in estuaries
WRM16	Drought management measures for enhanced groundwater recharge and increased soil moisture in water-stressed areas
WRM17	Development of a national drought monitoring system
WRM18	Planned, participatory and coordinated land and water resources management
WRM19	Transboundary river basin management and basin-level cooperation
WRM20	Development of a basin-wide and participatory watershed management framework to restore, harvest and optimize the use of water resources
WRM21	Remodeling of water-regulating and cross-drainage structures considering climate change scenarios

Source: NAP IP

Table 2.2 NAP IP in the Disaster Management, Social Safety, and Security Sectors

Code	NAP Investment Plan
CDM1	Construction and rehabilitation of gender-, age- and disability-sensitive multipurpose, climate-resilient and accessible cyclone and flood shelters with safe drinking water, sanitation and livestock shelter facilities
CDM2	Landslide early warning systems and risk management measures based on eco- or bioengineering measures
CDM3	Implementation of thunderstorm and lightning risk management measures in highly susceptible areas
CDM4	Protection and enhanced resilience of climate migrants with a particular focus on gender and disability
CDM5	Gender-, age- and disability-responsive, youth-led disaster preparedness and emergency rescue and evacuation services
CDM6	Increase the resilience of vulnerable poor communities by introducing gender-, age- and disability-responsive diversified livelihoods, effective insurance mechanisms and climate resilience funds
CDM7	Behavioural change and development of awareness among vulnerable communities for emergency responses and livelihood protection from climate induced disasters
CDM8	Increase the coverage of social security/social safety net programmes for building community-based resilience and adaptive capacity
CDM9	Halt child abuse, early marriage and domestic violence triggered by climate-induced disasters
CDM10	Accelerated livelihood improvements for women, people with disabilities and young entrepreneurs through vocational training on adaptation practices and ICT
CDM11	Introduction of risk transfer and insurance mechanisms for protection of critical and disaster protection infrastructure, vulnerable MSMEs and farmers
CDM12	Building climate-resilient houses, education & communication infrastructure in areas with high climate risk

Source: NAP IP

Table 2.3 NAP IP in the Climate-Smart Agriculture Sector

Code	NAP Investment Plan
CSA1	Extension of climate-smart technologies for increasing irrigation water use efficiency
CSA2	Augmentation of surface water for irrigation and multipurpose use
CSA3	Extension of stress-tolerant, pest and diseases-resistant rice and non-rice crops
CSA4	Introduction and scaling up of innovative and indigenous agriculture
CSA5	Crop diversification/intensification for natural resources optimization and reduction of climate stress
CSA6	Farm modernization/ mechanization to reduce climate vulnerability
CSA7	Increased fertilizer use efficiency for enhancing production
CSA8	Extension of good agricultural practices, modern agricultural technology and sloping agricultural land technology
CSA9	Strengthening and development of impact-based early warning system and data management for agriculture
CSA10	Improvement of storage or post-harvest facilities, transport, communications, and e-commerce-based market facilities for agricultural products
CSA11	Development of agrofood processing industries based on climate-sensitive crop zoning
CSA12	Development of e-commerce and engagement of women, people with disabilities and youth in e-commerce-based entrepreneurship

Source: NAP IP

Table 2.4 NAP IP in the Governance and Organization Sectors

Code	NAP Investment Plan
PIN1	Preparation of a roadmap for implementing the NAP
PIN2	Development of a regulatory and institutional framework for advancing the NAP
PIN3	Update and reform policies and plans for mainstreaming CCA
PIN4	Operationalize the NAP monitoring, evaluation and learning framework based on a theory of change.
PIN5	Reform local government institutes towards the inclusion of community-based organizations, women, people with disabilities and youth in the implementation of locally led adaptation
PIN6	Innovative, appropriate and enhanced financial instruments for supporting climate change adaptation
PIN7	Private sector financing in leading the implementation of climate change adaptation

Source: NAP IP

Table 2.5 NAP IP in the Capacity Development and Research Sectors

Code	NAP Investment Plan
CDR1	Transformative capacity development and knowledge management for integrating climate change adaptation into planning processes and climate financing
CDR2	Awareness-raising, training on skills for enhanced adaptive capacities and improved diversified livelihoods at the community level
CDR3	Coordinated research, field-level demonstrations, knowledge management and communication of adaptation at the local level
CDR4	Capacity development for the implementation of nature-based solutions and locally led adaptation
CDR5	Generation of national, regional and local-level evidence and scenario-based climate information through climate downscaling and publication of a national climate outlook, risk and vulnerability atlas
CDR6	Research on the impact of climate change on land and water resources
CDR7	Action research and field demonstrations on climate-smart agriculture
CDR8	Research and innovation related to climate-resilient fisheries and aquaculture
CDR9	Research and innovation related to climate-smart livestock and poultry
CDR10	Action research for locally led and indigenous climate change adaptation
CDR11	Action research for developing and exploring the potential use of ecosystem-based adaptation and nature-based solutions
CDR12	Research on climate change impacts on land, water and ocean ecosystems
CDR13	Research and popularize climate-stress-tolerant plant species
CDR14	Research on and piloting of climate-resilient infrastructure, improved health measures and WASH technologies
CDR15	Action research for low-impact development techniques, green infrastructure and integrated drainage management for smart city development

Source: NAP IP

ATTACHMENT 3 Major Objectives and Specific Activities in the Water, Disaster Risk Reduction, and Agriculture Sector in the 8th Five-Year Plan

Table 3.1 The Major Objectives of the Water Sector for 8FYP

1. Continuing and strengthen river dredging to enhance navigability and to facilitate water transportation.
2. Increasing water use efficiency in crop production and enhance the utilization of surface water irrigation.
3. Protecting riverbank from erosion through integrated long-terms measures.
4. Ensuring conjunctive use of surface and ground water for sustainable irrigation, securing groundwater conservation.
5. Strengthening regional and international cooperation for basin-wide water resources development and management of trans-boundary rivers.
6. Preventing of saline intrusion through augmenting the freshwater flow in the southwest region including the Sundarbans.
7. Developing modern early warning systems to minimize economic losses from flood and other disasters.
8. Adapting of climate change mitigation strategies.
9. Rainwater harvesting.
10. Implementing integrated coastal zone management strategies.
11. Strengthening capacities of the institution in the water resource management.
12. Mainstreaming Valuing Water into Public Investment Decision Making in collaboration with Planning Commission to allow for future investment decisions which further support sustainable water resources management and thus sustainable economic development.
13. Identifying and demonstrating options to incorporate Valuing Water into private sector decision making in order to lead to more sustainable investment and operational choices.

Source: The Eighth Five-Year Plan

Table 3.2 Specific Activities for Better Disaster Risk Reduction under 8FYP

1. Institutionalization of DRR and CCA.
2. Promote private sector resilience to disasters and climate change risks through improved public private partnerships.
3. Develop adaptive research on disaster and climatic issues
4. Adopt proven technologies
5. Develop a vulnerability index which will help channelize equitable resources to the targeted districts.
6. Develop a focused and specific DRR-CCA indicator in the overall performance tracking for the plans, programmes and projects.
7. Increase the number of recipients of social welfare/safety net allocations after any disaster.
8. Improve business processes and initiate financial management reform in MoDMR and DDM and relevant GoB agencies.
9. Develop a better coordination mechanism within the ministry and across the government.
10. Increased investments in gender sensitive DRR and climate risk reduction to reduce the cost for response and recovery.

11. Support skill development by giving training to GOs, NGO officials and volunteers concerned in Disaster Management and develop greater partnership with NGOs to improve "cyclone preparedness" capacity.
12. Incorporate best practices and technology in Disaster Management of Bangladesh from around the world.
13. Improve guidelines for Road and Water Safety.
14. Improve guidelines for Industrial Safety.
15. Improve guidelines for Disaster Shelter Management.
16. Strengthen Disaster Impact and Risk Assessment Guidelines.
17. Improve Emergency Fund Management Guidelines.
18. Improve early warning systems through relevant technology adoption.
19. Increase investments in training emergency responders to cope with extreme events.
20. Increase afforestation through a major programme along all coastal areas of the country.
21. Strengthen Indigenous Coping Mechanism Guidebook.
22. Enhance Community Risk Assessment Guidelines.
23. Improve Emergency Response and Information Management Guidelines.

Source: The Eighth Five-Year Plan

Table 3.3 The Major Objectives of the Agriculture Sector for 8FYP

1. Increase availability of food, right to food and purchasing power by increasing productivity and production of crops.
2. Increase farmers' capability and income through institutional infrastructure development and efficient technology services.
3. Adopt and implement food production plans to meet the needs of nutritious, safe and demand-driven foods.
4. Restore and develop the agricultural supply chain aftermath of COVID-19 crisis; minimize the impact of COVID-19 for smooth agriculture growth and ensure food security after the crisis.
5. Develop agricultural research for promoting export of products through coordination with local and international partner organizations; modernize agricultural research, education, extension, input management and develop skilled manpower for sustainable technology innovation.
6. Provide assistance to the farmers in increasing agricultural production and ensuring marketing facilities of agricultural commodities and obtaining fair prices.
7. Introduce precision agriculture and synchronise farming, reduce the use of physical labour and introduce cost saving farming system through farm mechanization.
8. Ensure sustained agricultural growth through more efficient and balanced utilization of land, water and other resources, and encourage more use of surface water for irrigation and reduction of pressure on ground water while expanding irrigation facilities through improving existing irrigation system and related infrastructures.
9. Installations of solar panels for small scale irrigation in rural areas will be a priority.
10. Promote gradual shifting of high water- consuming crops to low water consuming high value crops.
11. Introduce nanotechnology in agriculture promote science-led agriculture technology systems and encourage research and adoption of modern agricultural practices for development of drought, submergence and saline prone agriculture considering water and time economy, adaptation to

climate change, proper use of genetically modified technology in agriculture, and promote adoption of modern agricultural practices in dry land, wetland, hills and coastal areas including use of environment friendly green technologies and climate-smart/resilient technologies; introduce salinity, submergence and other stress tolerant varieties specially in the Southern regions.

12. Create new sectors of agricultural commercialization and employment generation through value addition, improving supply chain, demand-driven and export-oriented agricultural development.
13. Ensure proper use of water resources through active participation in the formulation of strategies and their proper implementation through inter-ministerial/inter-agency coordination.
14. Enhance farmers' income and livelihood through Holistic Farming System Approach (HFSA) with special emphasis on productivity enhancement of homestead areas.
15. Maintain plant genetic resources, genetic diversity of seeds of food crops and medicinal plants and conserve local and land races for protection from extinction.

Source: The Eighth Five-Year Plan

ATTACHMENT 4 Estimated Level of Investment in Mujib Climate Prosperity Plan

Table 4.1 Estimated Level of Investment in Mujib Climate Prosperity Plan

THE MUJIB PROSPERITY PLAN'S ESTIMATED LEVEL OF INVESTMENT

MUJIB CLIMATE PROSPERITY PLAN	EST. INVESTMENT SIZE UP TO 2030 PER PROGRAM	TOTAL
POINT 1: ACCELERATED ADAPTATION		
Bangladesh Delta Plan 2100 (Phase 1) Resilience Bonds towards Accelerated Adaptation and Protective Infrastructure	USD 137.90 billion	USD 37.90 BILLION
POINT 2: JUST TRANSITION OF LABOR AND FUTURE-PROOFING INDUSTRY WITH TECHNOLOGY TRANSFER		
2A: Just Transition and Modernization through Training and Skills Development for Labor Markets of the Future	USD 1.51 billion	USD 11.63 BILLION
2B: Future-Proof Bangladesh's Position in the Global Supply Chain	USD 10.12 billion	
POINT 3: INCREASING PUBLIC REVENUE TO SPEND ON THE MOST VULNERABLE		
3A: Investment in the Realization of Locally Led Adaptation Outcomes	USD 3.89 billion	USD 3.92 BILLION
3B: Established Carbon Financing Regime for Revenue Generation	USD 25.13 million	
POINT 4: COMPREHENSIVE CLIMATE AND DISASTER RISK FINANCING AND MANAGEMENT		
4A: Micro, Small and Medium Enterprise Financial Protection and Productivity Enhancement	USD 2.87 billion	USD 4.89 BILLION
4B: Development of Climate-Resilient and Nature-Based Agricultural and Fisheries Supply and Value Chains including National Disaster Risk Financing and Management to Safeguard Food Security, Nutrition and Water Security	USD 2.02 billion	
POINT 5: LEVERAGING 21ST CENTURY TECHNOLOGIES FOR WELL-BEING		
5A: Mujib Resilient Well-Being Programs	USD 150.75 million	USD 4.55 BILLION
5B: Accelerated Digital Revolution	USD 4.40 billion	
POINT 6: MAXIMIZED RENEWABLE ENERGY, ENERGY EFFICIENCY AND POWER & TRANSPORTATION SECTOR RESILIENCE		
6A: Maximized Renewable Energy Wealth, Energy Efficiency and Energy Storage Infrastructure	USD 13.55 billion	
6B: Modernization of the Grid and the Ancillary Market to Support Resilience	USD 3.18 billion	USD 7.09 BILLION
6C: Transitioning to Transport Solutions of the Future	USD 3.90 billion	
TOTAL		**USD 83.55 BILLION**

Source: MCPP

ATTACHMENT 5　List of JICA Studies/Projects Considered for Review

Table 5.1 JICA Studies/Projects in the Disaster Risk Reduction Sector

No.	Scheme	Study/Project Name
1	Grant	Project for Strengthening of Fire Fighting Facilities
2	T/C	Water Drainage System Improvement Project in Dhaka
3	Grant	Replacement of Weather Surveillance Radars
4	Grant	Improvement of the Fire Fighting and Rescue Equipment
5	Loan	Emergency Commodity Loan
6	T/C	Greater Dhaka Protection Project (Study in Dhaka Metropolitan Area of Bangladesh Flood Action Plan)
7	Grant	The project for the Improvement of the Storm Water Drainage System in Dhaka City
8	T/C	Northwest Regional Study (Bangladesh Flood Action Plan No.2)
9	Grant	The project for the Improvement of the Storm Water Drainage System in Dhaka City
10	Loan	Commodity Loan For The Cyclone Disaster Relief
11	Grant	The Project For Procurement Of G. I. Sheet For Post Cyclone Rehabilitation
12	Grant	The project for the Improvement of the Storm Water Drainage System in Dhaka City
13	Grant	Project for the Establishment of Microwave Link for Meteorology
14	Grant	Project for the Construction of Revetment on the Bank of Meghna River
15	Grant	Project for the Construction of Multipurpose Cyclone Shelters
16	Grant	The Project for the Construction of Multipurpose Cyclone Shelters (Phase 2)
17	Expert	Data Acquisition / Coordinator
18	Grant	The Project for the Construction of Multipurpose Cyclone Shelters III
19	Grant	The Project for Improvement of Weather Warning Services Related to Natural Disasters
20	Grant	The Project for Supply of Equipment and Materials for Flood Disaster Relief
21	Grant	The Project for the Construction of Multipurpose Cyclone Shelters (Phase 4)
22	T/C	The Feasibility Study for Upgradation and Expansion of Data Communication / Transmission Network of Flood Forecasting and Warning Service
23	Grant	The Project for Construction of Multipurpose Cyclone Shelters (Phase V)
24	Grant	The Project for Construction of Multipurpose Cyclone Shelters (Phase V)
25	Grant	The Project for the Improvement of the Meteorological Radar System at Cox's Bazar and Khepupara (P1)
26	Grant	The Project for the Improvement of the Meteorological Radar System at Cox's Bazar and Khepupara (P2)
27	Grant	The Project for the Improvement of the Storm Water Drainage System in Dhaka City (Phase II)
28	Grant	The Project for the Establishment of the Meteorological Radar System at Moulvibazar
29	Grant	The Project for the Improvement of the Storm Water Drainage System in Dhaka City (Phase II)
30	Loan	Emergency Disaster Damage Rehabilitation Project
31	Grant	The Programme for Construction of Multipurpose Cyclone Shelters in the Area Affected by the Cyclone Sidr
32	T/C	Development of Human Capacity on Operation of Weather Analysis and Forecasting
33	Expert	Advisor on River Management
34	T/C	Project for Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings
35	T/C	Research Project on Disaster Prevention/Mitigation Measures against Floods and Storm Surges
36	Loan	Haor Flood Management and Livelihood Improvement Project
37	Expert	Integrated Water Resource Management
38	Grant	Project for Improvement of Meteorological Radar System in Dhaka and Rangpur (Detailed Design)
39	Expert	Disaster Management Sector Coordination
40	Grant	The Project for Improvement of Meteorological Radar System in Dhaka and Rangpur
41	Loan	Urban Building Safety Project
42	T/C	Building Safety Promotion Project For Disaster Risk Reduction (BSPP)
43	Loan	Disaster Risk Management Enhancement Project
44	T/C	The Project for Technical development to upgrade structural integrity of buildings in densely populated urban areas and its strategic implementation towards resilient cities
45	Expert	Disaster Management Sector Coordination and Project Implementation
46	Grant	the Project for Improvement of Rescue Capacities in the Coastal and Inland Waters
47	Expert	Integrated Water Resource Management Advisor
48	Expert	Disaster Risk Reduction Sector Coordination Advisor
49	T/C	Project for Planning Capacity Enhancement and Establishment of a Technology Adaptation Cycle on Comprehensive Nodi (River) Management
50	T/C	The Project for Capacity Enhancement on Formulation and Implementation of Local Disaster Risk Reduction Plan
51	Grass-root T/C	Development of Youth-led Community Disaster Preparedness System
52	Grass-root T/C	Community Disaster Preparedness in Cyclone Prone Areas
53	Grass-root T/C	Capacity Enhancement for Disaster Preparedness Using Community Radio
54	Grass-root T/C	Community-Based Disaster Risk Reduction in Urban Areas
55	Grass-root T/C	The Project to Develop Resilient Communities and People to Cyclones

where, Grant: grant aid, T/C: technical cooperation, Loan: ODA loan, Expert: dispatchment of (an) expert(s)
Source: JICA's 50 Years in Bangladesh, Toward Sonar Bangla, JICA, JST

Table 5.2 JICA Studies/Projects in the Agriculture Sector Including Water Sector

No.	Scheme	Study/Project Name
1	Grant	The Food Aid
2	T/C	Participatory Rural Development Project
3	T/C	Study on Groundwater Development for Northwestern Areas in People's Republic of Bangladesh
4	T/C	Rural Infrastructure Development
5	T/C	Arsenic Contamination Advisor (Community-baced Water Management)
6	T/C	Arsenic Contamination Advisor (Arsenic Analysis & Removal)
7	T/C	Study for Rural Development Focusing on Flood Proofing
8	Loan	Greater Faridpur Rural Infrastructure Development Project
9	T/C	Women in Development
10	T/C	Rural Development Technical Advisor
11	T/C	Arsenic Mitigation Advisor to DPHE
12	T/C	Rural Development Engineering Center Set-up Project
13	T/C	Participatory Rural Development Advisor
14	T/C	Arsenic Mitigation Advisor to LGD
15	T/C	The Master Plan Study on Small Scale Water Resources Development for Poverty Alleviation through Effective Use of Surface Water
16	T/C	Arsenic Mitigation Advisor to DPHE
17	Loan	Eastern Bangladesh Rural Infrastructure Development Project
18	T/C	Rural Infrastructure Development Advisor
19	T/C	Participatory Rural Development Project (PRDP-2)
20	T/C	Project for Sustainable Mitigation for Arsenic Contamination under the Integrated Local Government System
21	T/C	Poultry Technology Development and Dissemination Project
22	T/C	Strengthening of Activities in Rural Development Enginieering Center(RDEC) Project(Phase 2)
23	Loan	Small Scale Water Resources Development Project
24	T/C	Rural Infrastructure Development Technical Advisor
25	Grant	The Food Aid Programme
26	Loan	South Western Bangladesh Rural Development Project
27	T/C	Rural Infrastructure Development Technical Advisor
28	Grant	Improvement of the Capacity of Public Food Storage in the People’s Republic of Bangladesh (Detailed Design)
29	Grant	Improvement of the Capacity of Public Food Storage in the People's Republic of Bangladesh
30	T/C	Rural Infrastructure Development
31	T/C	Capacity Development Project for Participatory Water Resources Management through Integrated Rural Development
32	Grant	the Project for Ground Water Investigation and Development of Deep Ground Water Source in Urban and Rural Areas
33	T/C	Rural Infrastructure Development Advisor
34	T/C	The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
35	Loan	Small and Marginal Sized Farmers Agricultural Productivity Improvement and Diversification Financing Project
36	T/C	Rural Infrastructure Development & Management Advisor
37	T/C	Project for Improvement of Total Management Capacity of Department of Public Health Engineering on Rural Water Supply and Sanitation
38	T/C	Integrated Rural Development
39	Loan	Small Scale Water Resources Development Project (Phase 2)
40	T/C	Project for developing inclusive insurance program for sustainable poverty reduction
41	Loan	Food Value Chain Improvement Project
42	T/C	Fisheries Livelihood Enhancement Project in the Costal Area of the Bay of Bengal
43	T/C	The Market-oriented Agriculture Promotion Project for Smallholder Horticulture Farmers through Multi-stakeholder Partnerships
44	T/C	Rural Urban Development Advisor
45	Grass-root T/C	Practice and Dissemination of Disaster-resistant Climate Change-adaptive Rice Cultivation
46	SATREP	Development of breeding and water management techniques contributing to rice safety and high nutritional value

where, Grant: grant aid, T/C: technical cooperation, Loan: ODA loan, Expert: dispatchment of (an) expert(s)
Note: Studies/projects in the water sector are included in the table.
Source: JICA’s 50 Years in Bangladesh, Toward Sonar Bangla, JICA, JST

ATTACHMENT 6 Approaches

Approach (1): Large-scale Concrete Hollow Block Tanks for Public Water Supply in Local Communities

1. Outline and Features of the Approach

Summary of Approach:

In rural areas where there has been an issue of a chronic shortage of drinking water, concrete hollow block tanks storing rainwater at public facilities (e.g., schools) are planned and constructed for drinking water supply to facility users (e.g., students, teachers, school staff, etc.) and neighboring residents. This approach mainly consists of the following:

- Basic survey for rainwater tank installation
- Rainwater tank construction
- Establishment of a management committee
- Compilation of the maintenance manual of the rainwater harvesting system

Keyword:

Rainwater harvesting, safe water distribution, reduction of labor and cost for safe water access, ownership, sustainable business, local corporation, NGO, Sky Water Harvesting System

2. Project Delivering the Approach (Upazila Integrated Capacity Development Project (UICDP) Phase 1 and 2)

Introduction

Since August 2017, more than 700,000 Rohingya refugees have flowed into Cox's Bazar District from Myanmar, and as of 2020, a total of 27 refugee camps have been established in Ukhia Upazila and Teknaf Upazila of the district (Upazila Integrated Capacity Development Project (UICDP) Phase 1 Progress Report, JICA, 2020). This influx of refugees has made securing water resources an urgent issue.

On the other hand, in Bangladesh, there are concerns about sea level rise due to climate change, and it is expected that saltwater intrusion will make it more difficult to obtain safe drinking water in coastal areas, like these two Upazilas.

Amid this background, in parallel with support for formulating Upazila development plans, it was decided to provide support for constructing rainwater tanks in areas in Teknaf Upazila.

Utilization of rainwater among the surrounding community

Key Activities

Basic survey on rainwater tanks

- ✓ Selection of the locations and capacity of tanks

Construction of rainwater tanks

- ✓ Design and construction supervision for the large-scale concrete-block-made rainwater tanks

Establishment of a maintenance committee

- ✓ Establishment of the maintenance committee
- ✓ Training on O/M targeting maintenance committee member

Large-scale concrete-block-made tank

Project Outcomes

- ✓ Construction of the large-scale rainwater tank
- ✓ Establishment of a maintenance committee

Key Indicators/Generated Impacts

- ✓ The number of constructions of large-scale rainwater tanks (2 tanks each at two locations under this project)

Approach (1): Large-scale Concrete Hollow Block Tanks for Public Water Supply in Local Communities

- ✓ The number of beneficiaries and beneficiary households (students, teachers, guards, communities nearby) in terms of 1) health conditions, 2) reduced time and work for fetching water, and 3) gained additional income by reducing the time for fetching water
- ✓ Record of annual and emergency maintenance

Lessons Learned

- ✓ The concrete hollow block-made tanks can be installed anywhere in Bangladesh as long as there is enough open space.
- ✓ If it is installed in an urban area, such as Dhaka, initial rainfall for 15 minutes should be drained, and then rainwater is stored.

Community with safe water

Developed Tools and Guidelines

- ✓ Operation and Maintenance Manual of "Sky Water Harvesting System" in Bangladesh

Devises for Ensuring Sustainability

- ✓ Prompt and continuous maintenance by maintenance committees
- ✓ Raising awareness on maintenance of the tanks by signage, etc.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Promoting the health conditions of beneficiaries by improving drinking water
- ✓ Reduction of labor and cost for water fetching (especially for women and children)
- ✓ Increment of income (e.g., sewing at home)

Project Information Relevant to the Approach

Title: Upazila Integrated Capacity Development Project (UICDP) Phase 1 and 2

Scheme: Technical Cooperation

Project Period: September 2017 to December 2022
(only with the study and construction on the rainwater tanks: February to September 2022)

Implementing Agencies: Teknaf Upaila Perishad, Directorate of Secondary and Higher Education (DSHE), SB Ltd.

Related URL:
General Info
https://www.jica.go.jp/Resource/project/english/bangladesh/011/index.html
Policy Documents
https://www.jica.go.jp/Resource/project/english/bangladesh/011/materials/index.html

Acknowledgment for Interview Meeting: Dr. Makoto MURASE, C.E.O., Institute for Skywater Harvesting, Co., Ltd, Mr. Kiyoshi SATO, Institute for Skywater Harvesting, Co., Ltd,

Approach (2): Rainwater Harvesting in Coastal Areas through the Collaboration between Social Businesses and Communities

1. Outline and Features of the Approach

Summary of Approach:

In rural coastal areas, where salinity issues are seen in drinking water, this approach, collaborating with a private company and local NGOs installs rainwater tanks, grows awareness about rainwater harvesting, and develops a social business model that achieves sustainable and affordable safe water access, primarily targeting the BOP. This approach mainly consists of the following:

- Market survey regarding drinking water
- Mason training to learn rainwater tank manufacturing methods
- Production and installation of rainwater tanks
- Awareness raising and monitoring of rainwater use

Keyword:

Rainwater harvesting, safe drinking water supply, AMAMIZU (which means "water from the sky" in Japanese) tank, reduction of labor and costs on water fetching, residents' ownership of their tanks, local corporations, NGOs

2. Project Delivering the Approach (Preparatory survey on a Rainwater Tank Social Business with Microcredit Loan)

Introduction

Securing safe water is an urgent issue for regional development throughout Bangladesh. Amid concerns about sea level rise due to climate change, coastal areas face serious problems such as salt intrusion in addition to arsenic pollution. Rainwater harvesting, or called "sky water" harvesting in this project, with gratitude to the sky for drinking water distribution, which can be maintained safely and with a low maintenance cost, is highly effective in solving such problems in areas where many low-income people live with no prospects for water supply development.

Key Activities

Water-needs survey of the target area (Bagerhat District)

- ✓ Interview survey targeting 300 households to know if the demands for the rainwater tank are high enough to run the business. The survey covers items such as present drinking water resources, average distance, time and costs to access the water resource, and cost for treatment for water-related diseases, etc.

Survey on the effect of existing rainwater tanks on water businesses

- ✓ Survey the existing water tanks considering the aspects of their durability and the cost of the existing tanks
- ✓ Survey water businesses, such as water delivery, manufacturing, and distribution of bottled water to find the areas and costs where the water purchase is available

Pilot Project

- ✓ Establishment of a local company, Skywater Bangladesh Limited (SB Ltd.) for production, storage, sales, installation, and monitoring
- ✓ Establishment of production centers and satellite plants for the low-cost mortar-made rainwater tank, or "AMAMIZU" (which means "Rainwater" in Japanese) with a capacity of 650L and 1,000L under SB Ltd.

Water fetching from a pond

Production of AMAMIZU tank

Approach (2): Rainwater Harvesting in Coastal Areas through the Collaboration between Social Businesses and Communities

- ✓ Training of local mason for manufacturing AMAMIZU tanks
- ✓ Production, storage, sales, and installation of AMAMIZU tanks
- ✓ Monitoring and awareness raising of rainwater harvesting by local NGOs and further business models

AMAMIZU Tank transportation by boat

Project Outcomes

- ✓ Development and utilization of the AMAMIZU system including production, storage, transportation, and installation
- ✓ Construction and inauguration of AMAMIZU Production Center and satellite plant (2 satellite plants and 7 stockyards have been constructed under this project)

Key Indicators/Generated Impacts

- ✓ The number of sales of the AMAMIZU tanks (476 tanks with a capacity of 1,000L under the pilot project)
- ✓ The number of beneficiaries and beneficiary households in terms of 1) health conditions, 2) reduced time and work for fetching water, and 3) additional income gained by reducing the time for fetching water (190 households purchased the tanks, one-third of medical expense and one-fifth of time and distance is required after the installation, water fetching and purchase cost becomes 75 BDT from 250 BDT per month in average (in 2013) after the installation under the pilot project.)
- ✓ Record of maintenance works
- ✓ Business revenue

Lessons Learned

- ✓ Product payment allocation which requires a partial payment to owners (residents) with the involvement of a local company raises awareness of the ownership of the tank.
- ✓ Since some residents had problems with the payment, the cost is presently covered by NGOs and the residents. The tank is first sold to the NGO presently, and then, the NGO requests the owners (residents) to bear a little part of the payment.
- ✓ Transportation for delivering the tank is the key. The road that is flat and durable should be chosen where available. Boat transportation is also applicable.
- ✓ It is important to differentiate from conventional low-quality concrete tanks for branding purposes.

AMAMIZU system

Developed Tools and Guidelines

- ✓ Local meeting flyer (English version, Bengali version)
- ✓ Promotional flyer (Bengali version)

Devices for Ensuring Sustainability

- ✓ Sustainable social business, sales at low prices rather than donations, aiming to make the beneficiaries realize ownership of their tanks

Approach (2): Rainwater Harvesting in Coastal Areas through the Collaboration between Social Businesses and Communities

- ✓ Long product warranty (7 years) and high-quality maintenance.
- ✓ Selling tanks to NGOs which manages the sales of the tanks to the residents
- ✓ Small-scale rainwater tanks for low-income people and large tanks for wealthy people or public usage (introduced in another approach).

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Involvement of women as interviewees of the basic survey, targets for raising awareness on utilization of rainwater and sales promotion staff

Project Information Relevant to the Approach

Title: Preparatory Survey on a Rainwater Tank Social Business with Microcredit Loan

Scheme: Technical Cooperation

Project Period: From May 2011 to September 2013

Implementing Agencies: DPHE, Skywater Bangladesh Ltd., Skywater Harvesting Ltd., PR Bangladesh (NGO)

Related URL:
Report (in Japanese only)
https://www.jica.go.jp/bangladesh/bangland/pdf/knowledge2.pdf
Promotion movies:
English version: http://www.youtube.com/watch?v=xWxuTbI73bI&feature=digest_thu
Bengali version: http://www.youtube.com/watch?v=Cxj9p2p69RA&feature=related
Japanese version: http://www.youtube.com/watch?v=oDTTx4mK-9M&feature=digest_thu

Acknowledgment for Interview Meeting: Dr. Makoto Murase, C.E.O., Institute for Skywater Harvesting, Co., Ltd

Approach (3): Reducing Health Damage Caused by Arsenic-contaminated Drinking Water with Residents and Hospitals

1. Outline and Features of the Approach

Summary of Approach:

With the aim of installing sustainable arsenic contamination control measures, this approach raises awareness of residents on arsenic water problems and provides a fund collection system among residents. This approach also strengthens the planning capacity of the residents' committee for alternative water sources and assists arsenic poisoning patience management at hospitals in Upazilas where arsenic contamination is serious. This approach mainly consists of the following:

- Enhancing the ability of water source management of residents
- Formulation and enhancing the coordination ability of the arsenic countermeasures committee
- Technical support for the installation of alternative water sources such as piped water
- Support for arsenic poisoning patients

Keyword:

Arsenic contamination, participatory mitigation, fund collection system, arsenic mitigation committee, alternative water source, hospital, handbook

2. Project Delivering the Approach (Project for Sustainable Mitigation of Arsenic Contamination under the Integrated Local Government System)

Introduction

In Bangladesh, arsenic contamination of groundwater has become a serious problem that hinders the ability to secure safe drinking water, especially in rural areas. Approximately 20.2 million people in 270 out of 485 districts are forced to drink water with arsenic concentrations exceeding 50 ppb (0.05 mg/l) (as of 2013, Ex-post evaluation result of the project, JICA, 2013).

Amid this background, climate change causing droughts and floods makes access to safe water more difficult. Hence, the provision of countermeasures against arsenic contamination in highly contaminated areas, such as Sharsha Upazila and Chowgacha district, is an urgent issue.

One of the water sources

Key Activities

Enhancing the ability of residents

- ✓ Awareness activities with guidelines on participatory arsenic mitigation
- ✓ Formation of Users' Committees
- ✓ Establishment of a fund collection system from the users for the installation of alternative water sources

Enhancing the coordination ability of the Arsenic Mitigation Committee

- ✓ Provision of training to arsenic mitigation committees at District, Upazila, Union, and Ward levels
- ✓ Compilation of the framework of planning and coordination for arsenic mitigation activities
- ✓ Establishment of an application-approval system for installation and repair of alternative water source

Pipe water supply system

Approach (3): Reducing Health Damage Caused by Arsenic-contaminated Drinking Water with Residents and Hospitals

Technical support for the installation of alternative water sources

- ✓ Provision of training to DPHE officers on alternative water sources and water quality monitoring.
- ✓ Conduct of preliminary survey, guidance, and training to contractors on the installation of alternative water sources.

Support for arsenic poisoning patients

- ✓ Provision of training to doctors and health workers
- ✓ Identification of arsenicosis patients and provision of guidance
- ✓ Management of data on arsenicosis patients at Upazila Health Complex

Dug well and sand filter

Arsenic iron removal plant

Project Outcomes

- ✓ The ability of residents to implement arsenic pollution control measures will be improved.
- ✓ Arsenic countermeasure activities are coordinated by the Arsenic Mitigation Committee.
- ✓ DPHE will provide technical support for the installation and maintenance of alternative water sources, which will be constructed based on the decision of the Arsenic Mitigation Committee.
- ✓ The health conditions of arsenic poisoning patients are managed by medical personnel (district hospitals).

Key Indicators/Generated Impacts

- ✓ The number of residents who obtained access to safe drinking water. (30,850 people after the project)
- ✓ The number of well-maintained alternative water sources that have been installed. (out of 151 water sources constructed, 128 sources were still used by communities, operated and managed by users' management committee 5 years after the completion of the project)
- ✓ The number of registered arsenic poisoning patients with the health card and frequency of seeing doctors. (after the project, 1,165 people were registered as arsenic poisoning patients, and the number of patients increased to 1,648 people 5 years after the completion of the project. All of them possess health cards to record their health conditions.)
- ✓ Monitoring activities by the maintenance committee (such activities were continued by arsenic mitigation committees, and were handed over to the development coordination committee in 2010.)

Lessons Learned

- ✓ Compared to surface water, groundwater is more reliable as the water source in terms of the amount of discharge.
- ✓ Some wells showed a lowering water table, dense arsenic, or no water during the dry season and those were abandoned.

(Presently, a countermeasure against arsenic contamination only is not considered effective to be a project. Sanitation and/or rural development should be also combined.)

Approach (3): Reducing Health Damage Caused by Arsenic-contaminated Drinking Water with Residents and Hospitals

Developed Tools and Guidelines

- ✓ Guidelines on participatory arsenic mitigation
- ✓ Handbooks for flameworking of sustainable mitigation of arsenic contamination

Devises for Ensuring Sustainability

- ✓ Securing budget for planning and maintenance
- ✓ Collection of maintenance costs from the user for the small-scale water source such as the arsenic iron removal plant. (in any case, there are a certain number of people who do not pay for maintenance, and it is crucial for small-scale water sources.)
- ✓ Utilization of technical handbook among staff to avoid discontinuation of knowledge caused by transfer of personnel
- ✓ Technical assistance from mechanics of DPHE for the maintenance of the water sources and assistance on enlightenment activities
- ✓ F/S and Installation of new water sources by DPHE

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Promoting the health condition of beneficiaries by improving drinking water
- ✓ Reduction of water fetching labor and cost (especially for women and children)
- ✓ Increment of income (e.g., sewing at home)

Project Information Relevant to the Approach

Title: Project for Sustainable Mitigation of Arsenic Contamination under the Integrated Local Government System

Scheme: Technical Cooperation

Project Period: December 2005 to December 2008

Implementing Agencies: LGD, DPHE, UHC, Asia Arsenic Network (AAN)

Related URL:－

Acknowledgment for Interview Meeting: Mr. Sayed A. H. Sunny, Program Officer, Asia Arsenic Network, Ms. Mahbuba Munmun, Executive Engineer, DPHE

Approach (4): Securing Safe Water Resources in Rural Areas Based on Water Potential

1. Outline and Features of the Approach

Summary of Approach

To increase the number of safe water resources and provision in rural areas where the rate of safe drinking water coverage ratio is relatively low, the water resource management system, water development planning, and operation and maintenance capacity are strengthened. This approach mainly consists of the following:

- Improving planning, construction, and management methods of water supply facilities in rural Bangladesh areas
- Delivering a strategic action plan for drinking water supply in line with the sector risk development plan
- Demonstration of selection of water sources and improvement of construction skills
- Improving skills and organization structures in monitoring and surveillance

Keyword:

Rural village, rural city, Pourashava, water supply, DPHE, medium-term plan, long-term plan, water resource potential map (surface water, groundwater, rainwater, Division, Upazila), pipe water supply facilities, point water supply facilities, water supply project, planning, organizational structure, financial planning, monitoring, training

2. Project Delivering the Approach (Project for Improvement of Comprehensive Management Capacity of Department of Public Health Engineering on Water Supply (Phase 1 and 2))

Introduction

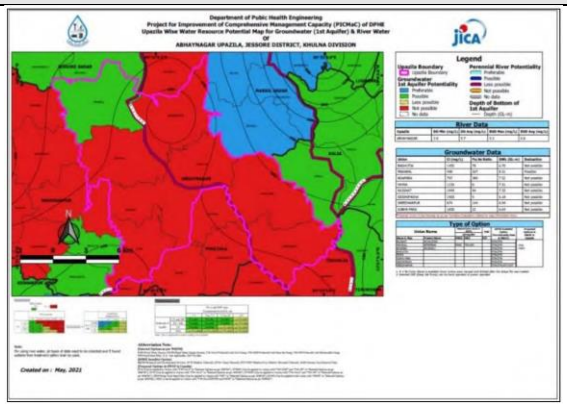
Bangladesh has made significant progress in improving access to water and sanitation, with 98 percent of the population accessing water from technologically improved sources. However, the water quality is still poor, and approximately 40% of improved water sources are said to be contaminated with E. coli. Nature-originated arsenic in groundwater also affects people, with about 13 percent of the country's water sources containing levels above the standards in Bangladesh (Promising Progress: A Diagnostic of Water Supply, Sanitation, Hygiene, and Poverty in Bangladesh, World Bank, 2018). In addition, the risk to safe drinking water provision in Bangladesh is high, such as salt intrusion in coastal areas. Under such circumstances, climate change is increasing the intensity and frequency of natural disasters that disrupt water and sanitation services, making the provision of safe drinking water an urgent issue.

Small-scale piped public water supply facilities in Ghazipur district

Key Activities

Improving planning, construction, and management methods of water supply facilities in rural areas

- ✓ Data collection on the present situation of planning, construction, and management of water supply
- ✓ Setting of work items in planning, construction, and management phases
- ✓ Extracting issues and delivering solutions on organizations and regulations.
- ✓ Data collection on the present situation of data management systems



Sample of Upazila water resource potential map

Approach (4): Securing Safe Water Resources in Rural Areas Based on Water Potential

- ✓ Creation of the data platform with training in its application

Delivering a strategic action plan for drinking water supply in line with the sector risk development plan

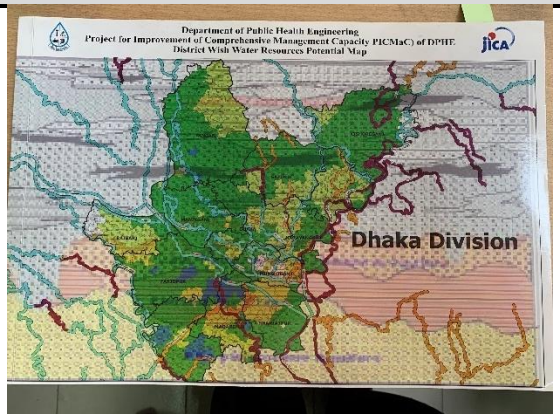
- ✓ Creation of water potential map
- ✓ Collection of socio-economic data
- ✓ Quantity calculation and rough cost estimation for water supply facilities for rural and Pourashava area

Demonstration of selection of water sources and improvement of construction skills

- ✓ Selection of a pilot area and data collection on the present situation of water supply
- ✓ Training in the selection, plan, and construction of water supply facilities at the pilot area

Improving skills and organization structures in monitoring and surveillance

- ✓ Data collection of the present situation and regulations of monitoring and surveillance
- ✓ Setting up the basic activities of monitoring and surveillance and data management method
- ✓ Training in those applications



District-wise water resource potential map report

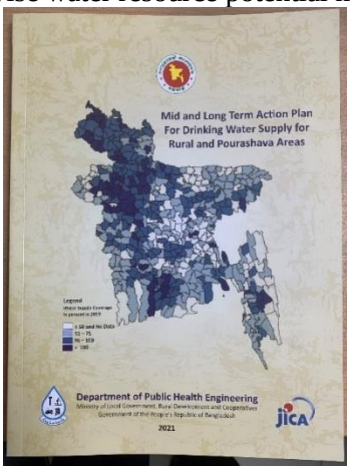


Photo of mid and long-term action plan for drinking water supply for rural and Pourashava areas

Project Outcomes

- ✓ "Comprehensive technical guidelines for water supply in rural areas" are developed.
- ✓ Information systems related to water supply in rural areas are strengthened.
- ✓ A "medium- and long-term action plan for drinking water supply for rural and Pourashava areas" for DPHE is prepared in accordance with the sector development plan.
- ✓ Technical skills related to water source development and appropriate water supply facility selection are improved.
- ✓ Monitoring and surveillance activities are conducted.
- ✓ Staff from DPHE headquarters and district offices will acquire general knowledge about the operation and maintenance of piped water supply systems.

Key Indicators/Generated Impacts

Water Supply Service

- ➢ Supply and demand for safe drinking water services
- ➢ Implementation efficiency of DPHE water supply projects (budget execution rate)
- ➢ The operation rate of water supply facilities developed by DPHE

Preparation of Guidelines

- ➢ Guidelines application rate
- ➢ Application rate and update activities of water resource potential map when proposing water supply facilities
- ➢ The number of participants in a guideline dissemination seminar

Training

- ➢ The number of participants in training related to facility selection
- ➢ The number of participants in training on pipe water supply systems

Approach (4): Securing Safe Water Resources in Rural Areas Based on Water Potential

Lessons Learned

- ✓ Regular data acquisition in DPHE and from related organizations, e.g., meteorological data, socio-economic data, and data from monitoring and surveillance is the basis of planning, designing, construction, and management.
- ✓ The guidelines and data acquisition rules compiled during the project should be also used continuously after the project.
- ✓ Technical transfer in DPHE should be promoted more.

Developed Tools and Guidelines

- ✓ Comprehensive technical guidelines for water supply in rural areas
- ✓ Medium- to long-term implementation plan
- ✓ Manual for rural areas technical support regarding pipe water supply operation and maintenance management
- ✓ Training programs

Devises for Ensuring Sustainability

- ✓ Continuous use of information management system and clarification of management responsibilities
- ✓ Securing the information, engineers, and funds necessary to update the water resource potential maps
- ✓ Regular monitoring and surveillance activities are conducted and well-managed.
- ✓ Organizational reorganization from the Groundwater Circle to the Water Resources Circle, taking into consideration the shift from the use of groundwater to the use of surface water.
- ✓ Reflecting medium-term plans results in long-term plans
- ✓ Securing maintenance and management engineers for excavators, etc.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Promoting the health of residents in the rural areas by improving drinking water

Project Information Relevant to the Approach

Title: Project for Improvement of Comprehensive Management Capacity of Department of Public Health Engineering on Water Supply (Phase 1 and 2)

Scheme: Technical Cooperation

Project Period: December 2014 to June 2021 (Phase 1), February 2022 to March 2025 (Phase 2)

Implementing Agencies: DPHE, BWDB (BWDB provides river water information)

Related URL:
Report in English
(Phase 1) https://libopac.jica.go.jp/images/report/P1000045447.html
General Info (in Japanese)
(Phase 1) https://www.jica.go.jp/oda/project/1200032/index.html
(Phase 2) https://www.jica.go.jp/oda/project/2003684/index.html

Acknowledgment for Interview Meeting: Ms. Mahbuba Munmun, Executive Engineer, DPHE

Approach (5): Flash Flood Measures and Livelihood Improvement in Haor Areas

1. Outline and Features of the Approach

Summary of Approach:

In order to mitigate flash flood damage and adapt to climate change impacts in the Haor area, this approach develops submersible embankments and roads and provides agriculture and fishery support to protect Boro rice cultivation from flash flood damage and improve the quality of life and livelihood of local communities in the area. This approach involves communities from the planning stage to the O&M stage and also motivates them by providing livelihood support so that the ownership of the communities is strengthened for better stricture maintenance and sustainability.

This approach mainly consists of the following:

- Developing and periodical updating a river management plan for the entire Haor area (scientific and fair investment for mitigation and ensuring effectiveness)
- Design and construction of strong and economical flood mitigation structures
- Strengthening agricultural and fishery promotion activities for sustainable infrastructure operation, poverty reduction, and climate resilience.

Keyword:

Haor area, monsoon season, pre-monsoon season, river embankment, submersible embankment, river management plan, hazard assessment, risk assessment, qualities of design and construction, rural infrastructure, agriculture, and fishery promotion

2. Project Delivering the Approach (Haor Flood Management and Livelihood Improvement Project)

Introduction

Boro rice is a crucial crop for Bangladesh's self-sufficiency in food production and it is a valuable source of income for the residents in the Haor area. In the Haor area, flood damage on Boro rice caused by the flash floods in the pre-monsoon season is severe and significantly reducing yields.

In addition, there are many direct damages such as damage to the submersible embankment due to overflow, to the residential buildings due to flooding above and below the floor level, and indirect damage such as traffic cutoffs due to submerged roads.

Climate change raises such flood risks, and the implementation of countermeasures is an urgent issue.

Damage to the submersible embankment due to overflowing water

Key Activities

Review of existing flood control master plan and projects to propose improvement

- ✓ Proposing a river management planning method for the entire Haor area
  - Flood hazard and risk assessment
  - Economic evaluation of structural measures
- ✓ Proposals for improvements in the design and construction of embankments and sluice gate structures
  - Design of safe submersible embankments, foundation materials, and compilation of standards

Implementation of priority projects in the flood control/river management plan in the Haor area (Kishoreganj, Habiganj, Netrakona, Sunamganj, Brahmanbaria districts)

Constructed submergible embankment

Approach (5): Flash Flood Measures and Livelihood Improvement in Haor Areas

- ✓ Structural measures: Selection of 29 projects (based on the results of the above risk assessment and economic evaluation study)
- ✓ Non-structural measures: (1) Planning and implementation of flood evacuation shelters/markets with consideration for users, (2) Survey of seed and food banks, (3) Crop diversification and improved access to markets to reduce damage caused by flash floods, (4) Popularization of beel fishing

Implementation of the yen loan project

- ✓ Rehabilitation and construction of flood prevention facilities (levees, submersible embankments, drainage channels, sluices, etc.) (BWDB)
- ✓ Improvement and new construction of rural infrastructure (submersible roads, rural markets, docks, etc.) (LGED)
- ✓ Construction supervision
- ✓ Agriculture and fishery promotion activities (various support contributing to productivity improvement, BWDB for agricultural activities, LGED for fishing activities)

Agriculture Promotion Support

- ✓ Field program (adaptive trial of new varieties, field demonstration on improved agricultural practices, etc.)
- ✓ Farmer training program (farming skills, farmers' organization strengthening, etc.)
- ✓ Field staff in a farm field school empowerment
- ✓ Small-scale farmer support
- ✓ Farm machinery support
- ✓ Technology development

Support for residents

- ✓ Provision of Operation and Maintenance guidelines and training for residents
- ✓ Construction and opening of maintenance office
- ✓ Opening of a bank savings account for maintenance

Adaptive trial of BRRI dhan-67


Damaged sluice gate


Sluice gate

Project Outcomes

- ✓ River embankment (67 km), submergible embankment (323 km), and other river structures are implemented (125 new regulators were installed. 86 gates and other structures were repaired).
- ✓ Rural infrastructure is improved.
- ✓ A water management group is formed and functioning (305 water management groups were formulated during the project implementation.).
- ✓ The annual maximum inundation area will decrease.
- ✓ Crops and fishing species will diversify, and Boro rice yields and fishing catches will increase.
- ✓ The income of the households in the protected area will be increased by utilizing the assets (sewing machine, solar panel, livestock, etc.) provided.

Approach (5): Flash Flood Measures and Livelihood Improvement in Haor Areas

Key Indicators/Generated Impacts

Flood measures

- ✓ Annual maximum area inundated by floods (e.g., the annual maximum inundation area in the pre-monsoon season was reduced from 36% in 2015 to 18% in 2023)
- ✓ Water management group activity status

Rural infrastructures

- ✓ Annual average daily traffic volume (e.g., the annual average daily traffic increased from 804 nos/day in 2015 to 1,901 nos/day in 2023)
- ✓ Average travel time between cities

Agriculture and fishery promotion

- ✓ Boro rice yield and diversity of crops produced (e.g., the Boro rice production increased from 3.7 tons/ha in 2015 to 5.1 tons/ha in 2023)
- ✓ Fish catch and fish species diversity
- ✓ Average household income and assets held by farmers and fishermen

Lessons Learned

- ✓ It is important to categorize the type of slope and foundation protection of embankment taking into account natural conditions such as waves and direction of water flow for efficient investment.
- ✓ The period for land acquisition is unpredictable since it is conducted by a district authority, which is independent of the project implementing agencies.
- ✓ Close communication with residents is important not only for the maintenance activities of the structures but also for the design of the river structures such as the causeway.

Developed Tools and Guidelines

- ✓ Northeast region model (updated version)
- ✓ Construction material standards (embankments)
- ✓ Operation and Maintenance guidelines for residents

Devises for Ensuring Sustainability

- ✓ Securing maintenance costs and maintenance activities
- ✓ Close communication with residents is important not only for the maintenance activities of the structures but also for the design of the river structures such as the causeway.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Participation of community-level (union) representatives in stakeholder meetings and planning workshops.
- ✓ As part of agricultural and fishery promotion activities resulting in income increase, provide technical assistance related to vegetable and fruit cultivation and aquaculture for very small-scale farmers (land ownership area of 1 acre or less), agricultural workers, and poor households headed by women.
- ✓ By outsourcing minor construction and repairs to LCS (Labor Contracting Society), which is mainly made up of poor women, employment opportunities for local poor women will increase their income.

Project Information Relevant to the Approach

Title: Haor Flood Management and Livelihood Improvement Project

Scheme: Japanese Yen Loan

Project Period: June 2014 to June 2023

Implementing Agencies: BWDB, LGED

Related URL: https://www.jica.go.jp/Resource/bangladesh/english/activities/activity14_01_06.html (General Info)

Acknowledgment for Interview Meeting: Mr. Md. Asaduzzaman, Project Director, BWDB, Mr. Md Rayhan Shiddique, Project Director, LGED, Consultant: Mr. Md Fakhrul Abedin Co-Team Leader-02, Nippon Koei Co., Ltd.

Approach (6): Sustainable Flood Mitigation Infrastructure Development

1. Outline and Features of the Approach

Summary of Approach:

This approach aims to ensure the flood control function, improve the efficiency of maintenance and management, and reduce life cycle costs. To support this, various manuals are prepared and a pilot project for embankment rehabilitation is conducted. With such implementation of a pilot project, a suitable design for sustainable water-related structures is studied. An action plan was also created to disseminate and efficiently use various manuals.

This approach mainly consists of the following:

- Preparation and dissemination of river embankment design manuals
- Preparation and dissemination of river embankment construction manuals
- Preparation and dissemination of river structure maintenance and management manuals

Keyword:

Embankment, riverbank erosion, flash flood, local scouring, piping, design manual, construction manual, maintenance manual, action plan, embankment rehabilitation, pilot project, GIS database

2. Project Delivering the Approach (The Project for Capacity Development of Management for Sustainable Water Related Infrastructure)

Introduction

In Bangladesh, many flood disasters occur and some of the reasons are the insufficient design and maintenance of embankments. BWDB had constructed 11,393 km of the embankment (as of 2017), and there are still some challenges in the maintenance of the embankment. For example, the maintenance and management standards have not been clear enough, and repeated rehabilitation work has been required. In addition, climate change raises flood risks, and the implementation of countermeasures is an urgent issue. In order to improve these conditions, there was an urgent need to establish standards for the design, construction, and maintenance of river structures.

This approach meets with the code “WRM10” in NAP IP, or “Protection against flash floods, wave action, erosion, and sedimentation”, “WRM 14”, or “River management through bank stabilization and other ancillary works” and contributes to the country's climate change adaptation measures.

Sediment collection at riverbank erosion site in Mymensingh on the right bank of the old Brahmaputra River

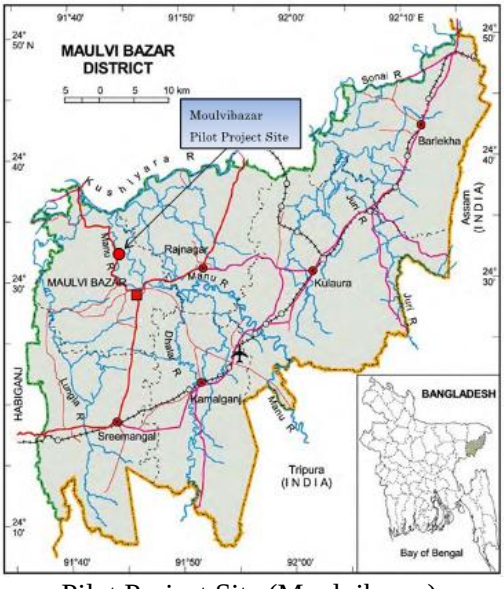
Key Activities

Introduction of sustainable embankment design methods reflecting the existing damage information

- ✓ Review of existing embankment design standards and extraction of issues
- ✓ Preparation of embankment design manual
- ✓ Application of the manual in the implementation of pilot projects
- ✓ Reflecting the knowledge of the pilot project in the manual

Improvement of locally applicable embankment construction method

- ✓ Review of existing embankment construction methods and extraction of issues
- ✓ Consideration of appropriate construction methods based on material tests, etc.
- ✓ Preparation of embankment construction manual



Pilot Project Site (Moulvibazar)

Approach (6): Sustainable Flood Mitigation Infrastructure Development

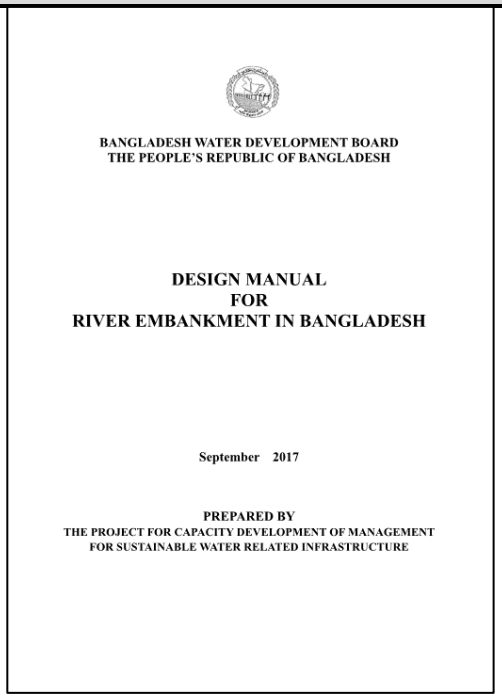
- ✓ Application of the manual in the implementation of pilot projects
- ✓ Reflecting the knowledge of the pilot project in the manual

Ensuring maintenance and management systems for river structures

- ✓ Review of existing maintenance management methods and extraction of issues
- ✓ Preparation of maintenance management manual
- ✓ Select local offices and conduct river structure maintenance and management activities on a trial basis based on the manual
- ✓ Reflecting knowledge from trial maintenance activities in the manual
- ✓ Creation of a GIS database of disaster damage information and rehabilitation history in selected regional office jurisdiction areas

Disseminating various manuals and considering their efficient use

- ✓ Holding seminars/workshops/training
- ✓ Development of an action plan



BANGLADESH WATER DEVELOPMENT BOARD
THE PEOPLE'S REPUBLIC OF BANGLADESH

DESIGN MANUAL
FOR
RIVER EMBANKMENT IN BANGLADESH

September 2017

PREPARED BY
THE PROJECT FOR CAPACITY DEVELOPMENT OF MANAGEMENT
FOR SUSTAINABLE WATER RELATED INFRASTRUCTURE

Design Manual

Slope Protection of Embankment at Pilot Project Site

Project Outcomes

- ✓ Embankment was constructed at the Pilot Project site (L = 230m, Slope = 1:2.0, berm width = 2.0m)
- ✓ Sustainable embankment design methods will be introduced.
- ✓ The construction process of embankments will be improved.
- ✓ A maintenance system for river structures will be developed.

Key Indicators/Generated Impacts

- ✓ Reducing damage caused by floods
  - ➢ Records of river structures constructed and maintained based on the created manual
- ✓ Damage Records of river structures constructed and maintained without reference to manuals
- ✓ Maintenance of the manuals
  - ➢ The number of offices that have adopted the manual
  - ➢ The number of offices that adopt the action plan
  - ➢ The number of seminars and workshops held
- ✓ The number of GIS databases maintained

Approach (6): Sustainable Flood Mitigation Infrastructure Development

Lessons Learned

- ✓ Traditional design methods in civil engineering are more practical than the ones with the latest numerical analyses.
- ✓ Accumulation of data on damaged structures by flood is essential to designing resilient river structures reflecting the features of the rivers.
- ✓ Most of the embankment damage was caused by the damage on the high riverbed in the rivers on a similar scale.

Constructed Embankment in the Pilot Project

Developed Tools and Guidelines

- ✓ River embankment design manual (based on construction materials and construction methods in the target area)
- ✓ Construction manual for river embankments (based on construction materials and construction methods in the target area)
- ✓ Maintenance and management manual for river structures (based on construction materials and construction methods in the target area)

Devises for Ensuring Sustainability

- ✓ Securing maintenance costs and maintenance activities

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Provide employment opportunities to local low-income women, increasing their income by outsourcing minor construction and repairs to LCS (Labor Contracting Society), which usually and mainly comprises low-income women.

Project Information Relevant to the Approach

Title: The Project for Capacity Development of Management for Sustainable Water Related Infrastructure

Scheme: Technical Cooperation

Project Period: August 2013 to October 2017

Implementing Agencies: BWDB

Related URL:
Final Report - Project Completion Report
https://libopac.jica.go.jp/images/report/12292561.pdf
Final Report – Main Report
https://openjicareport.jica.go.jp/pdf/12292579_01.pdf
https://openjicareport.jica.go.jp/pdf/12292579_02.pdf
https://openjicareport.jica.go.jp/pdf/12292579_03.pdf
Final Report – Annexes
https://libopac.jica.go.jp/images/report/12292587_01.pdf
https://libopac.jica.go.jp/images/report/12292587_02.pdf
General Info
https://www.jica.go.jp/oda/project/1200027/index.html

Acknowledgment for Interview Meeting: Dr. Shamal Chandra Das, BWDB, Mr. Md. Jabed Iqbal, Executive Engineer, O&M Division, BWDB, Moulvibazar

Approach (7): Flood Mitigation Method and Planning Suitable for Various/Diverse-scale Rivers

1. Outline and Features of the Approach

Summary of Approach:

This approach establishes tools for systematic and diverse river control and planning for large-scale rivers and flood mitigation planning methods for middle and small-scale rivers. This approach mainly consists of the following:

- Selection of river channel control methods for large low-lying rivers (e.g., Jamuna River), development of river training tools for selection and maintenance of river structures
- River shape monitoring works for large low-lying rivers
- River flood mitigation planning for relatively small rivers (e.g., Karnafuri, Sang, and Matamufuri river scale)

Keyword:

Major rivers, small rivers, river management planning, master plan, river channel planning, structure design, maintenance management, knowledge tools, River Training Methodology (RTM), training

2. Project Delivering the Approach (Project for Planning Capacity Enhancement and Establishment of a Technology Adaptation Cycle on Comprehensive Nodi (River) Management)

Introduction

Generally, for rivers, the goal of river management in terms of disaster management should be to promote flood mitigation prior to disasters and stabilize the river overall. However, in Bangladesh, the focus of disaster mitigation activities is a post-disaster response, and the response tends to be conducted locally. As a result, repeated rehabilitation work has been required and river management investments tend not to be utilized efficiently. Furthermore, many rivers do not have river management plans. Amid the rising flood risk caused by climate change, river development and management based on scientific planning and evaluation are required.

This approach meets with the code "WRM 18" in NAP IP, or "Planned, participatory and coordinated land and water resources management" and contributes to the country's climate change adaptation measures.

Photo of Matamuhuri River with embankment and abandoned gate

Key Activities

Selection of river channel control measures for large low-lying rivers and development of river training tools for the selection and maintenance of river structures

- ✓ Gathering information on the natural environment, social conditions, etc. necessary for river management
- ✓ Preparation of handbook related to technical tools (creation of river structure register, collection of examples from similar rivers)
- ✓ Development of river management methods using river channel control methodologies

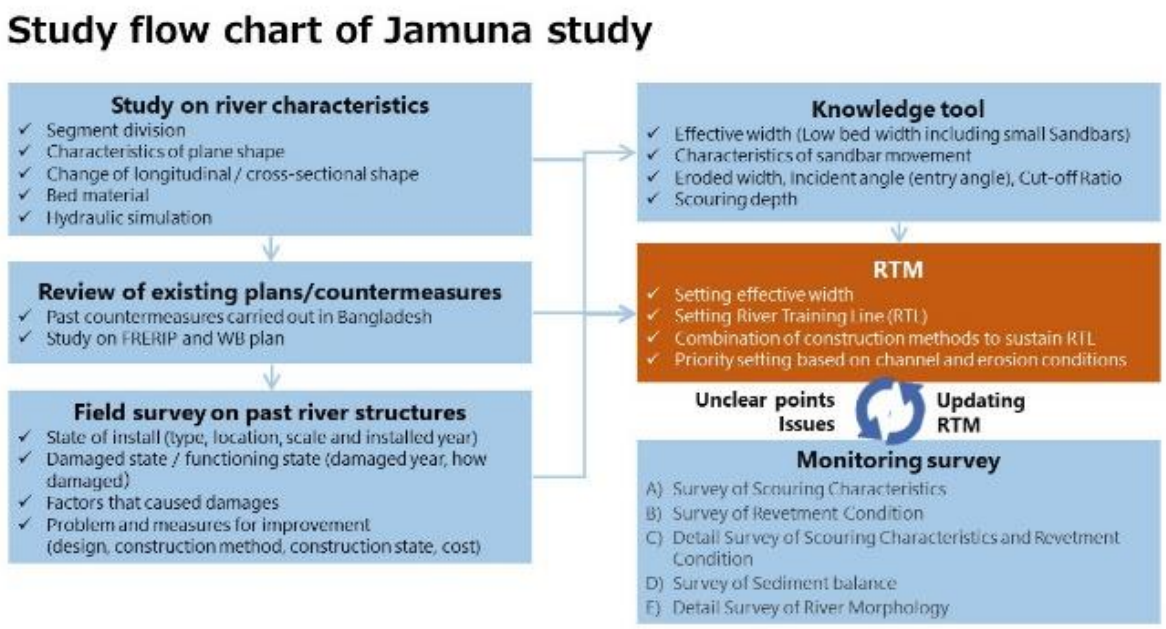
River shape monitoring works for large low-lying rivers

- ✓ Cross-section survey at a curved area, spatial sedimentation measurements, underwater scanning to comprehend the scouring depth, effect of bank protection foundations (geo-bags, concrete blocks), etc.

River flood mitigation planning for relatively small rivers

- ✓ Review of current planning status and selection of model basins
- ✓ Examination and proposal of river flood mitigation methods based on Japanese river planning methods (design discharge, design high water level, river channel alignment, sediment control, etc.) and taking into account the characteristics of rivers in Bangladesh (low water levels in the dry season, etc.).

Approach (7): Flood Mitigation Method and Planning Suitable for Various/Diverse-scale Rivers



River Training Methodology (RTM) in the River Management Flow

Project Outcomes

- ✓ BWDB selects the most effective river control method for each river.
- ✓ Knowledge tools are developed to efficiently install and maintain river structures, to be utilized by BWDB.
- ✓ BWDB etc. can create comprehensive river development and management plans for each river.

Key Indicators/Generated Impacts

- ✓ A data collection framework (collection system, collaboration with other organizations, etc.) is established.
- ✓ Training for RTM utilization is regularly conducted. (The number of training sessions)
- ✓ Usage status of the handbook when creating a Development Project Proposal (The number of usages at central and local offices)
- ✓ The number of DPPs proposed based on the comprehensive river management
  The number of employees who can utilize the knowledge tools in river management

Lessons Learned

- ✓ The technical evaluation of the river channel management in a large-scale river requires a large amount of budget. Even in a pilot project, the size of the structure becomes fairly large, so as does the budget.
- ✓ The related organizations and stakeholders should communicate with each other to align their strategies and plans for the improvement and development of the target areas in a formal way, e.g., in a river management committee.

Embankment of Sangu River

Approach (7): Flood Mitigation Method and Planning Suitable for Various/Diverse-scale Rivers

Developed Tools and Guidelines

- ✓ RTM (River Training Methodology) Operation Handbook
- ✓ Knowledge tools (evaluation of river channels using Channel Unstable Index, confirmation of changes in CUI over time, etc.)

Devises for Ensuring Sustainability

- ✓ Approval of knowledge tools and RTM operations within BWDB
- ✓ Institutional arrangement for data collection with such relevant partners is continuously conducted.
- ✓ Handbooks, knowledge tools, etc. will be utilized for a succession of technology that is not affected by personnel transfers or low budget allocation.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Because women and low-income people have a hard time raising their voices and are more susceptible to flooding and water use, consideration needs to be given to stakeholder discussions, such as setting up Focus Group Discussions (FGD) for women and other relevant low-income people only.

Project Information Relevant to the Approach

Title: Project for Planning Capacity Enhancement and Establishment of a Technology Adaptation Cycle on Comprehensive Nodi (River) Management

Scheme: Technical Cooperation

Project Period: September 2020 to August 2024

Implementing Agencies: BWDB

Related URL:
General Info (Japanese)
https://www.jica.go.jp/oda/project/1900519/index.html
Press release on signing of Record of Discussion
https://www.jica.go.jp/Resource/english/news/press/2019/20200316_31_en.html

Acknowledgment for Interview Meeting: Mr. Abdul Basit, Superintending Engineer, BWDB

Approach (8): Upazila-level Disaster Risk Reduction Planning and Implementation

1. Outline and Features of the Approach

Summary of Approach:

The formulation of disaster risk reduction plans that reflect local disaster characteristics and their implementation through smooth coordination among relevant agencies are useful in managing disaster risks effectively at the local level. In particular, it is important to understand local disaster risks properly by sharing knowledge among local-level stakeholders such as Upazilas and Unions, to plan pre/post-disaster activities based on the understanding, and to monitor their implementation. The approach consists primarily of the following:

- Upazila-level disaster hazard and risk assessment;
- Enhancement of Upazila-level project coordination system involving the Department of Disaster Management (DDM) and its local offices, District/Upazila Disaster Management Committees (DMCs), and other relevant organizations;
- Formulation of practical Upazila-level disaster risk reduction plans in collaboration with relevant ministries, agencies, and local governments.

Keyword:

Local disaster risk reduction plan, hazard and risk assessment, disaster management committee, central and local cooperation, inter-agency collaboration

2. Project Delivering the Approach (Project for Capacity Enhancement on Formulation and Implementation of Local Disaster Risk Reduction Plan)

Introduction

The concept of pre-disaster risk reduction has been gradually disseminated in Bangladesh. In order to prevent future damage by disasters, especially at the local level, the effort needs to be scaled up. It is necessary to plan and implement appropriate disaster risk reduction measures based on an understanding of disaster risks at each locality, with sufficient prior coordination among relevant agencies based on accurate and objective information. In light of the above situation, the Local Disaster Risk Reduction Planning and Implementation Project is being implemented to strengthen the disaster risk reduction capabilities at the Upazila level.

Damage to local roads due to flooding at Cox's Bazar

Key Activities

Upazila-level Hazard and Risk Assessment

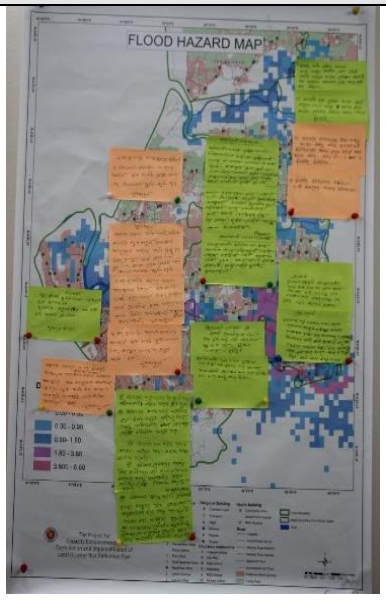
- ✓ Development of hazard and risk assessment methods applicable to Upazila Disaster Risk Reduction Planning (UzDRRP)

Establishment of Planning Coordination Bodies including DDM and Other Relevant Organizations

- ✓ Establishment of a Technical Sub-Committee (TSC) at the central level to discuss the selection of measures and implementation procedures of UzDRRPs
- ✓ Formulation of Upazila Sub-Committee (UzSC) to identify the contents and activities required for UzDRRP.

Practical UzDRRP Planning, Monitoring, and Revision

- ✓ Planning of structural measures and non-structural measures by UzSC to reduce disaster risk in pilot areas
- ✓ Review the implementation status of UzDRRP by utilizing the existing monitoring system and revise the plan by the District Disaster Management Committee (DDMC) and Upazila Disaster Management Committee (UzDMC) if necessary.



Discussion of risk areas based on hazard maps

Approach (8): Upazila-level Disaster Risk Reduction Planning and Implementation

Project Outcomes

- ✓ The system and methods of hazard and risk assessment for UzDRRP are developed.
- ✓ The institutional arrangement is developed in DDM to support the formulation of UzDRRP.
- ✓ Practical UzDRRP is developed at pilot sites in collaboration with relevant ministries and local governments.
- ✓ The capacity of local NGOs in disaster risk reduction planning is strengthened.
- ✓ The mechanism is established to expand the formulation of UzDRRPs nationwide.

Key Indicators/Generated Impacts

- ✓ Number of UzDRRP developed and approved by UzDMC
- ✓ Number of reports of hazard and risk assessments
- ✓ The budget for the projects is developed and executed in accordance with UzDRRP
- ✓ The nationwide development plan is prepared and submitted to MoDMR

Lessons Learned

- ✓ Continuous involvement of central government agencies from the early stage of activities to ensure smooth coordination between local disaster risk reduction plans and ongoing/future projects by central government agencies.
- ✓ Facilitation of Upazila-level project coordination meetings (UzSC) is important for smooth consensus building with communities on the selection of priority projects based on an understanding of disaster risk.

Workshop on the local hazard assessment at Cox's Bazar

Developed Tools and Guidelines

- ✓ Guideline for Preparation of Local Disaster Risk Reduction Plan
- ✓ Guideline for Local Disaster Hazard and Risk Assessment

Devises for Ensuring Sustainability

- ✓ It is important to monitor the implementation status of the prepared plans and update periodically as necessary by the Upazila Disaster Management Committee and relevant agencies to ensure the viability of the plans.
- ✓ The experience and knowledge in disaster risk assessment and planning should be accumulated in the Department of Disaster Management in order to strengthen the institutional capacity. That is vital for the nationwide roll-out and continuous updating of local disaster risk reduction plans.
- ✓ Union-level representatives who are familiar with local circumstances should be involved in the UzSC.
- ✓ It is also important to involve local consultants and NGOs who know well about the local situation in the facilitation of local-level coordination meetings and promote their capacity enhancement for the further dissemination and elaboration of local disaster risk reduction planning.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Group, Environment and Climate Change Adaptation, etc.)

- ✓ Enhancement of residents' understanding of disaster risk through discussions on the consistency and complementarity of indigenous disaster knowledge with the results of scientific and quantitative risk analysis.

Project Information Relevant to the Approach

Title: Project for Capacity Enhancement on Formulation and Implementation of Local Disaster Risk Reduction Plan

Scheme: Technical Cooperation

Project Period: From December 2020 to July 2025

Implementing Agencies: DDM, DRRO, PIO, Upazila DMC, District DMC

Approach (8): Upazila-level Disaster Risk Reduction Planning and Implementation
Related URL: https://www.jica.go.jp/oda/project/1900512/index.html (in Japanese only)
Acknowledgment for Interview Meeting: Mr.Firoz Uddin, Project Director, Department of Disaster Management

Approach (9): Disaster Risk Reduction Based on Collaboration among Residents' Self-help, Community Mutual-help, and Public-help

1. Outline and Features of the Approach

Summary of Approach:

This approach is to promote disaster risk reduction based on the spirit of "self-help", "mutual-help", and "public-help", which intend to raise the awareness of residents through disaster-related education in schools, to enhance the capacity of Disaster Management Committees (DMCs) established in local administrations, and to strengthen relationships among relevant stakeholders. The approach also provides opportunities to share disaster-related knowledge between residents and local government and to think about future disaster risk reduction to enhance the disaster preparedness of the community as a whole. The approach mainly consists of the following contents:

- School-based disaster education and awareness-raising
- Strengthening the functions of Union-level disaster management
- Strengthening the functions of Upazila-level disaster management
- Strengthening the cooperation between the District-, Upazila-, and Union-level DMCs

Keyword:

Disaster management committee, disaster education, cooperation between residents and government, DRR Olympic

2. Project Delivering the Approach (Mobilizing and Organizing Humanitarian Operations and Risk Reduction Activities in Disaster-prone Coastal Areas)

Introduction

Most of Bangladesh is low-lying terrain, less than 5 meters above sea level, making the country vulnerable to floods and cyclone-induced storm surges. In order to cope with disasters under such conditions, aside from infrastructure development such as shelter construction, it is important to strengthen "self-help" preparedness knowledge at the household level daily by providing disaster education at schools. Additionally, in order to strengthen community "mutual-help", it is essential to strengthen and activate the Union DMC, while the Upazila DMC, which is the higher administrative body of the Union, must function properly as "public-help" to build and activate relationships among relevant organizations.

Source: Jagrata Juba Sangha

Disaster awareness activities for local residents

Source: Shapla Neer

Rayenda Union disaster management committee

Key Activities

Disaster Education for Self-help

- ✓ Disaster education and awareness-raising programs for school students (including madrasas)

Strengthening of Community Mutual-help and Public-help

- ✓ Development and implementation of Union-level Disaster Management Plan following Standing Order on Disaster (SoD) of Bangladesh Government

Strengthening the Cooperation among Relevant Stakeholders

- ✓ Supporting local-level DMCs to establish effective coordination and conduct coordination meetings

Source: Shapla Neer

Boloybunia Union disaster management committee

Approach (9): Disaster Risk Reduction Based on Collaboration among Residents' Self-help, Community Mutual-help, and Public-help

- ✓ Conduct of "DRR Olympic" (Performance events by students on the theme of DRR)

Project Outcomes

- ✓ Disaster preparedness knowledge for Self-help is disseminated from schools to households and communities;
- ✓ Mutual-help mechanisms are established and functional in each Union community;
- ✓ Upazila/Union DMCs understand the needs of their communities and reflect them in disaster management administrative mechanisms;
- ✓ A collaborative mechanism between the District, Upazila, and Union DMCs is in place and functional.

Key Indicators/Generated Impacts

- ✓ More than 90% implementation of regular meetings of Union DMCs in line with SOD;
- ✓ More than 80% implementation of regular meetings of Upazila DMCs in line with SOD;
- ✓ More than 90% of students educated on disaster risk management by schools understand how to behave before and after a disaster. During Cyclone Bulbul in 2019, 94% of households with students who received disaster education sessions were found to have taken appropriate evacuation actions, such as bringing food, drinking water, and important documents.
- ✓ Upazila DMCs submit disaster management plans to District DMCs
- ✓ Union DMCs submit disaster risk management plans to Upazila DMCs

Lessons Learned

- ✓ Disaster education for students is significantly important. As they acquire knowledge about disaster preparedness, this knowledge can be transferred to their families and communities.
- ✓ It is often difficult to get stakeholders, especially government officials, deeply involved in community-level activities because of their busy schedules. It is necessary to explain the contents of the SOD and the role of each DMC in detail from the beginning of the activities and to share the importance of proper functioning of each DMC.
- ✓ Holding events that motivate stakeholders, such as the local DRR Olympics, is also effective in strengthening stakeholder involvement.

Source: Shapla Neer

Students performing a play on the theme of disaster risk reduction at the DRR Olympic

Developed Tools and Guidelines

- ✓ Disaster Preparedness Training Materials for Upazila/Union DMCs
- ✓ Disaster Preparedness School Education Materials
- ✓ Guidelines for Teachers on Disaster Preparedness Education

Devises for Ensuring Sustainability

- ✓ By involving young generations in the activities, community's disaster risk reduction capacity can be enhanced in a sustainable way as they will take initiatives in disaster risk reduction in the future when they grow up.
- ✓ By training teachers who can conduct disaster education sessions, a system to ensure the continuation of disaster education in schools was established.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ As the first local effort for fundraising, a soccer and badminton tournament event supported by donations from local residents was conducted. The funds raised were used for disaster management activities, with a portion of the funds set aside for emergency response in the event of a disaster.
- ✓ Regarding the promotion of women's involvement, efforts were made to consciously encourage women's participation as DMC members and to encourage them to speak up during the meeting.

Project Information Relevant to the Approach

Title: Mobilizing and Organizing Humanitarian Operations and Risk reduction activities in disaster-prone coastal Areas (MOHORA)

Approach (9): Disaster Risk Reduction Based on Collaboration among Residents' Self-help, Community Mutual-help, and Public-help
Scheme: Grassroots Technical Cooperation
Project Period: From October 2017 to June 2021
Implementing Agencies: Union DMC, Upazila DMC, District DMC, Shapla Neer Bangladesh, Jagrata Juba Shangha
Related URL: http://www.jjsbangladesh.org/jjs-organized-durjogmela-disaster-fair-in-participation-of-secondary-school-students-to-celebrate-national-disaster-preparedness-day-2019/
Acknowledgment for Interview Meeting: Ms. Tomoko Uchiyama, Shapla Neer Bangladesh, Mr. ATM Zakir Hossain, Jagrata Juba Shangha

Approach (10): Construction and Maintenance of Multi-purpose Shelters with Considerations for Gender and Educational Environment

1. Outline and Features of the Approach

Summary of Approach:

This approach aims to increase the number of people who can be evacuated during a cyclone by installing evacuation shelters in areas at high risk of cyclone damage. On the other hand, the shelters are designed to be as primary schools during normal times, thereby contributing to improving the learning environment for primary education. The shelters need to be designed in a gender-sensitive and evacuation-friendly manner. In addition, the shelters should be equipped with stable electricity and water supply. In terms of operation and maintenance, a sustainable maintenance system should be established with the participation of the Directorate of Primary Education (DPE), School Management Committee (SMC), and local residents as well as the Local Government Engineering Department (LGED).

- Development of gender-sensitive multi-purpose cyclone shelters
- Development of educational facilities that can function as schools by neighboring children in normal times
- Installation of solar panels and water utilization equipment to improve living conditions in shelters
- Appropriate maintenance of multi-purpose cyclone shelters with close collaboration and clear demarcation among public and community organizations

Keyword:

Cyclone shelter, multi-purpose, O&M, school education, gender-responsive

2. Project Delivering the Approach (Programme for Construction of Multipurpose Cyclone Shelters in the Area Affected by the Cyclone Sidr)

Introduction

In Bangladesh, large-scale cyclones have been hitting every few years, causing extensive damage in coastal areas. Though many efforts have been made to build cyclone shelters, there is yet a shortfall in the total number of cyclone shelters needed as described in the "Master Plan for the Development of Multi-Purpose Cyclone Shelters (1993)", prepared by the Government of Bangladesh in cooperation with United Nations Development Program (UNDP) and World Bank. Therefore, shelter development is considered to be one of the highest priorities to mitigate disaster impacts.

The Government of Bangladesh has been actively promoting the spread of primary education, and the net enrollment rate has been improving. However, while quantitative expansion of primary education services has been achieved, improving the quality of primary education is an important issue. Curriculum improvement, improvement of the physical learning environment, and awareness-raising activities to support schooling by communities at the village level are important. The use of cyclone shelters as school facilities during normal times could address the issue.

Cyclone shelter at Debpur, Kalapara Upazila (before Project)

Constructed Multi-purpose cyclone shelter at Debpur, Kalapara Upazila (after Project)

Approach (10): Construction and Maintenance of Multi-purpose Shelters with Considerations for Gender and Educational Environment

Key Activities

- ✓ Construction of cyclone shelters with multi-purpose functions
- ✓ Consideration of gender and better response in emergency situations to shelter facilities (separate toilets for men and women, rainwater catchment tanks, etc.)
- ✓ Installation of school education facilities (classrooms, teachers' rooms, warehouses, etc.)
- ✓ Proper maintenance and management by collaboration among LGED, DPE, and SMC.

Meetings with the school principal and school management committee

Project Outcomes

- ✓ The facilities function as cyclone shelters during disasters.
- ✓ The shelters serve as schools for neighboring children during normal times.
- ✓ The cyclone shelters are properly maintained.

Key Indicators/Generated Impacts

- ✓ It was confirmed that 14,000 residents within 1.5 km of the 12 multi-purpose cyclone shelters constructed were able to evacuate people affected to the shelters in case of emergency. As for the three multi-purpose cyclone shelters in Borgna District, when the cyclone hit Bangladesh in May 2013, more than 1,500 villagers were sheltered for an average of 1 to 2 days, dramatically reducing human losses.
- ✓ Since its completion in 2010, the three shelters in Borgna District have been used as public primary schools during normal times and can accommodate more than 800 students. The shelters are also used as nursery schools.

Lessons Learned

- ✓ Training and guidelines need to be developed regarding shelter operation and maintenance conducted by SMC and the community as well as LGED and DPE. In developing these operation and maintenance tools, it is important to keep in mind the management of facilities not only in times of disaster but also in normal times.
- ✓ Restrooms and other ancillary facilities need to be considered in a manner that reflects users' perspectives. Therefore, site selection of these facilities should be done in consultation with the local community.
- ✓ The installation of solar panels and rainwater harvesting will make shelter life more comfortable and motivate residents to evacuate.
- ✓ For rapid and safe evacuation, site selection for shelters should be evaluated based on road network conditions. If necessary, pavement conditions leading to shelters should be improved.
- ✓ In past projects, roads were not constructed with sufficient width for buses to pass through. It is important for smooth evacuation to have roads wide enough not only in front of the shelter but also in the surrounding areas of the shelter.

Classroom at Debpur, Kalapara Upazila (before Project)

Classroom at Debpur, Kalapara Upazila (after Project)

Developed Tools and Guidelines

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Approach (10): Construction and Maintenance of Multi-purpose Shelters with Considerations for Gender and Educational Environment

Devises for Ensuring Sustainability

- ✓ In addition to major repair works by government agencies, daily maintenance by the SMC is also important to ensure its functionality during emergencies.
- ✓ The Upazila Coordination Meeting (UCM) is held monthly, chaired by the Upazila Nirbahi Officer (UNO), and attended by LGED, SMC, and others to exchange opinions regarding shelter maintenance. However, there are cases where specific maintenance and management activities do not proceed due to a lack of budget. Providing funding on a continuous basis will be important to maintain the effectiveness of the facility.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ In normal times, the multi-purpose shelters are used as primary schools, contributing to the improvement of the learning environment for primary education.
- ✓ The buildings also serve as places to promote social activities in the community.

Project Information Relevant to the Approach

Title: Programme for Construction of Multipurpose Cyclone Shelters in the Area Affected by the Cyclone Sidr

Scheme: Grant Aid

Project Period: From June 2008 (E/N Signing) to August 2010

Implementing Agencies: LGED, DDM, DPE, SMC

Related URL: https://www.jica.go.jp/Resource/bangladesh/english/activities/activity14_01_01.html

Acknowledgment for Interview Meeting:
Mr. Gopal Krishna Debnath, Additional Chief Engineer, Local Government Engineering Department
Dr. Md. Nurul Amin Chowdhury Deputy Director, Planning and Development, Directorate of Primary Education

Approach (11): Development and Maintenance of Meteorological Radar Systems

1. Outline and Features of the Approach

Summary of Approach:

Extensive and detailed understanding of weather information in and around Bangladesh is critical for the prevention and mitigation of weather-related disasters. The approach is to develop, update, and maintain multiple meteorological doppler radar systems that cover the entire country of Bangladesh, which aim to contribute to the mitigation of damage caused by weather disasters such as floods and tropical cyclones through the enhancement of the meteorological observation network.

- Development and renewal of meteorological doppler radar systems
- Maintenance and management of meteorological doppler radar systems

Keyword:

Meteorological radar, weather forecasting, equipment upgrades, maintenance

2. Project Delivering the Approach ((1) Project for Improvement of Meteorological Radar System in Dhaka and Rangpur, (2) Project for the Establishment of the Meteorological Radar System at Moulvibazar, (3) Project for Improvement of Meteorological Radar System in Cox's Bazar, Khepupara)

Introduction

Bangladesh has five meteorological radar systems that have been developed through Japanese grant cooperation, enabling the Bangladesh Meteorological Department (BMD) to monitor meteorological phenomena occurring throughout the country and bordering areas. The BMD combines the data from these five radar systems with ground-based and high-altitude observations to produce weather forecasts and warnings. The BMD's weather radar observation network plays an important role in forecasting the dangers of natural disasters in advance and providing timely and accurate forecasts and warnings in order to take appropriate countermeasures.

As meteorological radar systems become obsolete with the passage of time after completion, it is necessary to renew the equipment, and regular maintenance is important. In order to maintain the functionality of the facility, not only is the maintenance and management of hardware important, but it is also necessary to secure and train human resources to ensure that the maintenance and management activities are carried out properly.

Overview of the Dhaka (Joydevpur) radar tower building

Doppler radar installed inside radar tower in Cox's Bazar

Key Activities

- ✓ Development and updating of meteorological Doppler radar systems
- ✓ Development and updating of data processing, communication, and display systems
- ✓ Maintenance and management of meteorological radar systems

Project Outcomes

- ✓ Development of meteorological observation systems
- ✓ Enhancement of cyclone and flood monitoring capacity

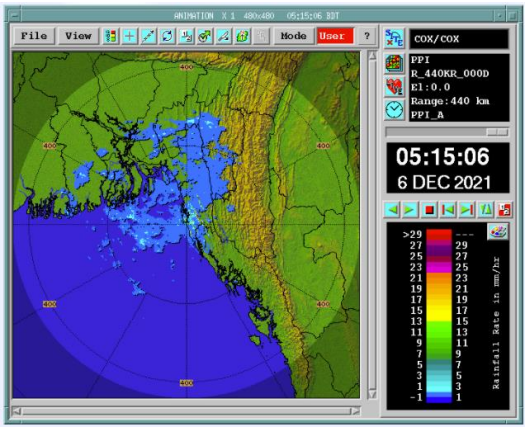
Approach (11): Development and Maintenance of Meteorological Radar Systems

Key Indicators/Generated Impacts

- ✓ Composite images of rainfall distribution over Bangladesh can be generated, resulting in real-time observation of nationwide rainfall distribution conditions at the Storm Warning Centre (SWC) and the Flood Forecasting and Warning Centre (FFWC).
- ✓ The updated meteorological radar makes it possible to obtain observation data every 30 minutes to an hour during the occurrences of cyclone.
- ✓ With the installation of the meteorological data satellite communication system, data is transmitted stably and quickly to the SWC in Dhaka, with an average transmission time of about 15 minutes. The SWC produces weather bulletins immediately upon receipt and distributes them to disaster management agencies and the media.

Lessons Learned

- ✓ The BMD's technical skills in troubleshooting for the system breakdowns have been steadily improving, but are still not sufficient, so the training of technical personnel from a long-term perspective is still required. Although the guidelines on maintenance management are in place, hands-on training through demonstrations and lectures would be effective in establishing skills.
- ✓ Since past equipment failures have been caused by unstable power supply, the radar systems need to be designed to be able to be operated by in-house power generation instead of private power generation as a measure to prevent similar problems.



Weather display system for radar images at the Storm Warning Center

Developed Tools and Guidelines

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Devises for Ensuring Sustainability

- ✓ The equipment and facilities were designed to minimize replacement parts and consumables to reduce operation and maintenance costs. Still, aging of the facilities is inevitable. Therefore, repair works should be carried out at the appropriate time.
- ✓ The BMD has been facing a shortage of young technical engineers, while senior technicians are retiring. In order to establish a reliable maintenance system, it is very important to assign sufficient number of skilled technicians.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ There are numerous stakeholders in weather information dissemination, including not only the BMD, but also other ministries and agencies, media, and NGOs. In order for weather forecasting and warnings to be effective, it is important not only to enhance and maintain the functions of the BMD but also to strengthen the capacity of local governments and residents, who are the recipients of the information, in addition to those related organizations.

Project Information Relevant to the Approach

Title: (1) Project for Improvement of Meteorological Radar System in Dhaka and Rangpur, (2) Project for the Establishment of the Meteorological Radar System at Moulvibazar, (3) Project for Improvement of Meteorological Radar System in Cox's Bazar, Khepupara

Scheme: Grant Aid

Project Period: (1) From June 2015 to April 2026, (2) From June 2007 to March 2009, (3) From July 2005 to February 2008

Implementing Agencies: BMD

Related URL:
https://www.jica.go.jp/Resource/bangladesh/english/activities/activity14_01_08.html
https://www.jica.go.jp/oda/project/0702800/index.html (in Japanese only)
https://www.jica.go.jp/Resource/bangladesh/english/activities/activity14_01_02.html

Approach (11): Development and Maintenance of Meteorological Radar Systems

Acknowledgment for Interview Meeting:
Mr. Ahmed Arif Rashid, Deputy Director (Engineering), Bangladesh Meteorological Department
Mr. Md. Mominur Rahman, Electronic Engineer, Bangladesh Meteorological Department

Approach (12): Improved and Accurate Weather Observation and Forecasting

1. Outline and Features of the Approach

Summary of Approach:

In order to mitigate weather-related disasters, it is important to provide accurate weather forecast information and communicate it to relevant organizations and residents in a reliable and easy-to-understand manner. This approach aims to improve systems and mechanisms for weather information collection, analysis, forecasting, and dissemination. This will be achieved through the following components:

- Improvement of weather observation system, which is the basis for weather analysis and forecasting operations.
- Establishment of medium- to long-term forecasts through the introduction of numerical forecasting technology.
- Analysis of climate change trends by utilizing accumulated data.
- Enhancement of the function to disseminate accurate information.

Keyword:

Weather observations, calibration, data archive, numerical forecasting, climate change trends

2. Project Delivering the Approach (Development of Human Capacity on Operation of Weather Analysis and Forecasting)

Introduction:

Bangladesh experiences floods caused by heavy rains during the monsoon season, flash floods during the pre-monsoon season, and storm surges caused by cyclones almost every year. The role of the Bangladesh Meteorological Department (BMD), the country's sole provider of weather service, in managing these disaster risks is extremely important. In order for the BMD to make a greater contribution to the goal of natural disaster mitigation, it is essential that weather radar systems and other weather disaster management infrastructure equipment and facilities are effectively utilized and that forecast and warning information is appropriately and promptly disseminated to the public.
In order to ensure the stable and long-term use of the equipment and facilities that have been developed, there is an urgent need to establish a system and train technicians, as well as to further improve meteorological services.

Operation and maintenance training at Khepupara meteorological radar station

Rain gauge repair and operation check

Key Activities

- ✓ Training for weather observation, quality control of observation data, and maintenance and management of observation equipment
- ✓ Climate statistical analysis using archived and quality-controlled observation data
- ✓ Basic training in numerical forecasting
- ✓ Preparation and implementation of weather radar observation routine schedules for operational cost reduction

Project Outcomes

- ✓ BMD's capacity regarding daily weather observations is enhanced.
- ✓ Trend analysis of climate change using accumulated weather data is conducted.

Approach (12): Improved and Accurate Weather Observation and Forecasting

- ✓ Basic numerical forecasting techniques are applied on a trial basis for 1-3 day forecasts.
- ✓ Ground weather observation and monitoring equipment are properly operated and maintained.

Key Indicators/Generated Impacts

- ✓ Training on data observation in accordance with the Meteorological Observation Guidelines and Instrument Maintenance Manual was conducted.
- ✓ Annual precipitation and temperature observations for more than 30 years at 6 meteorological stations (Dhaka, Rajshahi, Sylhet, Barisal, Khulna, and Chittagong) were used to produce charts showing trends in inter-annual variability. Currently, the number of locations has been increased to 60.
- ✓ More than six staff members were trained to produce guidance using numerical forecast models. Currently, the prediction period has been extended up to 15 days.
- ✓ More than 80% of the staff at each weather radar station are working according to the operation and maintenance manual.

Lessons Learned

- ✓ Since there was no data available to determine the atmospheric pressure, relative humidity, and dew point temperature used by the BMD, standard formulas for the BMD were developed based on the formulas provided in international standards (WMO guidelines). Referring to international standards and formulas in this way can complement the lack of information and lead to the accumulation of knowledge.
- ✓ It is important to increase the operating hours of meteorological radars in order to obtain sufficient data for the analysis of the correlation between ground observations and weather radar data.

Dhaka weather observation station

Educational activities at schools on meteorological information

Developed Tools and Guidelines

- ✓ Revised Guideline for Meteorological Observations
- ✓ Manual for Maintenance and Management of Observation Sites and Instruments
- ✓ Operation and Maintenance Manual for Weather Radar Systems

Devises for Ensuring Sustainability

- ✓ Establish close cooperation and liaison with overseas research institutions.
- ✓ The BMD has been facing a shortage of young technical engineers, while senior technicians are retiring. It is extremely important to acquire and train technicians based on human resource development plans in order to establish a reliable weather data management and forecasting system. The technical personnel should be trained through continued pilot numerical forecasting and hands-on training in data management.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Group, Environment and Climate Change Adaptation, etc.)

- ✓ Continuous public awareness activities in cooperation with mass media can promote the public's understanding of weather-related disasters.
- ✓ In order to improve the quality of the weather content provided by the BMD, it is important to consult

Approach (12): Improved and Accurate Weather Observation and Forecasting

with and receive feedback from the BWDB, DDM, and other public institutions that utilize the content.

✓ It is important to replace numerical information with more verbalized information and information about what will happen in the future so that weather information can be easily interpreted by the community and other relevant agencies aside from the BMD. This will facilitate behavioral change toward appropriate disaster risk management and evacuation activities based on a correct understanding of weather information.

Project Information Relevant to the Approach

Title: (1) Development of Human Capacity on Operation of Weather Analysis and Forecasting, (2) Project for Strengthening the Capacity of Weather and Climate Services

Scheme: Technical Cooperation

Project Period: (1) From October 2009 to December 2013, (2) From June 2022 to February 2026

Implementing Agencies: BMD

Related URL: https://www.jica.go.jp/oda/project/0800332/index.html (in Japanese only)

Acknowledgment for Interview Meeting:
Mr. Ahmed Arif Rashid, Deputy Director (Engineering), Bangladesh Meteorological Department
Mr. S.M. Quamrul Hassan, Meteorologist, Bangladesh Meteorological Department

Approach (13): Risk Assessment, Forecasting, and Countermeasures for Flood and Storm Surge Risk Reduction

1. Outline and Features of the Approach

Summary of Approach:

This approach involves research aimed at establishing analysis and forecasting methods for flood and storm surge damage, and riverbank erosion prevention measures. By proposing and testing measures to prevent and mitigate water-related disasters, this approach will contribute to building a society with disaster resilience. This effort will be accomplished through the realization of the following components:

- Research and development of risk assessment methodology for riverine flood
- Development of improved storm surge forecasting and warning systems for coastal areas
- Mechanistic analysis of riverbank erosion and levee failure, and study of mitigation measures

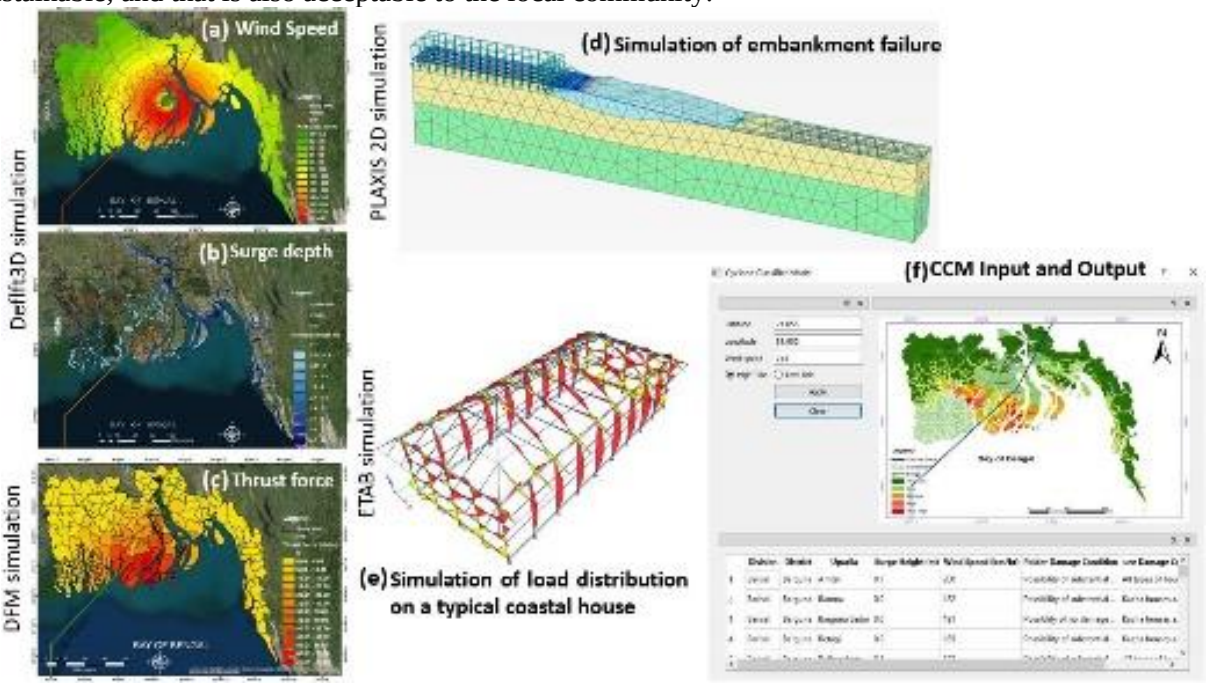
Keyword:

Hydraulic simulation, risk assessment, hydraulic experiment, comparative verification

2. Project Delivering the Approach (Research on Disaster Prevention/Mitigation against Floods and Storm Surges)

Introduction

The Government of Bangladesh has been attempting to reduce the risk of water-related disasters, including floods and storm surges. While steady improvements have been made, there are still many challenges. Along major rivers, the government of Bangladesh and its development partners have been constructing embankments and revetments, but the planning, construction, and maintenance of these works have been carried out without fully understanding the complex dynamics of the rivers, resulting in repeated damage due to breaches and collapses. In coastal areas, a large number of cyclone shelters have been constructed to facilitate the evacuation of people, but in some cases, their location, size, and resistance to the hazards have not been sufficiently verified from an engineering standpoint and may not be fully functional in the event of disasters. In light of such circumstances, there is a growing need for disaster countermeasures to be implemented in an effective manner based on scientific evidence, that is technically and economically sustainable, and that is also acceptable to the local community.



Source: BUET

Storm surge simulation by Cyclone Classifier Model (CCM)

Key Activities

- ✓ Creation of hazard maps for river flood damage and vulnerability
- ✓ Creation of hazard maps for storm surge damage and vulnerability
- ✓ Study on the impact of cyclones and storm surges on public infrastructure
- ✓ Installation of bandal-like flow control structures and field survey of flow and river bed variability characteristics around the structures

Approach (13): Risk Assessment, Forecasting, and Countermeasures for Flood and Storm Surge Risk Reduction

Project Outcomes

- ✓ A risk assessment methodology combining river flood simulation and local damage characteristics was developed.
- ✓ A risk assessment methodology combining storm surge simulation and local damage characteristics was developed.
- ✓ A comparison between riverbed movement simulations and laboratory experiments was conducted.
- ✓ Field measurements of flow and river bed fluctuations around banal-like structures and analysis of their functions were carried out.

Key Indicators/Generated Impacts

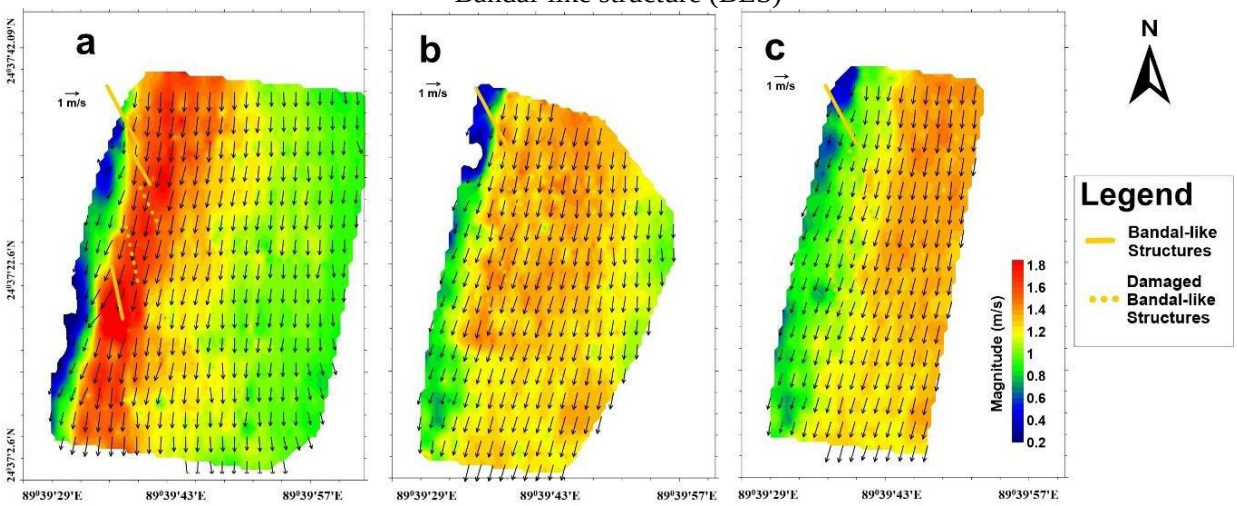
- ✓ Flood and storm surge hazard maps were prepared in the targeted areas.
- ✓ Verification of the technical, economic, and social effectiveness of riverbank erosion control measures piloted in the target areas was progressed.

Lessons Learned

- ✓ In flood and storm surge damage forecasting, it is important to continuously collect information from the community, since incorporating social attributes such as age composition, gender composition, and proportion of vulnerable groups in each Upazila into risk assessment will lead to more practical risk assessment.
- ✓ Since rivers in Bangladesh and Japan have different topographical characteristics and watershed scales, the application of other countries' river management approaches to Bangladesh should be considered in light of their application conditions and limitations.

Source: BUET

Bandal-like structure (BLS)



Source: BUET

Analysis of flow velocity around the experimental reach and BLS during wet monsoon

Approach (13): Risk Assessment, Forecasting, and Countermeasures for Flood and Storm Surge Risk Reduction

Developed Tools and Guidelines

- ✓ Flood Hazard and Risk Assessment Model (DFRM)
- ✓ Storm Surge Hazard and Risk Assessment Model (CCM)

Devises for Ensuring Sustainability

- ✓ In order to promote the practical application of research achievements such as DFRM and CCM by relevant stakeholders, it is necessary to convince government organizations and communities by visualizing the simulation outputs such as wind speed and surge depth obtained from the tools in an easy-to-understand way and showing that they reflect actual situations. In addition, it is important to deepen public-academic collaboration through further involvement of government agencies in research activities.
- ✓ It is also important to continuously validate the system against actual phenomena and share the results.

Source: BUET
Workshop on flood management at Fulchari Upazila

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Bandal-like structures are a method of riverbank erosion control that has been used by local residents for many years, using natural materials such as Bamboo. Local people know empirically which direction Bandal-like structures are most effective and how to reinforce the structures with vegetation and fences. In the future, it is important to combine the indigenous knowledge of the local people with scientific knowledge for the purpose of finding effective riverbank management methods.

Project Information Relevant to the Approach

Title: Research on Disaster Prevention/Mitigation against Floods and Storm Surges

Scheme: Science and Technology Research Partnership for Sustainable Development (SATREPS)

Project Period: From April 2014 to March 2019

Implementing Agencies: BUET, Kyoto University

Related URL: https://www.jst.go.jp/global/english/kadai/h2507_bangladesh.html

Acknowledgment for Interview Meeting:
Dr. Md. Munsur Rahman, Professor of the Institute of Water and Flood Management, Bangladesh University of Engineering and Technology

Approach (14): Dissemination of New Climate Change-Adapted Paddy Rice Varieties in the Haor area

1. Outline and Features of the Approach

Summary of Approach:

In the Haor area, the production of Boro rice and inland fisheries are the only sources of income. However, flash floods that come from the neighboring India, and threatened Boro rice almost every year. By introducing a new variety of Boro rice that can be harvested early, farmers can reduce the impact of flash floods on their rice yields. In addition, new varieties that are resistant to cold damage, that are resistant to blast disease, bring high yields, or are of good taste, have been developed. By planting a mix of new varieties with different strengths, farmers can reduce the risk of reduced rice yields due to weather.

The activities include:

- Sustainable promotion of new varieties by NGOs with the cooperation of related organizations. (e.g., Development of new varieties by BRRI, Cultivation technology guidance for new varieties by DAE)

Keyword:

Climate Change-Adaptive Agriculture, New Varieties of Paddy Rice, Cropping Pattern, Flash Floods, Haor area

2. Project Delivering the Approach (Practice and Dissemination of Disaster-Resistance Climate Change-Adaptive Agriculture in Haor, Bangladesh)

Introduction

Most of the farmland in the Haor area is flooded during the rainy season, so only one crop of paddy rice is grown per year (Boro rice is grown in the dry season). The yield of Boro rice is significantly reduced if flash floods in the pre-monsoon season occur before the harvest. In addition, since cold weather causes damage to the crop yield, it can be said that the paddy rice cultivation in this area is vulnerable to climate change.

Most of the residents of the Haor area (about 19.37 million people; Source: Maser Plan of Haor Area Vol I Summary Report April 2012, Introduction) are engaged in agriculture. Flash floods generated in upstream catchment areas have a significant impact on the livelihoods of residents in this area and on the stable supply of food in the country. For this reason, it is necessary to introduce new varieties that can be harvested early and are also resistant to cold-weather damage. BRRI has already developed varieties that can be harvested early or are resistant to cold-weather damage, and farmers can combine them to reduce the risk of loss of yields due to climate change.

As a result of the NGO's dissemination activities, several farmers have adopted new varieties (i.e., BR84, BR88, BR89, BRH55). Early flash floods did not occur, but due to the spread of rice blast disease, both new and existing varieties have low yields. However, the new BR89 and BRH55 varieties yielded above-average yields.

Rice paddies in the Haor area
(Share the Planet Associate)

Existing varieties

New varieties

Rice Variaty	Early harvest	Resistance to cold	Crop yield	2021-2022 in Target Area			2022-2023 in Target Area		
				Cultivated Area		Yield	Cultivated Area		Yield
				(ha)	%	ton/ha	(ha)	%	ton/ha
BRRI 29	○	×	○	80.70	37.86%	5.02	30.91	17.25%	0.00
HIRA 2	○	○	○	58.94	27.65%	5.83	28.84	16.10%	4.60
Janakraj	○	△	○	35.51	16.66%	5.31	9.53	5.32%	4.80
BRRI 84	○			0.00	0.00%	0.00	17.18	9.59%	1.70
BRRI 88	○			0.00	0.00%	0.00	15.74	8.79%	3.19
BRRI 89	○	○	○	0.00	0.00%	0.00	16.35	9.13%	4.70
BRRI HB 5	○	○	○	0.00	0.00%	0.00	18.06	10.08%	5.76
Others				37.98	17.82%		45.79	23.75%	
Total / Average				213.13	100.00%	4.64	182.4	100.00%	3.63

Progress of dissemination in the target area

Key Activities

Collaboration with related organizations

- Orientation for the farmers, group formation, and training arrangement
- Survey on the current status of the target farmers and meetings to share progress

Approach (14): Dissemination of New Climate Change-Adapted Paddy Rice Varieties in the Haor area

- Briefing sessions on new varieties and cultivation technology workshops with the cooperation of DAE and BRRI (Contents: Advantages and cultivation methods of new varieties, disaster risk reduction effect of combined planting)

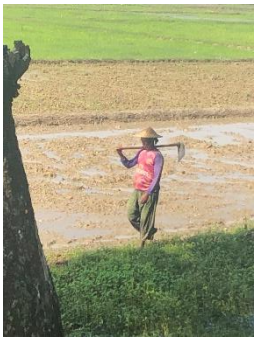
Establishment of a system for the production and preservation of new variety seeds

- Purchase and storage of seeds
- Distribution and sale of seeds
- Establishment and operation of Sales Support Centers

Dissemination of information on project progress and results over a wide area

- Promotion of coordination among the agricultural administrative agencies
- Promotion of understanding of civil society through activities like the use of media and installation of signboards and so on.

Preparation for planting in the Haor area
(Share the Planet Associate)



Water-filled rice paddies in the Haor area
(Share the Planet Associate)

Project Outcomes

- ✓ Planting a combination of new varietie is effective in avoiding a decline in paddy rice production due to climate change and other factors.
- ✓ Farmers can choose new varieties that suit their management policies and can consult on cultivation methods.

Key Indicators/Generated Impacts

- ✓ 50%*[1] of farmers in the target areas practice Climate-Adaptive Agriculture (reducing the risk of loss of yield by combining new paddy rice varieties)
- ✓ Farmers in the target areas can purchase more than 5,300 tons*[2] of new varieties each year
- ✓ Introductions by local media (newspapers, TV) at least 2 times*[3]

Lessons Learned

- ✓ The 2017 flash flood hit earlier than usual, causing the amount of Boro rice in Habiganj district to drop sharply. While there is a memory of the damage caused by flash floods, it is relatively easier to promote Climate Change-Adaptive Agriculture. When disseminating new varieties to areas that have not been affected in recent years, it is useful to have people who have experienced disasters explain the damage so that they can imagine the effects of the new varieties.
- ✓ By introducing multiple varieties (early, short-term, high-yielding, and taste) and understanding their characteristics, farmers can make combinations of varieties that are suitable for them, avoiding the risk of yield loss and increasing income.
- ✓ Climate Change-Adaptive Agriculture can be popularized through collaboration between technology development, technology dissemination, farmer groups' and NGOs' involvement.
- ✓ Disseminating information will help to gain public understanding of the need for Climate Change-Adaptive Agriculture.

Developed Tools and Guidelines

- ✓ Cultivation Manual for Climate Adaptive Rice Varieties
- ✓ Booklets/leaflets for disseminating information

Devices for Ensuring Sustainability

- ✓ It is necessary to secure a source of suppliers from which farmers can select new varieties.
- ✓ It is important for farmers to be able to obtain agricultural information, such as weather forecasts, unit prices of agricultural products, and damage caused by pests and diseases.

Approach (14): Dissemination of New Climate Change-Adapted Paddy Rice Varieties in the Haor area
✓ It is important to engage technical extension officers who can advise the farmers on cultivation methods and planting timings for new varieties. It is also necessary to improve the skills of technical extension officers through training.
Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Group, Environment and Climate Change Adaptation, etc.)
✓ Training on climate change-adaptive paddy rice cultivation methods and seed preservation is encouraged not only for men but also for married couples to participate. ✓ Encouraging women to participate in training in compost-making (vermicompost-making), which is indispensable for farming.
Project Information Relevant to the Approach
Title: Practice and Dissemination of Disaster-Resistance Climate Change-Adaptive Agriculture in Haor, Bangladesh
Scheme: Grassroots Technical Cooperation
Project Period: June 2022 to June 2027
Implementing Agencies: BRRI、NGO (Share the Planet, ASED HABIGANJ), Technology Extension Officer of DAE
Related URL:－
Acknowledgment for Interview Meeting: Share the Planet, Representative Mr. Tsutsui

Note:

*[1]: It was assumed that there were two workers on one farm, and at least one of them would participate in the training.

*[2]: Basis for Estimation 5,294 tons = volume per unit area (20 kg/1 ha) × target area (264,700 ha)
It was assumed that throughout the Habiganj district.was the target area.

*[3]: Considering that the media devices (TV, radio, Internet, etc.) used to collect information and the time of day during which media can be viewed differ from person to person, the index of the number of views was set to two or more.

Approach (15): Stepwise Development of Small-scale Irrigation and Drainage Systems with Initiative of Communities (WMCAs)

1. Outline and Features of the Approach

Summary of Approach:

Facilities for small-scale irrigation and drainage are effective in stabilizing the profits of beneficiary farmers. This approach builds facilities for small-scale irrigation and drainage. In addition, it fosters the Water Management Co-operative Associations (hereinafter referred to as WMCAs) to manage the facilities. In this approach, sub-projects are implemented in the target area. The sub-projects consist of four components 1) Flood Management, 2) Drainage Improvement, 3) Water Conservation, and 4) Command Area Development.

In a Phase 2 project, the sub-projects are categorized into three development types:

- New Development:
  Water management facilities will be built under the leadership of the WMCA as needed.
- Additional Development:
  Construct additional water use facilities that the WMCA deems necessary.
- Flagship Development:
  To well-run WMCA, provide agribusiness training and logistics system development

Keyword:

Small Scale Water Resource Development, WMCA, Improving Water Facilities, Agribusiness, Farming Equipment and Facility

2. Project Delivering the Approach (Small Scale Water Resources Development Project (Phase-1 & Phase-2))

Introduction

Agriculture, which is a key industry in rural areas, is strongly required to improve agricultural productivity on arable land in order to respond to the current situation of a decrease in farmland and an increase in demand for food. In order to improve agricultural productivity, it is necessary to solve the problems that are occurring in rural areas (i.e., water shortages due to excessive use of groundwater, flood damage due to aging levees, insufficient drainage due to sediment accumulation in drainage channels, and water shortages due to aging water storage facilities and waterways).

For this reason, Japan (and other donors) have selected target areas and implemented flood control measures, drainage improvement, water security, infrastructure development, etc., and have achieved good results. In particular, the phase-2 will involve the construction of facilities that the WMCA has identified as necessary for better operations based on its experience in facilities management. In addition, well-run WMCA will be provided with agribusiness and logistic support.

Key Activities

- New Development:
  Water management facilities (sluices, irrigation canals, etc.) are built at the request of the farmers. A prerequisite for the adoption of the sub-project is the establishment of aFarmers' Association (WMCA) to operate and maintain the facilities. The training required for incorporation and operation is provided.
- Additional Development:
  Once the WMCA starts operating the facility, it will accumulate the track records of facility management. Cooperatives with good management will understand the need for additional support (installation of sluices, dredging of drainage channels, organizational management training, etc.) based on their accumulated experience and the opinions of their members. Facility development and training will be carried out in areas where

Example of an irrigation and drainage facility (regulator) constructed in a sub-project of Phase 1

Approach (15): Stepwise Development of Small-scale Irrigation and Drainage Systems with Initiative of Communities (WMCAs)

irrigation facilities were constructed in the preceding project, it will be clear whether additional support is required or not once the actual operation of the facilities begins.

- Flagship Development:
  In this category, an outstanding WMCA will be selected, and in addition to the above supports, agribusiness training and the development of logistics system (farm roads, local market development, etc.) will be provided.

A WMCA meeting was established in the sub-project command area

Paddy fields made it possible to plant due to irrigation

Project Outcomes

- ✓ This approach aims to contribute to food security through flood management, drainage improvement, water conservation, and command area development, which ultimately improve the income of rural residents.

Key Indicators/Generated Impacts

- ✓ Amount of planned effects (i.e., irrigation area, flooded area, etc.)
- ✓ Frequency of use of construction facilities
- ✓ Transportation time, transportation distance, and sales volume of agricultural products in the flagship development area
- ✓ Number of proposals from beneficiaries (WMCA members)

Lessons Learned

- ✓ Disclosing information on the achievements of existing sub-projects (establishment and operation of WMCA and the utility of facilities) will help to search for potential new sub-projects for development.
- ✓ WMCA that is active will accumulate knowledge on issues, difficulties, and responses related to management. This knowledge is effective for districts where additional development, such as additional facilities and training, is necessary.
- ✓ The fees collected by WMCA may be used to solve social problems that are not related to water management and facility management. Good interpersonal relationships within the sub-project area are often a prerequisite for sound project management.
- ✓ Setting easy-to-understand indicators (e.g., irrigated area or flood areas) and knowing the impact of other districts can help WMCA determine whether facilities are needed for additional development.

Developed Tools and Guidelines

- ✓ Phase-2 Implementation Guidelines

Approach (15): Stepwise Development of Small-scale Irrigation and Drainage Systems with Initiative of Communities (WMCAs)

Devices for Ensuring Sustainability

- ✓ In Small-Scale Water Resources Development (JICA Phase-2), organizational development will be practiced in collaboration with the Local Government Engineering Department (LGED) and related training institutions in accordance with the Organizational Development Action Plan approved by the implementing organization. It is expected that organizational development will proceed by utilizing the memorandum of understanding regarding mutual cooperation that has already been concluded between LGED and related organizations.
- ✓ With the support of the project implementation unit and coordinators, the WMCA will prepare an "Independence and Continuity Plan for the WMCA". It is necessary to use this plan as a guideline for WMCA's activities after the project is completed.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ It supports the activities of the Social and Gender Development Section of the Integrated Water Resources Management Unit in LGED.
- ✓ In small-scale water resource development, the interests of farmers tend to take precedence, but since the impact on fishermen is also significant, the promotion of dialogue between the two parties through WMCAs is important.
- ✓ Within the sub-project areas, there is a mixture of large/small and landless farmers. The sound operation of common facilities (levees, sluices, drainage channels, etc.) will depend on a good relationship between the members of the WMCA. Landless farmers, especially poor women, can earn income by engaging in poultry, goat breeding, sewing machine operation, etc. The financial part can be taken care of by the WMCAs by lending some money from their fund with low interest.

Project Information Relevant to the Approach

Title: Small-Scale Water Resources Development Project (Phase-1&2)

Scheme: Loan Project

Project Period: From Dec. 2007 to Apr. 2017 (Phase-1), From Oct. 2017 to Dec. 2023 (Phase-2)

Implementing Agencies: LGED, Department of Agricultural Extension (DAE)

Related URL: oldweb.lged.gov.bd/ProjectGalleryDetail.aspx?GalleryID=280&projectID=750

Acknowledgment for Interview Meeting: Sociologist and Fishery experts of Foliar Khal Sub-project in Phulbaria, Mymensigh

Approach (16): Smallholder Horticultural Farmers Empowerment & Promotion (Bangla-SHEP)

1. Outline and Features of the Approach

Summary of Approach:

Price crashes due to crop oversupply and middlemen setting low prices worsen the livelihoods of smallholder horticultural farmers. This approach (hereinafter referred to as “Bangla-SHEP”) is an innovative agricultural extension method that changes the mindset of farmers from "selling what farmers grow" to "growing what the market needs". Bangla-SHEP is based on stakeholder collaboration. In other words, smallholder horticultural farmers decide which crops to grow through their own market research, Department of Agriculture Extension (DAE) provide guidance on the cultivation techniques of the crops of their choice, private companies sell the necessary agricultural inputs at fair prices, and microfinance loans if the farmer's budget is insufficient. By introducing Bangla-SHEP, farmers will be able to produce crops that meet market needs and stabilize their gross income.

This approach mainly consists of:

- On-the-job training on market research methods for smallholder horticultural farmers
- SHEP training for related organizations (government, microfinance, agricultural material suppliers, etc.)

Keyword:

Bangla-SHEP, market-oriented agricultural expansion, smallholder horticultural farmers, microfinance

2. Project Delivering the Approach (Small and Marginal Sized Farmers Agricultural Productivity Improvement and Diversification Financing Project)

Introduction

Smallholder horticultural farmers, who account for a large proportion of horticultural farmers in Bangladesh, sell their vegetables in two locations: urban supermarkets and rural markets. The former are traded at a high unit price, but have strict requirements for the quality of vegetables. The latter are less demanding on quality, but have a lower unit price.

Usually, smallholder horticultural farmers do not take into account demand, but grow crops taking into account the season. For this reason, if there is an oversupply, the unit price will fall. On the other hand, if the quantity is not enough, the middleman will set a very low unit price.

Therefore, in order to improve the management of smallholder horticultural farmers, it is necessary to introduce vegetable production methods that take into account demand trends (i.e., SHEP), and cooperation among related organizations is indispensable for the realization of this method.

Key Activities

- Establishment of an implementation system for the Bangla-SHEP approach
- Clarification of roles and responsibilities of related organizations responsible for implementation
- Preparation of action plans by the Department of Agricultural Extension (DAE), financial institutions, and private companies
- Selection of target areas suitable for horticultural agriculture by each organization
- Implementation of market-oriented agricultural promotion activities by DAE, financial institutions, and private companies (seed companies, etc.)
- Cultivation technology guidance by DAEs and private companies
- Establishment of selection criteria for farmer groups by DAEs and selection using them
- Implementation of market-oriented agricultural extension activities for selected farmer groups by the extension office of the DAE
- Facilitation of financial intermediary functions related to agricultural finance

Participatory market research

Participatory crop selection

Approach (16): Smallholder Horticultural Farmers Empowerment & Promotion (Bangla-SHEP)

Project Outcomes

- ✓ Maintaining an appropriate unit price for crops will improve the standard of living of smallholder farmers.

Key Indicators/Generated Impacts

- ✓ Whether or not there is a division of responsibilities for each organization
- ✓ Status of preparation of action plans for each organization
- ✓ Activities of each organization (number of investments to promote market-oriented agriculture)
- ✓ Number of microfinance applications (increase)
- ✓ Average income of smallholder horticultural farmers covered increased by at least 12% compared to baseline

Lessons Learned

- ✓ The fact that each institution has mastered how to select the criteria and how to prepare an action plan will be useful for the dissemination of this approach.
- ✓ This approach will bring results through the collaboration of multiple organizations. As relevant institutions become proficient in collaboration, their ability to respond to changes in the external environment is strengthened.
- ✓ Enabling small-scale horticultural farmers to ship according to market trends will not only improve farmers' livelihoods, but also stabilize the lives of consumers.

Baseline survey on gender equality

Developed Tools and Guidelines

Bangla-SHEP package

Devices for Ensuring Sustainability

- ✓ Continued micro-financing is required to enable farmers to access necessary finance.
- ✓ It is desirable to continue to provide guidance on cultivation techniques for new products that adapt to changing consumer needs.

Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)

- ✓ Women account for at least 30% of the total members of the farmer group selected by DAE. Furthermore, in the establishment of farmer groups, more than 30% of participants are women, promoting gender equality in farm management, and working to promote gender equality by improving farmers' livelihoods.

Project Information Relevant to the Approach

Title: Small and Marginal Sized Farmers Agricultural Productivity Improvement and Diversification Financing Project

Scheme: Loan Project

Project Period: From August 2021 to December 2025

Implementing Agencies: Ministry of Agriculture, Department of Agricultural Extension (DAE), Bangladesh Bank, financial institutions such as microfinance institutions, and private companies such as agricultural equipment companies

Related URL: https://www.jica.go.jp/oda/project/201903799/index.html (in Japanese only)
https://www.facebook.com/BanglaSHEP/

Acknowledgment for Interview Meeting: DAE PD Mr. MD Humayoun Kabir, Consultants (TAC International, Dr. Masahiro Kawamura, IC-NET Mr. Takeshi Ikeda)

Approach (17): Improving the Capacity of Public Food Storage to Reduce Response Time, Maintain Quality, and Expand Capacity

1. Outline and Features of the Approach

Summary of Approach:
This approach involves building food storage facilities equipped with air conditioning that can maintain the quality of stockpiled food and machines that can be loaded and unloaded quickly. This is important in terms of national food security and food distribution to the poor. Although self-sufficiency is increasing year by year, there are still significant challenges in terms of food security due to the sensitivity of the yield of rice to climatic conditions. Strengthening the capacity of rice stockpiles will mitigate fluctuations in supply to the market due to good or bad harvests caused by weather conditions.
The activities include:

- Securing storage capacity to meet the increasing production volume year by year
- Facility design that takes into account the stockpiling method such as parboiled bagging of the target rice
- Design of loading and unloading yards that take into account transportation methods (trucks and railways)

Keyword:
Food Security, Rice Self-Sufficiency, Food Stockpiling Facilities, Public Food Rationing, Access to Food, Stockpiling Methods, Transportation Methods, Parboiling

2. Project Delivering the Approach (Improvement of the Capacity of Public Food Storage in the People's Republic of Bangladesh)

Introduction

In recent years, Bangladesh has increased its self-sufficiency rate in rice. However, rice production can easily decline due to the effects of climate change (for example, early flash floods in the Haor area). In addition, although the population growth rate has slowed from 2.0% (2000) to 1.1% (2019), the demand for rice is still increasing due to population growth.
The construction of food storage warehouses is one of the effective measures to strengthen the resilience to climate change to maintain rice self-sufficiency. About 600 food warehouses have been built in Bangladesh, but the government has determined that this number is not enough to stockpile rice/wheat in case there is a disaster. As outlined in the 8th 5-year plan, the Ministry of Food has set the target to increase the storage capacity up to 3.7 million MT by 2025. Food stockpiles have problems other than lack of capacity. For example, many of the existing warehouses are not equipped with air conditioning equipment, so the quality of rice cannot be maintained. In addition, since it is done manually, it may not be possible to gather workers during an emergency.
To help achieve this goal, Japan (together with donors such as the World Bank and ADB) has secured 500,000 tons of rice and wheat reserves. Japan adopted the flat bagging method in consideration of the Bangladeshi rice storage method called parboiled. In Bangladesh, paddy for storage is first steamed (parboiled), then threshed, and finally bagged for storage. Parboiled is a treatment for long-term storage, but since the rice is more likely to be crushed, the flat-bagged method is more suitable than the silo method. In addition, in order to maintain quality, it is equipped with an air conditioner, and it is loaded using forklifts and pallets so that it can be carried out and loaded quickly. Technical training on operation management, including how to carry in and out, was also conducted.

Key Activities

Construction site: Santahar, Bogura District,

- ✓ Construction of rice stockpile warehouses
- ・ Construction of rice warehouses with proper air conditioning facilities
- ・ Construction of truck yards and approach ramps
- ・ Procurement of forklifts, pallets, and monitoring equipment (moisture content measuring instruments, shell temperature meters, temperature and humidity meters)
- ✓ Improvement of operational management methods
- ・ Warehouse operation and inventory management methods
- ・ Establishment of storage technology using pallets and forklifts
- ・ Establishment of technology for the operation and maintenance of air conditioning facilities

Approach (17): Improving the Capacity of Public Food Storage to Reduce Response Time, Maintain Quality, and Expand Capacity

Bagging flat storage (using forklifts)

Air conditioning equipment and bagging flat type system

Project Outcomes

- ✓ By increasing the capacity of rice storage, rice supply to customers was stabilized, regardless of fluctuations in production due to climate change. It also managed increasing production and population growth.
- ✓ The good quality of rice was maintained.
- ✓ Quick loading and unloading could be done.

Key Indicators/Generated Impacts

- ✓ Construction of a warehouse capable of storing 19,000 tons of rice
- ✓ Introduction of mechanical loading-unloading method using forklifts and trucks
- ✓ Pallet loading capacity is set to 1 ton by loading rice bags
- ✓ Establishment of modern operation and maintenance technology using air conditioning facilities and monitoring equipment

Lessons Learned

- ✓ Currently, 85kg or 50 kg of jute bags are used. Jute bags full of rice will have a cylindrical (bale-shaped) shape, so they will become unstable when stacked on pallets. If the rice bag is a 30kg paper bag, like a cement bag, it can be stacked stably, so that more than 1 ton of rice bags can be stacked on one pallet.
- ✓ In order to train instructors rather than operators, the training period for inventory management using machines should have been longer. As the number of mechanical warehouses increases, there will be a need for instructors of mechanical inventory management in Bangladesh.

Two-stories food storage warehouse

Truck ramps for loading and unloading and solar panels for power generation

Developed Tools and Guidelines

- ✓ Warehouses with air conditioning systems
- ✓ Three types of manuals on facility operation and management: (1) Warehouse operation and inventory management methods, (2) Storage technology (loading and forklift operation and maintenance), (3) Operation and maintenance of air conditioning equipment

Devices for Ensuring Sustainability

- ✓ It is important to provide training to new employees in order to maintain their skills in operation and management of the facilities (i.e., warehouse operation and inventory management methods, storage techniques, and operation and maintenance of air conditioning equipment).
- ✓ It is necessary to look for ways to reduce management costs. For example, the rooftop of the facility is

Approach (17): Improving the Capacity of Public Food Storage to Reduce Response Time, Maintain Quality, and Expand Capacity
unused, so photovoltaic panels can be installed. This will reduce the electricity costs required by the facility.
Considerations for Social, Environmental, and Climate Change Issues (Community Development, Gender, Vulnerable Groups, Environment and Climate Change Adaptation, etc.)
✓ The food storage warehouses secured by this approach are used not only for food security but also for food distribution to the poor. ✓ Shifting the work of loading and transporting bags of rice into food storage warehouses from human labor to the use of machines (forklifts) creates the possibility of women being employed as operators.
Project Information Relevant to the Approach
Title: Improvement of the Capacity of Public Food Storage in the People's Republic of Bangladesh
Scheme: Grant Aid Project
Project Period: February 2012 to November 2014
Implementing Agencies: Former Ministry of Food and Disaster Management (MoFDM, Current Ministry of Disaster Management and Relief (MoDMR) and Ministry of Food (MoF)), Directorate General of Food (DGF), District Controllers of Food (DCF), Regional Controllers of Food (RCF)
Related URL:－
Acknowledgment for Interview Meeting: DGF Director, Movement Storage and Silo Division, Mr. Mohsin Reza, Consultants (Kokusai Kogyo Co., Ltd, Mr. Yukio Katayanagi)

ATTACHMENT 7 Concept Ideas

Concept Idea (1)

Item	Contents
Project Title	Project for rainwater harvesting for residents and communities in rural area
Keywords	Water resource management, water resource management map, capacity strengthening of local officers, enhancing the ability of residents, inter-agency cooperation
NAP Sector/Investment Plan	WRM2: Management of freshwater resources and monitoring of salinity for reducing vulnerabilities in existing and potential salinity-prone areas WRM5: Community-based rainwater harvesting through indigenous techniques and conservation of wetlands, reservoirs, and natural springs for drinking water supplies in hard-to-reach and water-stressed areas
Project Rationale, Objectives, and Approach of the Project	(Background) Most of the land of Bangladesh is lowland, less than 5m above sea level. Bangladesh is one of the most vulnerable countries to natural disasters in the world and was rated as the seventh most vulnerable country to climate change by the Global Climate Risk Index 2021. It is considered particularly susceptible to the effects of floods, storm surges, cyclones, etc., and it is predicted that the damage caused by flooding will become more severe in the future. Bangladesh has an extensive coastline where the adverse impact of saltwater intrusion is significant and natural hazards caused by climate change in this region occur more frequently than before with greater intensity. Bangladesh's land area impacted by salinity increased by roughly 26.7%, or 0.223 million hectares, from 1973 to 2009, with about 35,440 hectares of the land becoming saline only between 2000 and 2009 (Saline Soils of Bangladesh, Soil Resource Development Institute, SRMAF Project, Ministry of Agriculture, 2010). According to another study, future sea level rise will drive the salinity further inward in the short- and medium-term. In the mid-term, the areas affected by 1 ppt salinity will grow by 7.5%, whereas the regions affected by 5 ppt salinity will grow by 9% (Technical Note: Impacts of projected Sea Level Rise on coastal embankments, CEGIS, 2021). Most of Bangladesh's groundwater is also contaminated with arsenic. Since arsenic contamination of groundwater was discovered in 1993, a nationwide survey was conducted and found that arsenic exceeding standard values was detected in approximately 30% of wells. Construction of alternative water sources later progressed, and by 2009 approximately 970,000 shared alternative water sources had been installed, but only about 690,000 of these were in operation. It is estimated that approximately 20 million people still do not have access to safe water due to arsenic contamination (Situation Analysis of Arsenic Mitigation 2009, JICA-DPHE, 2010). The main drinking water sources were tube wells, pond sand filters, and rainwater harvesting. Especially in rural areas, the development of large-scale safe water distribution such as pipe water distribution is proceeding, but still slow and full coverage can not be expected in the near future. These water sources were generally affected for several reasons, such as inundation of water sources by contaminated flood water, saline water intrusion, disruption of access to safe water resources, and disruption of the infrastructures of the water supply system. Under regular and emergent climate events such as sea level rise and flooding, access to safe water sources especially in the rural area would be much more difficult. Amid this situation, there is an increasing and urgent need to strengthen the climate change adaptation capacities and change policies toward the management of safe water sources, such as securing safe water for the residents and communities in the rural areas through the promotion of Bangladesh Delta Plan 2100, National Adaptation Plan, etc.

	(Purpose) Based on the above background, the project will be implemented for the following purposes. ✓ Provision of safe water to residents with low-cost rainwater tanks and to communities with concrete-block-made large-scale rainwater tank ✓ Awareness raising for safe water utilization
Expected Project Areas	One of the Unions or Upazilas in the low-land area (for low-cost rainwater tank utilization, the low-land areas tend to have a salinity problem in underground water) One or two facilities such as schools and hospitals (for concrete hollow block-made large-scale rainwater tanks)
Key Approach, Project/Programme Description	<u>Key Approach</u> ✓ Market survey regarding drinking water ✓ Mason training to learn rainwater tank manufacturing methods ✓ Manufacture and implementation of rainwater tanks by a domestic company and newly established local subsidiary ✓ Awareness raising and monitoring of rainwater use <u>Project Component</u> ✓ Introduce community-based and low-cost freshwater management for mass-level drinking water supplies. ✓ Identify and evaluate the effectiveness of community-based indigenous techniques for rainwater (or, "sky water" that means "water from the sky") harvesting. ✓ Identify and sensitize communities about the benefits of rainwater harvesting under climate stress conditions. ✓ Implement community-based rainwater harvesting techniques inclusive of gender.
Expected Project Results	✓ The increased adaptive capacity of human, natural, and economic systems to reduce risk and vulnerabilities and ensure protection against climate change-induced disasters in coastal areas. ✓ Reduction of risks and vulnerabilities of water scarcity and water security. ✓ Protection against climate-induced hazards like droughts in remote and water-stress areas. ✓ Improved life and livelihoods of the indigenous communities.
Engagement of Key Stakeholders	DPHE, DSHE, DPE, NGO and others

Indicative Cost Estimate	Total project cost:452 thousand USD ✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost. Unit: Thousand USD

Approach Name	1st Year	2nd Year	3rd Year	Total
Low-cost tank rainwater harvesting for residents				
Basic survey	49.00			49.00
304.85 Training	5.00			5.00
Construction of a plant	11.70	11.70		23.40
Production/Installation	17.40	17.40		34.80
Awareness	17.50	17.50		35.00
Subtotal	100.60	46.60		147.20
CHB tank rainwater harvesting (2 locations)				
Basic survey	9.10			9.10
Planning/ Design	4.60			4.60
Construction supervision		77.35	77.35	154.70
Construction		68.25	68.25	136.50
Subtotal	13.65	145.60	145.60	304.85
Total Amount	114.25	192.20	145.60	452.05

Remarks/ Acknowledgment	✓ DPHE is required to take the lead in managing the project. ✓ Since women play a major role in domestic water use, the involvement of women in raising awareness on the maintenance of the rainwater tank is effective. ✓ Since children also play an important role in raising awareness in their families and communities, education in such fields for children is also effective. In addition, when children become adults in the future, they will be able to become leaders in water resource management and hygiene in their communities.

Concept Idea (2)

Item	Contents
Project Title	Project for utilization and management of safe water resources and improvement of livelihood in rural areas
Keywords	Water resource management, water resource management map, capacity strengthening of local officers, enhancing the ability of residents, inter-agency cooperation
NAP Sector/Investment Plan	WRM2: Management of freshwater resources and monitoring of salinity for reducing vulnerabilities in existing and potential salinity-prone areas WRM18: Planned, participatory and coordinated land and water resources management
Project Rationale, Objectives, and Approach of the Project	(Background) Most of the land of Bangladesh is lowland, less than 5m above sea level. Bangladesh is one of the countries most vulnerable to natural disasters in the world and was rated as the seventh most vulnerable country in the world to climate change by the Global Climate Risk Index 2021. It is considered particularly susceptible to the effects of floods, storm surges, cyclones, etc., and it is predicted that the damage caused by flooding will become more severe in the future. Bangladesh has an extensive coastline where the adverse impact of saltwater intrusion is significant and natural hazards caused by climate change in this region occur more frequently than before with greater intensity. Bangladesh's land area impacted by salinity increased by roughly 26.7%, or 0.223 million hectares, from 1973 to 2009, with about 35,440 hectares of the land becoming saline only between 2000 and 2009 (Saline Soils of Bangladesh, Soil Resource Development Institute, SRMAF Project, Ministry of Agriculture, 2010). According to another study, future sea level rise will drive the salinity further inward in the short- and medium-term. In the mid-term, the areas affected by 1 ppt salinity will grow by 7.5%, whereas the regions affected by 5 ppt salinity will grow by 9% (Technical Note: Impacts of projected Sea Level Rise on coastal embankments, CEGIS, 2021). Most of Bangladesh's groundwater is also contaminated with arsenic. Since arsenic contamination of groundwater was discovered in 1993, a nationwide survey was conducted and found that arsenic exceeding standard values was detected in approximately 30% of wells. Construction of alternative water sources later progressed, and by 2009 approximately 970,000 shared alternative water sources had been installed, but only about 690,000 of these were in operation. It is estimated that approximately 20 million people still do not have access to safe water due to arsenic contamination (Situation Analysis of Arsenic Mitigation 2009, JICA-DPHE, 2010). The main drinking water sources were tube wells, pond sand filters, and rainwater harvesting. Especially in the rural areas, the development of large-scale safe water distribution such as pipe water distribution is proceeding, but still slow and full coverage can not be expected near future. These water sources were generally affected for several reasons, such as inundation of water sources by contaminated flood water, saline water intrusion, disruption of access to safe water resources, and disruption of the infrastructures of the water supply system. Under regular and emergent climate events such as sea level rise and flooding, access to safe water sources especially in the rural areas would be much more difficult. Amid this situation, there is an increasing and urgent need to strengthen the climate change adaptation capacities and change policies toward the achievement of a high safely managed water and sanitation coverage rate, that are a selection of the appropriate water sources based on the scientific methodologies and implementation of the water source management based on the approved action plan for drinking water from a medium-term and long-term perspective through the promotion of Bangladesh Delta Plan 2100, National Adaptation Plan, etc. DPHE is responsible for formulating water source development plans, constructing water supply facilities, and transferring facilities to local governments in rural areas

	and urban areas other than the four cities (Dhaka, Chottogram, Khulna, and Rajshahi). Although local governments normally should conduct operation and maintenance of such facilities, DPHE is required to provide technical support to local governments as necessary. However, it was not fully implemented due to a lack of adequate human resources in DPHE and a lack of local government ownership. In response, DPHE, with the support of JICA, developed comprehensive technical guidelines and proposed rules for information management through the "Project for Improvement of Comprehensive Management Capacity of Department of Public Health Engineering on Water Supply" (2014-2021). It aimed to strengthen information management systems and disseminate them through the establishment of standards and the preparation of water source data. A continuation of this project is currently being implemented, aiming to utilize and establish the guidelines at the DPHE district and Upazila offices, and to improve technical capabilities regarding the operation and maintenance of piped water supply facilities. In order to accelerate the improvement of safe water management and distribution, further formulation of water resource development plans at the district and Upazila level using these guidelines, construction of water supply facilities, and training for DPEH officers and local governments on maintenance and management in the selected Districts and Upazilas would be very useful. (Purpose) Based on the above background, the project will be implemented for the following purposes. ✓ Comprehensive management capacity for DPHE central, district, and Upazila officials to disseminate safe water supply is improved. ✓ The capacity of residents to manage the supply of safe water is improved. ✓ Strengthening cooperation between communities and government
Expected Project Areas	DPHE central office, About three districts those considered technically difficult to evaluate the water resource potentials except for Gazipur, Khulna, and Chattogram, which were supported by the JICA project. About two Upazilas from each district
Key Approach, Project/Programme Description	<u>Key Approach</u> ✓ Promotion of the application of the comprehensive technical guideline among DPHE central, district, and Upazila offices to select the appropriate water resources and facilities. ✓ Promotion of the application of the technical information management standard and date for water resource management among DPHE central, district, and Upazila offices ✓ Implementation and revision of Mid- and Long-term action plan ✓ Training for maintenance of the water-related facilities to DPHE officers and residents with raising awareness of residents on maintenance. <u>Project Component</u> ✓ Implement integrated water resources management for climate change adaptation through optimized use of scarce freshwater resources ✓ Monitoring and mapping of soil and water salinity through in situ testing ✓ and GIS mapping at the planning level ✓ Community-based, youth-led, and gender-inclusive freshwater pond management and rainwater harvesting ✓ Demarcation of potential saline-prone areas, development and implementation of a freshwater management plan for a smooth transition of a freshwater ecosystem to saline water ✓ Expand the use of deeper groundwater reserves ✓ Development of gender-inclusive and youth-led functional participatory water and disaster management groups ✓ Effective co-management of watersheds and water regulation

<table>
<tr><td></td><td>✓ Maintain coordination between participatory water management committees (e.g., water management groups) and disaster management committees</td></tr>
<tr><td>Expected Project Results</td><td>✓ The increased adaptive capacity of human, natural, and economic systems to reduce risk and vulnerabilities and ensure protection against climate change-induced disasters in coastal areas.
✓ Protection of life, property, and livelihood of people against hazards affecting the water and land resources.
✓ Community, gender-inclusive, and youth-led conservation of water and land resources for improved well-being.</td></tr>
<tr><td>Engagement of Key Stakeholders</td><td>DPHE, BMD, BWDB, NGOs and others</td></tr>
<tr><td>Indicative Cost Estimation</td><td>Total project cost: 1.01 million USD
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Approach Name</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>Total</th></tr>
<tr><td>Enhancing the capacity of water resource management at DPHE District and Upazila offices</td><td>0.32</td><td>0.32</td><td>0.31</td><td>0.95</td></tr>
<tr><td>Enhancing the capacity of water resource management for residents</td><td>0.02</td><td>0.02</td><td>0.02</td><td>0.06</td></tr>
<tr><td>Total Amount</td><td>0.34</td><td>0.34</td><td>0.33</td><td>1.01</td></tr>
</table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ DPHE is required to take the lead in formulating and updating the water resource management plan applying the comprehensive technical guidelines among DPHE central, district, and Upazila offices to select the appropriate water resources and facilities.
✓ DPHE is also required to take the lead in the promotion of the application of the technical information management standard and date for water resource management among DPHE central, district, and Upazila offices.
✓ In order to update the water resource map, the inter-agency-coordination by DPHE is required.
✓ Since the water resource potential changes over time, continuous data acquisition and regular revision are required.
✓ Since women play a major role in domestic water use, the involvement of women in raising awareness on the maintenance of water-related facilities and hygiene is effective.
✓ Since children also play an important role in raising awareness in their families and communities, education in such fields for children is also effective. In addition, when children become adults in the future, they will be able to become leaders in water resource management and hygiene in their communities.</td></tr>
</table>

Concept Idea (3)

Item	Contents
Project Title	Project for Haor flood management and livelihood improvement and new rice varieties' application
Keywords	Haor area, monsoon season, pre-monsoon season, river embankment, submersible embankment, river management plan, hazard assessment, risk assessment, qualities of design and construction, agriculture promotion
NAP Sector/Investment Plan	WRM 10: Protection against flash floods, wave action, erosion and sedimentation WRM 14: River management through bank stabilization and other ancillary works CSA3: Extension of stress-tolerant, pest and diseases-resistant rice and non-rice crops
Project Rationale, Objectives, and Approach of the Project	(Background) Most of the land of Bangladesh is lowland, less than 5m above sea level. Bangladesh is one of the countries most vulnerable to natural disasters in the world and was rated as the seventh most vulnerable country to climate change by the Global Climate Risk Index 2021. It is considered particularly susceptible to the effects of floods, storm surges, cyclones, etc., and it is predicted that the damage caused by flooding will become more severe in the future. According to the SSP5-8.5 scenario in IPCC AR6, the annual average flow of the Ganges, Brahmaputra, and Meghna river basins is expected to increase by 17-28%, 2-5%, and 1-4%, respectively, in the 2050s due to climate change. The pre-monsoon flows are also expected to increase significantly in all basins. Amid this situation, there is an increasing need to strengthen advanced disaster risk reduction and change policies through the promotion of Bangladesh Delta Plan 2100, National Adaptation Plan, etc. The Haor area is located in the northeastern part of Bangladesh and extends into the low-lying wetlands of the upper Meghna River basin. Because of its elevation, the Haor area is very prone to flooding and most of the basins of this region are submerged during the monsoon season. The flash flood that occurred in 2022 seriously affected 7.2 million people, evacuated or temporarily displaced 480,000 people, affected 2,543 km^2 of agricultural land and 44,254 water points in nine districts including major affected 5 districts, that are Sylhet, Sunamganj, Moulvibazar, Habiganj and Netrakona in the northeastern parts of Bangladesh (Flash Floods Humanitarian Response Plan 2022 United Nations Bangladesh Coordinated Appeal (July – December 2022), United Nations Bangladesh, 2022). In addition, there are many direct damages such as damage to the embankment itself due to overflow and to residential houses by inundation above and below the floor level. Indirect damage such as traffic interruption due to submerged roads was also seen. Taking advantage of the landform of the Haor area, in general, rice cultivation and fish cultivation are conducted during the dry season and monsoon season, respectively. Rice cultivation is the main source of income during the dry season and the major type of rice grown during the dry season is Boro rice. Boro rice is harvested in early May, which sometimes coincides with flash floods. Flood damage in Haor areas is most severe for Boro rice, and flash floods during the pre-monsoon season (April and May) in particular significantly reduce the yields of crops. Therefore, as a climate change adaptation measure in the Haor area, implementation of countermeasures against flash floods, especially during the pre-monsoon season, and livelihood improvement is effective and highly expected.

	(Purpose) Based on the above background, the project will be implemented for the following purposes. ✓ Selection of priority Haors in flood prevention and river management plans in Haor areas ✓ Flood control and agricultural promotion activities
Expected Project Areas	Haor area, where flood mitigation is urgently required Up to approximately 30 Haors
Key Approach, Project/Programme Description	<u>Key Approach</u> 1) Flood management ✓ Collection and analysis of hydrological, hydraulic, and disaster-related information, and analysis of existing projects, problem extraction ✓ River planning studies, including runoff analysis using the North East Regional Model (NERM), reexamination of design water levels, analysis of sedimentation balance, and reflection of the latest land use and assets. ✓ Update of the list of priority projects (structural measures) ✓ Design and construction of embankments and river structures that reflect the results of existing projects ✓ Provision of Local Training (LT) for BWDB officials, field staff, and WMG members for capacity development regarding O&M works 2) Agricultural promotion activities ✓ Establishment of a production system for new varieties of paddy rice that can shorten and accelerate the planting period ✓ Dissemination of cultivation methods and cropping patterns for the above new varieties of paddy rice ✓ Dissemination of information on the above results to stakeholders ✓ Small-scale farmer support ✓ Farm machinery support <u>Project Component</u> ✓ Ensure regular and timely O&M of water management and drainage (regulators, culverts, etc.) structures, embankments, and submersible embankments ✓ Develop design guidelines and monitoring tools for construction and regular O&M of embankment sedimentation ✓ Participatory conservation of wetlands ecosystems through promoting submersible embankments and elevated roads with adequate openings for cross-drainage ✓ Provisioning of causeways in Haor areas for facilitating agricultural and fisheries production ✓ Construction, rehabilitation, and maintenance of erosion protection structures along erosion-prone rivers ✓ Maintaining connectivity of rivers or khals with perennial beels, and seasonal wetlands in Haor areas ✓ Development of awareness at the planning and local levels of the principles of 'living with floods' in deeply flooded Haor areas ensuring the conservation of rich ecosystems ✓ Assess erosion risk-prone areas through analysis of historical river morphology and bank line shifting ✓ Design riverbank stabilization and training on related structural and non-structural measures considering the hydro morphological characteristics of rivers and climate change ✓ Implement river stabilization and training works to provide erosion protection and management of rivers ✓ Ensure regular and timely O&M of protection measures

<table>
<tr><td></td><td>✓ Ensure the availability of seeds of different stress-tolerant rice.
✓ Extension of different stress (cold, flood, lodging, etc.) tolerant varieties through training, field-level demonstration, and input supply.
✓ The stress-resistant rice variety will be well-known by providing training on appropriate cultivation methods.</td></tr>
<tr><td>Expected Project Results</td><td>✓ Ensured protection against floods, erosion, accretion, etc., adverse impacts of climate change
✓ The increased adaptive capacity of the people living in flood-prone and erosion-prone areas
✓ Improvement of agricultural activities and the livelihoods of the stakeholders
✓ Community and youth-led conservation of nature for improved well-being
✓ Protection of the lives, properties, and livelihoods of people living near the riverbanks
✓ Reduction of the risks and vulnerabilities regarding riverbank erosion
✓ Restoration and conservation of the river ecosystem</td></tr>
<tr><td>Engagement of Key Stakeholders</td><td>BWDB, LGED, and others</td></tr>
<tr><td>Indicative Cost Estimation</td><td>Total project cost: 86.99 million USD
(for approximately 30 Haors, 1,750 km^2)
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Item</th><th>1st to 2nd Year</th><th>3rd to 9th Year</th><th>Total</th></tr>
<tr><td>Flood Management</td><td></td><td></td><td>84.78</td></tr>
<tr><td>Plann, design, construction</td><td>2.17</td><td>82.17</td><td>84.34</td></tr>
<tr><td>Local Training (LT)</td><td>0.10</td><td>0.34</td><td>0.44</td></tr>
<tr><td>Agriculture Promotion</td><td></td><td></td><td>2.04</td></tr>
<tr><td>Practice and Dissemination of Climate-Resilient Agriculture (Boro Rice)</td><td>0.40</td><td>0.59</td><td>0.99</td></tr>
<tr><td>Supporting Sub-projects</td><td>0.23</td><td>0.82</td><td>1.05</td></tr>
<tr><td>Small-Scale Income Generation Sub-project (SIGS)</td><td>0.04</td><td>0.13</td><td>0.17</td></tr>
<tr><td>Total Amount</td><td></td><td></td><td>86.99</td></tr>
</table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ In order to update the hydrological, hydraulic, and disaster-related information, the inter-agency-coordination by BWDB is required.
✓ Installation of automatic water level observation and the preparation of water level-flow curves are recommended.
✓ A more detailed flood inundation analysis targeting the project area is desired.
✓ It is important to check whether there is a weak soil layer (especially the beet layer) at the embankment site.
✓ It is also desirable to incorporate the design discharge at reference points and set the design flood level based on the flow rate.
✓ Close communication with residents is important not only for the maintenance activities of the structures but also for the design of the river structures such as causeways for transportation accessibility.
✓ Because women and low-income people have a hard time raising their voices and are more susceptible to flooding and water use, consideration needs to be given to stakeholder discussions, such as setting up Focus Group Discussions (FGD) for women and other relevant low-income people only.</td></tr>
</table>

Concept Idea (4)

Item	Contents
Project Title	Project for comprehensive flood mitigation planning for mid-and-small scale rivers
Keywords	Small rivers, river management planning, flood mitigation, master plan, river channel planning, structure design, maintenance management, training
NAP Sector/Investment Plan	WRM 18: Planned, participatory and coordinated land and water resources management
Project Rationale, Objectives, and Approach of the Project	(Background) Most of the land of Bangladesh is lowland, less than 5m above sea level. Bangladesh is one of the countries most vulnerable to natural disasters in the world and was rated as the seventh most vulnerable country in the world to climate change by the Global Climate Risk Index 2021. It is considered particularly susceptible to the effects of floods, storm surges, cyclones, etc., and it is predicted that the damage caused by flooding will become more severe in the future. According to the SSP5-8.5 scenario in IPCC AR6, the annual average flow of the Ganges, Brahmaputra, and Meghna river basins is expected to increase by 17-28%, 2-5%, and 1-4%, respectively, in the 2050s due to climate change. Amid this situation, there is an increasing need to strengthen advanced disaster prevention and change policies toward disaster damage management through the promotion of Bangladesh Delta Plan 2100, National Adaptation Plan, etc. The flood in August 2023, rainfalls of 199 mm from August 1 to August 4, and 1,093 mm from August 1 to August 12 were observed in Lama station in Matamuhuri River in the east side of Bangladesh. With the rainfall, the maximum discharge of 3,780 m3 was estimated at the same station, which was evaluated as the discharge in approximately 50 year-return periods. Generally, for rivers, one of the goals of river management is to promote the implementation of flood mitigation measures prior to disasters. However, in Bangladesh, without a comprehensive river improvement plan, post-disaster responses are taken as the main focus of disaster mitigation activities, and such responses are conducted repeatedly. As a result, river management investments tend not to be utilized efficiently. Therefore, amid the rising flood risk caused by climate change and the lack of prior mitigation measures against disaster, flood mitigation plans based on scientific planning and evaluation are required. (Purpose) Based on the above background, the project will be implemented for the following purposes. ✓ River flood mitigation planning for relatively small rivers
Expected Project Areas	Any mid and small-scale rivers
Key Approach, Project/Programme Description	<u>Key Approach</u> ✓ Review of current planning status and selection of model basins ✓ Collection and analysis of hydrological, hydraulic, and disaster-related information, and analysis of existing projects, problem extraction ✓ Examination and proposal of river channel management methods with design discharge, design high water level, river channel alignment, sediment control, etc.

<table>
<tr><td></td><td>Project Component
✓ Community-based climate change risk, vulnerability, and adaptation need mapping to support locally-led adaptation
✓ Climate-sensitive land zoning
✓ Development of gender-inclusive and youth-led functional participatory water and disaster management groups
✓ Effective co-management of watersheds and water regulation</td></tr>
<tr><td>Expected Project Results</td><td>✓ The increased adaptive capacity of humans, natural systems, and economic systems
✓ Protection of life, property, and livelihood of people against hazards affecting the water and land resources
✓ Community, gender-inclusive, and youth-led conservation of water and land resources for improved well-being</td></tr>
<tr><td>Engagement of Key Stakeholders</td><td>BWDB, IWM, and others</td></tr>
<tr><td>Indicative Cost Estimation</td><td>Total project cost: 1.41 million USD for two to three basins
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Item</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>Total</th></tr>
<tr><td>Engineering Service</td><td>0.46</td><td>0.46</td><td>0.46</td><td>1.38</td></tr>
<tr><td>Survey works</td><td>0.01</td><td>0.01</td><td>0.01</td><td>0.03</td></tr>
<tr><td>Total Amount</td><td>0.47</td><td>0.47</td><td>0.47</td><td>1.41</td></tr>
</table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ Basic surveys on existing studies about hydrological, hydraulic, and disasters should be carefully conducted in order to avoid overlapping studies.
✓ The BWDB and engaging consultants should work together to have a well-oriented consensus on river management policies, plans, river-related designs, and constructions.
✓ BWDB is in charge of updating the hydrological, hydraulic, and disaster-related information.
✓ Installation of automatic water level observation and the preparation of water level-flow curves are recommended.
✓ Sedimentation monitoring is recommended.
✓ It is recommended to allow sufficient time for land acquisition.
✓ If possible, hydrological and hydraulic information should be acquired from the neighboring countries.</td></tr>
</table>

Concept Idea (5)

Item	Contents
Project Title	Project for local disaster risk reduction plans based on cooperation among self-help, mutual-help, and public-help
Keywords	Community capacity strengthening, local disaster risk reduction planning, youth initiative, cooperation between residents and administration
NAP Sector/Investment Plan	CDM5: Gender-, age- and disability-responsive, youth-led disaster preparedness and emergency rescue and evacuation services CDM7: Behavioural change and development of awareness among vulnerable communities for emergency responses and livelihood protection from climate-induced disasters
Project Rationale, Objectives, and Approach of the Project	(Background) Due to the effects of climate change, changes in the timing, frequency, and magnitude of hydrological and meteorological phenomena have been noted, and these phenomena have occurred. According to the IPCC's Sixth Assessment Report (AR6), the projected future rainfall in Bangladesh is expected to increase by 0.1 to 1.4% in the 2030s and by 2.4 to 3.5% in the 2050s. The frequency of high-intensity rainfall is projected to increase, while that of small-scale rainfall is projected to decrease. According to the National Adaptation Plan (NAP), sea levels are rising along the coast of Bangladesh due to the geographical characteristics of the delta in addition to climate change impacts. Sea levels rose by 1.7 mm per year between 1901 and 2010, and by 2.8±0.8 mm per year between 1993 and 2010. IPCC AR6 reports that future sea level rise in the Bay of Bengal is projected to be 0.11 to 0.12 m in the short term (2030), 0.23 to 0.27 m in the medium term (2050), and 0.54~0.86 m in the long term (2100). Bangladesh has a wide variety of disaster characteristics despite its limited land area, and the changing trends in the weather events described above raise concerns about the increased risk of disaster in communities. Along large rivers, riverbank erosion is expected to intensify due to increased flood flows, and the amount of sediment transported from upstream areas is expected to increase. In Chattogram hills and northern areas, the risk of landslides increases due to increased rainfall. In coastal areas, the sea water level at the time of storm surge is expected to increase, causing severe damage to a wider area of coastal areas. Bangladesh is one of the most vulnerable countries to climate change in the world due to its geographical and social characteristics (Global Climate Risk Index, Germanwatch, 2021). While various efforts are being made at the ministry and community levels to adapt to climate change impacts, addressing climate change will require further behavioral change not only among government organizations but also among members of local communities, as well as those who influence policies. When planning disaster risk reduction interventions, it is common to use hazard maps to identify the disaster characteristics of the target area and to consider structural and non-structural measures on that basis. In Bangladesh, however, although hazard maps covering the entire country or a part of the country have been developed with the cooperation of international organizations, detailed hazard maps that can identify the characteristics of disaster-prone areas at a local level have not been sufficiently developed. In developing disaster risk reduction interventions at the local level, it is important to understand disaster risks based on the natural disaster and climate change impact characteristics of the respective areas and to develop implementation plans based on this understanding. In addition, it is crucial to establish a reliably functioning evacuation system from the perspective of responding to a disaster of a scale larger than the above plan. At the local level, there is insufficient information sharing and coordination on interventions being implemented or planned by various ministries. In order to improve the effectiveness and efficiency of disaster risk reduction activities at the

	local level, there is a need to strengthen coordination and establish a cooperative system among the implementing agencies. The involvement of central-level agencies is also important in coordinating the collaboration among projects at the District and Upazila levels. In the community, it is necessary to strengthen its capacity and sustainably maintain its functions by cultivating people who will be responsible for the development of the community in the long term and by preparing each resident for disaster risk reduction on their initiative. In addition, in order to strengthen the community's "self-help" and "mutual-help", it is important for the Disaster Management Committee (DMC), or "public-help", to function properly so that the community and government can collaborate effectively. (Purpose) Based on the above background, the project will be implemented for the following purposes. ✓ Disaster risk reduction planning and management capacity building at the local level ✓ Youth-led community disaster awareness raising ✓ Strengthening community and government collaboration
Expected Project Areas	Eight flood or cyclone-prone districts (Bagerhat, Pirojpur, Borguna, Patuakhali, Shatkhira, Khulna, Noakhali, Cox's Bazar, Kurigram, Sunamganj, Manikganj, etc.) Four Upazilas selected from each selected District Two unions from selected each Upazila Two wards from selected each Union
Key Approach, Project/Programme Description	<u>Key Approach</u> ✓ Development of local disaster risk reduction plans and the implementation ✓ Youth-led community-based disaster risk reduction ✓ Strengthening disaster risk reduction and management capacity based on collaboration between residents and government <u>Project Component</u> ✓ Assessment of localized impacts of climate change through community-based and participatory risk assessment in collaboration with scientific-knowledge-based risk information and mapping of identified risks with social resources and infrastructure. ✓ Formulation of a local disaster risk reduction plan based on the risk assessment with the initiative of DDM and Upazila DRR Planning sub-committee for enhancing proactive adaptation practices. ✓ Youth-led awareness programme for emergency response, evacuation, and disaster preparedness including preparation of gender-sensitive communications and inclusive materials and preparation of evacuation action plan (time-line) for accessing cyclone or flood shelters and facilities. ✓ Strengthening cooperation between the District, Upazila, and Union through regular coordination meetings and sharing of disaster risk reduction plans of each organization.
Expected Project Results	✓ Enhanced adaptive capacity and protection of life and livelihoods of vulnerable communities against disasters ✓ The increased adaptive capacity of natural and economic systems to reduce risk and vulnerabilities and ensure protection against climate change-induced disasters ✓ Community, gender-inclusive, and youth-led emergency response and livelihood protection ✓ A paradigm shift of capacity development and behavioral change took place

<table>
<tr><td>Engagement of Key Stakeholders</td><td>DDM, LGED, BWDB, BMD, DSS, DWA, DYD, NGOs, and others</td></tr>
<tr><td>Indicative Cost Estimation</td><td>Total project cost: 10.13 million USD
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Approach Name</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>4th Year</th><th>5th Year</th><th>Total</th></tr>
<tr><td>Upazila-level disaster risk reduction planning and implementation</td><td>1.33</td><td>1.33</td><td>1.33</td><td>1.33</td><td></td><td>5.33</td></tr>
<tr><td>Disaster risk reduction based on collaboration among residents' self-help, community mutual-help, and public-help</td><td></td><td></td><td>1.60</td><td>1.60</td><td>1.60</td><td>4.80</td></tr>
<tr><td>Total Amount</td><td>1.33</td><td>1.33</td><td>2.93</td><td>2.93</td><td>1.60</td><td>10.13</td></tr>
</table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ DDM is required to continuously lead the development and update of local disaster risk reduction plans at the upazila level. To this end, it is important to further strengthen the coordination and management capacity of DDM through the accumulation of knowledge on disaster risk assessment and project formation.
✓ It is important to develop and utilize guidelines in order to share knowledge and ensure sustainability in the formulation of local disaster risk reduction plans.
✓ In order to achieve the understanding of disaster risk and the selection of priority projects based on the understanding at the local level, it is important to promote human resource development of local consultants and NGO personnel on scientific-based hazard and risk analysis through practical experience. In addition, in order to facilitate consensus building with communities, the smooth operation of the Upazila Sub-Committee (UzSC) is important, so it is desirable to acquire knowledge through practical experience as well.
✓ In Union DMC, it was effective to involve people who know the local situation at the community level and have a strong commitment to local disaster risk reduction from the early stages of the project in order to ensure the continuity of the project. It is even more effective if that person is in a position to make decisions.
✓ With regard to the results of school education, it is expected that not only children who have received disaster-related education will acquire know-how, but also that children will take it home and spread the knowledge and awareness to their households and communities. Therefore, investing in youth has a significant positive impact. In addition, when children become adults in the future, they will be able to become leaders in disaster risk reduction in their communities. In disaster-related education, from the viewpoint of appropriate natural phenomena that cause disasters, it is desirable to enhance not only knowledge of disaster response behavior but also science and mathematics education.</td></tr>
</table>

Concept Idea (6)

Item	Contents
Project Title	Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment
Keywords	Multi-purpose shelter, maintenance, gender sensitivity, evacuation roads, drinking water
NAP Sector/Investment Plan	CDM1: Construction and rehabilitation of gender-, age- and disability-sensitive multipurpose, climate-resilient, and accessible cyclone and flood shelters with safe drinking water, sanitation, and livestock shelter facilities
Project Rationale, Objectives, and Approach of the Project	(Background) Bangladesh is threatened by tropical cyclones and associated storm surges because of its topographical characteristics and the concentration of population and economic activities. In recent years, particularly, sea level rise and cyclone size change caused by climate change are predicted, and sea level is expected to rise by 23-27 cm by 2050. As a result, cyclone damage is predicted to increase in the future. Due to the increased risk of damage to population and properties in coastal areas, the establishment of more cyclone shelters has been identified as the most priority area to be enhanced. Similarly, with regard to floods, changes in rainfall patterns caused by climate change are expected to lead to changes in the magnitude and frequency of their occurrence and the possibility of further damage is foreseen in the future. Due to climate change, the mean annual flow of the Ganges, Brahmaputra, and Meghna river basins will increase by 17-28 percent, 2-5 percent, and 1-4 percent, respectively, under the SSP5-8.5 scenario in the 2050s (CEGIS, 2021). The seasonal flow distribution in the 2050s will also increase substantially during the pre-monsoon in all three basins. The flow will increase significantly (18-30 percent) in the Ganges basin, while a smaller increase might occur in the Brahmaputra and Meghna basins. The higher increase in the Ganges basin is most probably attributed to additional flow from melting Himalayan glaciers. This will increase the flooding probability in the country. This impact is expected to be particularly severe in remote areas with large numbers of poor people in the north and northeast regions such as Kurigram, Gaibandha, and Jamalpur. Although the number of deaths due to cyclone damage has decreased significantly due to the construction of shelters in the past, especially since Cyclone Sidr in 2007, as mentioned above, the development of shelters in accordance with design criteria based on the impact of climate change is required in response to the expected intensification of flood and storm surge damage. In order to ensure the smooth evacuation of people to cyclone and flood shelters, it is necessary to improve accessibility by improving road conditions around shelters and increasing transport facilities. In addition, there are still factors that prevent people, particularly women, from seeking shelter in the event of a disaster, such as the lack of sanitation facilities and poor maintenance. Improving the living conditions of shelters is necessary to reduce sanitation, nutrition, and gender safety issues. Also, ensuring such living conditions above a certain level will also encourage residents to actively evacuate. There is a lack of proper maintenance of constructed cyclone shelters in coastal areas. It is reported that the reasons for insufficient maintenance are that skills related to maintenance and management are not fully shared among the relevant stakeholders and that sufficient funds are not provided for this purpose. Cyclones do not occur regularly, and the importance of maintenance and management tend to be a low priority in responsible public or related organizations. However, in light of the severity of disasters caused by climate change, it is important to establish a funding framework for maintenance and management practices and a skill-sharing framework among stakeholders such

	as LGED, DPE, DMC, and SMC in order to ensure that facilities perform their functions in an emergency. (Purpose) Based on the above background, the project will be implemented for the following purposes. ✓ Construction of evacuation shelters to mitigate cyclone and flood damage ✓ Improvement of shelter living conditions during evacuation ✓ Establishment of a continuous maintenance and management system for shelters by relevant stakeholders
Expected Project Areas	Construction of flood and cyclone shelters (school-cum shelters) in about 4 districts among coastal cyclone-prone areas (Bagerhat, Cox's Bazar, etc.) and flood-prone areas (Kurigram, Gaibandha, Jamalpur, etc.) (Construction of about 60 to 80 locations in total)
Project/Programme Description	<u>Key Approach</u> ✓ Construction of multi-purpose shelters based on design external forces considering climate change ✓ Improvement of evacuation routes, drinking water facilities, solar panels, separate toilets for men and women ✓ Establishment of an implementation system and technology transfer for continuous maintenance of shelter facilities <u>Project Component</u> ✓ Rehabilitation of existing cyclone shelters to make them gender- and disability-friendly and to serve multiple purposes ✓ Construction of gender- and disability-friendly, multipurpose, and climate-resilient cyclone and flood shelters meeting the desired level of shelter density in disaster-prone vulnerable areas based on the understanding of local disaster risks with consideration for climate change impact. ✓ Provision of safe drinking water, lactation and maternity facilities, gender- and disability-sensitive sanitation, disability accessibility, livestock shelters, solar energy, etc. ✓ Repair, rehabilitate, or construct access roads to shelters that are gender- and disability-responsive in smooth coordination among relevant agencies
Expected Project Results	✓ Community, gender-inclusive, and youth-led construction and rehabilitation of disaster shelters ✓ Enhanced climate resilience in both humans and livestock
Engagement of Key Stakeholders	LGED, DDM, BWDB, RHD, DOE, HBRI, PWD, DWA, DSS, DPHE, NGOs and others

<table>
<tr><td>Indicative Cost Estimation</td><td>Total project cost: 12.53 million USD
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table><tr><th>Approach Name</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>4th Year</th><th>Total</th></tr><tr><td>Construction and maintenance of multi-purpose shelters with considerations for gender and educational environment</td><td>2.93</td><td>2.93</td><td>2.93</td><td>2.93</td><td>11.73</td></tr><tr><td>Large scale-concrete hollow block tanks for public water supply in local communities</td><td>0.2</td><td>0.2</td><td>0.2</td><td>0.2</td><td>0.80</td></tr><tr><td>Total Amount</td><td>3.13</td><td>3.13</td><td>3.13</td><td>3.13</td><td>12.53</td></tr></table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ Training and guidelines need to be developed regarding shelter operation and maintenance conducted by SMC and the community as well as LGED and DPE. It is important that knowledge is provided with both normal and emergencies in mind.
✓ For rapid and safe evacuation, site selection for shelters should also be evaluated based on road network conditions. If necessary, pavement conditions leading to shelters should be improved. In some past projects, road construction with sufficient width was not carried out. Ideally, the road should be wide enough for two buses to pass through for smooth travel. This road width should be secured not only for the road in front of the shelter but also for neighboring road networks around the shelter for smooth evacuation. In addition, the safety of persons with disabilities during evacuation and their access to the shelter should be given due consideration at the shelter design stage.
✓ To ensure a gender-sensitive design, for example, the first floor should be designed for women and children only and the second floor for men only, and consideration should be given to providing toilets on each floor.
✓ In some cases, the site selection of toilets and other auxiliary facilities is based on the convenience of construction works by the contractor, such as the ease of carrying materials and proximity to water, without considering the viewpoints of users. The site selection should be carried out after consultation with local communities, etc.</td></tr>
</table>

Concept Idea (7)

Item	Contents
Project Title	Integrated development, maintenance, and rehabilitation of coastal polders toward more resilience
Keywords	Polder, Integrated Management, Recovery Fund, Maintenance
NAP Sector/Investment Plan	WRM1: Integrated management of coastal polders, sea dikes, and cyclone shelters against tropical cyclone, sea-level rise and storm surges BDP2100: CZ 1.8/1.21, CZ1.44, CZ1.40, CZ1.47
Project Rationale, Objectives, and Approach of the Project	(Background) Bangladesh is threatened by tropical cyclones and associated storm surges because of its topographical characteristics in addition to the recent concentration of population and economic activities. In particular, in recent years, sea level rise and intensification of cyclones caused by climate change are predicted, and sea level is expected to rise by 23-27 cm by 2050. As a result, the areas affected by storm surges caused by cyclones are predicted to expand in the future. Since Cyclone Sidr (2007), awareness of cyclone disasters in coastal communities has increased and the number of deaths has decreased dramatically. On the other hand, the development of coastal infrastructure such as polders is not yet sufficient. One of the reasons for insufficient development is that there are many vulnerable points/sections of facilities in coastal areas and they are scattered over a wide area, resulting in patchwork responses. Even if the weak sections of the polder are improved, damage occurs from other vulnerable sections, and consequently, the overall strength of the polders cannot be ensured. The lack of overall strength of the facility creates a vicious cycle of damage after a disaster, followed by large-budgeted repairs, but inadequate reinforcement leads to further repeated damage. In addition, the problem of waterlogging caused by poor drainage maintenance and inadequate sedimentation management inside polders has also been identified. Based on the above situation, it is necessary to develop and manage polders and their related facilities that are resilient as a whole to ensure sustainable effects. In addition, for future polder development, it is necessary to promote the design based on the external force considering the effect of climate change. As a problem of the rehabilitation project after the disaster in Bangladesh, the project approval process in the government of Bangladesh takes a long time which makes timely implementation of the project difficult. In some cases, residents cannot wait for the government's project implementation and carry out simple repair work by themselves. To alleviate this problem, it is effective to introduce a fund management and project approval/implementation process that supports the rapid implementation of rehabilitation projects. Currently, JICA's yen loan project "Disaster Risk Management Enhancement Project", is implementing several recovery projects through the operation of a disaster recovery fund. However, since this is a new initiative in Bangladesh, it is desirable to update the operational framework through the trial application. (Purpose) Based on the above background, the project will be implemented with the following objectives: ✓ Integrated facility maintenance of polders based on climate change impacts ✓ Maintenance and management of polders and related water infrastructure facilities by the relevant administrative agencies ✓ Prompt implementation of restoration projects after the disaster

<table>
<tr><td>Expected Project Areas</td><td>Construction of polders in about 5 districts out of the coastal cyclone-prone areas (Khulna, Shatkira, etc.) (construction of about 5 polders)</td></tr>
<tr><td>Project/Programme Description</td><td><u>Key Approach</u>
✓ Establishment of facility design external forces in consideration of climate change
✓ Integrated polder development from the viewpoint of ensuring the strength as a whole
✓ Maintenance of embankments and management of drainage channels inside and outside the polders
✓ Operation of rehabilitation project funds based on a rapid project selection and approval process

<u>Project Component</u>
✓ Repair, construct, and rehabilitate coastal polders, sea dikes, or embankments considering sea-level rise and extreme storm surge height under varying climate change scenarios
✓ Inside and outside polder management for proper drainage systems and sediment management
✓ Regular and timely operation and maintenance (O&M) of coastal polders
✓ Allocate and mobilize adequate funds for emergency responses and recovery of damaged polders</td></tr>
<tr><td>Expected Project Results</td><td>✓ Increased adaptive capacity and protection against sea-level rise and storm surges
✓ Increased protection against life, livelihood, and the ecosystem
✓ Minimized crop and livestock loss
✓ Improved socio-economic status</td></tr>
<tr><td>Engagement of Key Stakeholders</td><td>BWDB, LGED, RHD, DDM, LGD, BMD, WARPO and others</td></tr>
<tr><td>Indicative Cost Estimation</td><td>Total project cost: 80 million USD
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Approach Name</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>4th Year</th><th>5th Year</th><th>Total</th></tr>
<tr><td>Enhancement of infrastructure rehabilitation and reconstruction systems (Polder development component)</td><td>11.33</td><td>11.33</td><td>11.33</td><td>11.33</td><td>11.33</td><td>56.67</td></tr>
<tr><td>Enhancement of infrastructure rehabilitation and reconstruction systems (Emergency fund operation component)</td><td>4.67</td><td>4.67</td><td>4.67</td><td>4.67</td><td>4.67</td><td>23.33</td></tr>
<tr><td>Total Amount</td><td>16.00</td><td>16.00</td><td>16.00</td><td>16.00</td><td>16.00</td><td>80.00</td></tr>
</table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ Even though there are partial repair works applied for the weakest points of each polder, damage might occur from other vulnerable sections. In such a case, the strength of the polder as a whole cannot be ensured. It should be noted that rather than spreading the investment across multiple polders, the investment should be focused on each polder more comprehensively. With regard to the selection of a focused investment polder, priorities should be</td></tr>
</table>

	strategically considered in accordance with scientific knowledge-based hazard and risk analysis. ✓ It should be noted that if design standards in response to climate change are adopted, construction costs will increase due to an increase in embankment height. In some cases, a simpler, renovating repair method using CC blocks and geobacks is also considered, as far as the required strength can be secured. ✓ The Disaster Recovery Fund Guidelines have been prepared by the JICA ODA Loan Project (DRMEP). These guidelines include the definition and declaration of Heavy Disaster as a trigger for the use of the Fund, criteria for the project selection process and screening, and provisions on the upper and lower limits of the project scale (project cost). It is recommended that these operational guidelines be tested and updated as necessary. ✓ One of the factors that require time for restoration projects is the large number of sub-projects to be covered after the disaster and the fact that they are scattered over large areas. It is desirable to adjust the upper limit of the scale of each project so that it does not affect the quick implementation and completion of the project.

Concept Idea (8)

Item	Contents
Project Title	Enhancement of flood and storm surge warning system based on upazila-wise flood and storm surge damage prediction model and rainfall information obtained from meteorological radar
Keywords	Meteorological radar, flood prediction, storm surge prediction, damage prediction, maintenance management, comparative verification
NAP Sector/Investment Plan	WRM4: Strengthen early warning and dissemination services for climate change-induced slow-onset and sudden extreme water hazards using ICT and artificial intelligence
Project Rationale, Objectives, and Approach of the Project	(Background) The changes in weather phenomenon patterns due to the effects of climate change have been analyzed to some extent at the national or regional level in Bangladesh. According to the National Adaptation Plan, rainfall variation due to future climate change for Bangladesh ranges between 0.1-1.4 percent in the 2030s and 2.4-3.5 percent in the 2050s. The northeastern and eastern hills regions will receive higher rainfall, while there will be lower rainfall predicted in the western part. In the 2030s, future annual rainfall is predicted to be slightly higher or similar across the country. In the 2050s, rainfall will increase all over the country. A higher amount of change is expected in coastal areas and the Chattogram Hill Tracts. Future projections indicate that winter rainfall is decreasing for most of the country except in the coastal and Chattogram Hill Tracts regions. In contrast, pre-monsoon rainfall will decrease in the Chattogram Hill Tracts and the Bay of Bengal. Rainfall in the rest of the country will increase during this season. Monsoon and post-monsoon rainfall all over the country will increase. The frequency of heavy rainfall events is projected to rise while that of light rainfall events will fall, inferring a shift towards a lower number of wet days with an increase in the intensity of rainfall on days with rain, entailing an increased risk of flash floods. As described above, Bangladesh has a regional diversity of its hydrological and geographical characteristics. Therefore, in future disaster risk reduction, it is required to be able to analyze local rainfall events more precisely and to grasp the occurrence of sudden short-duration rainfall events promptly. Continuous efforts and improvements have been made in the preparation and issuance of warning signals by BMD and other organizations relevant to the early warning system. The knowledge and capacity of the population to evacuate have also been steadily improved, as evidenced by Cyclone Preparedness Program (CPP) activities, particularly in coastal areas. However, there are still issues in providing information that is easy to understand to the population in light of the changes in meteorological and hydrological phenomena expected in the future due to the effects of climate change. In addition to providing information on expected natural phenomena, it is also necessary to provide convincing information on the potential damage caused by such natural phenomena and to encourage residents to prepare for disasters and take evacuation actions. For this purpose, it is important to provide impact-based disaster forecasting information, which can be achieved by combining natural conditions with information on the attributes of the community, such as infrastructure facilities, the location of buildings and assets, and the residential status of groups in need of special assistance. Furthermore, from a long-term perspective, in order to further promote evacuation behavior, it is expected that impact-based information can be combined with geographic information to help residents understand the relationship between their geographical familiarity and the spatial distribution of disaster risk.

	(Purpose) Based on the above background, the project will be implemented for the following purposes. ✓ Strengthening the rainfall observation network ✓ Elaboration of forecasts for sudden and localized flood events ✓ Providing easy-to-understand and urgent information in the event of floods and storm surges
Expected Project Areas	Nationwide Maintenance of meteorological radar in Moulvibazar, Khepupara, and Cox's Bazar
Project/Programme Description	<u>Key Approach</u> ✓ Reinforcement of rainfall observation network by restoration, renewal, and reliable operation of radars ✓ Elaboration of flood forecasting and warning system based on sophisticated rainfall observation network (including river floods and internal flooding) ✓ Improvement of flood and storm surge damage prediction model through continuous verification <u>Project Component</u> ✓ Development of storm surge models and impact-based operational early warning and community-based dissemination systems for cyclonic storm surge to facilitate emergency responses ✓ Develop and strengthen impact-based early warning, ICT, and community-based dissemination systems for floods and flash floods using more extensive rainfall information with meteorological radars ✓ Expand hydrometeorological observation networks and strengthen forecast and climate information services through data acquisition and monitoring of local climate variables using more extensive rainfall information with meteorological radars
Expected Project Results	✓ Enhanced adaptive capacity and protection of life, livelihoods, and ecosystem against slow onset and other extreme events of climate change ✓ Developed innovative technologies and adaptation practices to support risk-informed planning and damage mitigation
Engagement of Key Stakeholders	BMD, BWDB, DDM, SPARRSO, BUET and others

Indicative Cost Estimation

Total project cost: 18.83 million USD

- ✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.

Unit: Million USD

Approach Name	1st to 4th Year	5th Year	6th Year	7th Year	Total
Development and maintenance of meteorological radar systems	3.00 * 4years	3.00	3.00		18.00
Improved and accurate weather observation and forecasting			0.167	0.167	0.33
Risk assessment, forecasting and countermeasures for flood and storm surge risk reduction		0.167	0.167	0.167	0.50
Total Amount	12.00	3.167	3.333	0.333	18.83

Remarks/ Acknowledgment

- ✓ For continuous meteorological radar operation, it is important to install facilities that can secure stable electricity.
- ✓ Securing a maintenance management system is of utmost importance as the basis for maintaining the functionality of the system. Therefore, it is necessary to secure the number of BMD personnel and provide hands-on training for maintenance management.
- ✓ In order to improve the validity and reliability of flood and storm surge damage forecasting models, it is important to continuously update the models through comparative verification between actual phenomena and forecast results.
- ✓ To ensure the accuracy of impact-based disaster prediction, it is important to continuously collect local-level socio-demographic information and reflect it in the risk assessment system.
- ✓ In the future, in order to further encourage quicker evacuation of residents, it is important not only to provide residents with easy-to-understand information but also to link scientific-based analysis and forecast information with geographic information to help residents visualize the situation.

Concept Idea (9)

Item	Contents
Project Title	Practice and dissemination of climate-adapted rice seeds in the Haor
Keywords	Climate-adaptive agriculture[*1], New varieties of paddy rice, cropping pattern, flash floods, Haor area
NAP Sector/Investment Plan	CSA3: Extension of stress-tolerant, pest and diseases-resistant rice and non-rice crops
Project Rationale, Objectives, and Approach of the Project	(Background) The flash flood in Sylhet in 2022 severely affected 7.2 million people, evacuated 481,827 people, affected 1,133 km2 of agricultural land, and damaged 44,254 water points and 49,885 sanitation facilities in nine districts in northeastern Bangladesh. In addition, there are many direct damages such as damage to the main body of the submersible levee due to overflowing it, flooding on and under the floor, and indirect damage such as traffic blockage due to submersion of the roads. When flash floods hit during or before the Boro rice harvest season (April - May) in the Haor area, the yield decreases significantly. Since paddy rice cultivation in the Haor area is only one crop per year, it will damage farmers' livelihoods and make it difficult to achieve rice self-sufficiency. According to the IPCC 6th Report Shared Socioeconomic Pathways (SSP)5-8.5 scenario, the average annual flow rate of the Ganges, Brahmaputra, and Meghna river basins is expected to increase, and all basins are expected to see a significant increase in the flow rate during the pre-monsoon season (National Adaptation Plan of Bangladesh (2023-2050), October 2022). There is a need for new varieties of paddy rice that can be harvested before flash floods hit. In addition, new varieties of paddy rice that are resistant to cold, disease, and insect damage are also needed. However, at the moment there are no new varieties that meet all the demands. (Purpose) By introducing a combination of new varieties that can be harvested early, new varieties that are resistant to cold damage, and new varieties that are resistant to disease and insect damage, farmers can diversify the risk of production cuts due to climate change.
Expected Project Areas	Rice paddies throughout the Haor area (7 districts) 1) Sylhet 82,011 ha 2) Sunamganj 222,415 ha 3) Moulavi Bazar 57,045 ha 4) Hobigonj 122,161 ha 5) Brahmanbaria 110,729 ha 6) Kishoreganj 163,815 ha 7) Netrokona 180,624 ha (Boro Rice Acreage by District (Yearbook 2022))
Project/Programme Description	<u>Key Approach</u> ✓ Combining new varieties of paddy rice to address the risk of reducing production (e.g., flash floods, cold snaps, diseases, and pests reduce production) ✓ Dissemination of cultivation methods and cropping patterns for the above new varieties of paddy rice ✓ Dissemination of information on the above results to stakeholders <u>Project Component</u> ✓ Ensure the availability of a variety of stress-resistant rice seeds. ✓ For the dissemination of varieties that are resistant to various stresses (cold, flooding, lodging, etc.), briefings on the effects, demonstrations in the field, and distribution of seeds should be practiced.

<table>
<tr><td></td><td>✓ For the spread of stress-resistant rice varieties, training on appropriate cultivation methods should be implemented.</td></tr>
<tr><td>Expected Project Results</td><td>✓ Diversifying the risk of damage from flash floods and other disasters increases the resilience of crop production.</td></tr>
<tr><td>Engagement of Key Stakeholders</td><td>MoA, DAE, BADC, BRRI, BARI, BARC, IRRI, Local Administration (District, Upazila, Union), NGO and others</td></tr>
<tr><td>Indicative Cost Estimate</td><td>Total project cost: 4.627 million USD
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Approach Name</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>4th Year</th><th>5th Year</th><th>Total</th></tr>
<tr><td>Dissemination of new climate change-adapted paddy rice varieties in the Haor area (dissemination to 6 districts other than Habigangj district)</td><td>0.925</td><td>0.925</td><td>0.925</td><td>0.925</td><td>0.927</td><td>4.627</td></tr>
<tr><td>Total Amount</td><td>0.925</td><td>0.925</td><td>0.925</td><td>0.925</td><td>0.927</td><td>4.627</td></tr>
</table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ The important thing in agriculture is observation and recording. Early detection of diseases and pests, as well as individuals that are likely to be resistant to them, can only be done by farmers who work in the field every day. The daily monitoring records of farmers provide important insights for BRRI and IRRI researchers to develop new varieties that farmers expect.</td></tr>
</table>

*1: Climate-adaptive agriculture is defined as "the introduction of farming methods and varieties that are resistant to abnormal weather conditions and the review of the annual cropping pattern."

Concept Idea (10)

Item	Contents
Project Title	Small-scale irrigation and drainage system development
Keywords	Small-scale water resource development, strengthening Water Management Co-operative Association (hereinafter referred to as WMCA), strengthening water facilities, agribusiness
NAP Sector/Investment Plan	CSA2 Effective use of surface water for irrigation and multi-purpose use
Project Rationale, Objectives, and Approach of the Project	(Background) About 70% of the total population of Bangladesh lives in rural areas, and many of them make their living from agriculture. Flood management, drainage improvement, water conservation, and command area development are essential for agricultural development, but in rural areas, water shortages due to overuse of groundwater, flood damage due to aging levees, and drainage problems due to sedimentation in drainage canals occur. There are problems such as water shortages due to deficiencies and aging of water storage facilities and waterways. The Local Government Engineering Department (LGED) has so far implemented four small-scale water resource development projects with technical cooperation from aid agencies. Each of the four development assistance projects has implemented a number of sub-projects. In the areas where the sub-projects have been implemented, facilities have been constructed for flood management, drainage improvement, water conservation, and command area development, and the facilities are operated and managed by the Water Management Co-operative Association (WMCA). From the experience of actually operating and managing facilities, problems such as lack of operational management knowledge and insufficient facility capacity have become clear. (Purpose) In the phase-2 project, the following three types of subprojects will be implemented to improve agricultural productivity and increase production in the rural area. 1) New Development Type: the sub-project will practice the same development as the sub-projects of the phase-1 project. 2) Additional Development Type: the sub-projects will add facilities and training to existing areas. 3) Flagship Development Type: For the extremely well-run WMCA, the sub-project supports agribusiness and logistic facilities.
Expected Project Areas	The target areas by development type are as follows. ・ New Development Type: 4 districts (Sylhet, Dhaka, Mymensingh, Rangpur) ・ Additional Development Type: 3 districts (Phase 1 districts: Sylhet, Dhaka, Mymensingh) ・ Flagship Development Type: 3 districts (3 districts selected from additional support)
Project/Programme Description	<u>Key Approach</u> ✓ Establishment of WMCA that can appropriately operate and maintain water facilities (flood levees, drainage channels, reservoirs, irrigation canals, sluices, etc.) ✓ Strengthening of WMCAs through technical training and construction of multifunctional WMCA office ✓ Improvement of existing business management and evaluation system

<table>
<tr><td></td><td>Project Component
✓ Rainwater harvesting through periodic re-excavation of perennial water bodies (ponds, beels, canals, rivers, etc.) for the round year surface water availability
✓ Improving rural infrastructures (farm roads, local market development, etc.)
✓ Training to establish and strengthen water management associations (organizational management, construction supervision, facility operation and maintenance, agricultural technology, etc.)</td></tr>
<tr><td>Expected Project Results</td><td>✓ Crop production increased.
✓ Resilience is enhanced for crop production due to reducing drought vulnerability and water shortage.</td></tr>
<tr><td>Engagement of Key Stakeholders</td><td>LGED, DAE, and others</td></tr>
<tr><td>Indicative Cost Estimate</td><td>Total project cost: 83.3 million USD
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Approach Name</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>4th Year</th><th>5th Year</th><th>Total</th></tr>
<tr><td>Stepwise development of a small-scale irrigation and drainage system with an initiative of communities (WMCAS)</td><td>16.8</td><td>16.8</td><td>16.8</td><td>16.8</td><td>16.1</td><td>83.3</td></tr>
<tr><td>Total Amount</td><td>16.8</td><td>16.8</td><td>16.8</td><td>16.8</td><td>16.1</td><td>83.3</td></tr>
</table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ WMCA is organized by people who share the benefits of the same facilities (flood protection dike, irrigation canals, etc.). Each member will have different economic power and influence, but for a successful organization, it is important to maintain equity in the division of the administrative tasks of the facility and the distribution of the benefits that the facility brings. Rather than enforcing strict rules, it is important to foster an awareness that everyone owns the facility. One WMCA uses membership fees to purchase work tools (sewing machines and livestock) for members in need. This is an effective way to show that the WMCA aims to improve everyone's lives.</td></tr>
</table>

Concept Idea (11)

Item	Contents
Project Title	Improvement of the livelihood of smallholder horticultural farmers by market-oriented agricultural extension (Bangla-SHEP)
Keywords	Microfinance, market-oriented agricultural expansion, smallholder horticultural farmers
NAP Sector/Investment Plan	CSA10 Improvement of storage or post-harvest facilities, transport, communications, and e-commerce-based market facilities for agricultural products CSA12 Development of e-commerce and engagement of women, people with disabilities, and youth for e-commerce-based entrepreneurship
Project Rationale, Objectives, and Approach of the Project	(Background) Bangladesh meets the LDC (Least Developed Countries) graduation criteria recognized by the United Nations Development Policy Committee in two rounds of examinations in 2018 and 2021 and is expected to graduate from LDC in 2026. With economic development, according to the 8th Five Year Plan July 2020- June 2025, the agricultural sector accounts for less than 15% of GDP, but it still accounts for about 38.2% of employment (2019), making it one of the key sectors for the country. In addition to improving the quality and adding value to agricultural products, the government has made it a priority to strengthen the value chain of production, processing, sales, and consumption, and will work to diversify crops, including vegetables and fruits. On the other hand, many farmers operate on a small scale, making it difficult to secure funds and farming techniques, and it is difficult to introduce new crops and high-yielding varieties. In addition, there are issues such as buying up by middlemen in the sale of agricultural products such as vegetables, and they are in a situation where they cannot receive reasonable compensation. (Purpose) Bangla-SHEP enables smallholder horticultural farmers to conduct market research to produce crops that meet the needs of consumers and increase their total income. In order to achieve this, it is necessary to cooperate with related institutions (DAEs, agricultural material companies, microfinance, etc.) and cooperation among farmers. (The project aims to continue the dissemination of the ongoing Bangla-SHEP.)
Expected Project Areas	Target group (Primary Beneficiaries): smallholder horticultural farmers, especially those who are aware of the results of the ongoing Bangla-SHEP and expect similar outcomes. Target human resources: Employees of the following organizations, 1) Department of Agricultural Extension, Ministry of Agriculture 2) Financial institutions such as the Bangladesh Bank and microfinance institutions 3) Private companies such as agricultural materials and equipment companies Target Areas: Districts that meet the following two criteria: (1) Ten of the following districts: ・ Dhaka Region ・ Mymensingh Division ・ Rangpur Division ・ Rajshahi Region (2) Areas suitable for growing horticultural crops

<table>
<tr><td>Project/Programme Description</td><td>
<u>Key Approach</u>
✓ Establishment of a system for implementing the Bangla-SHEP approach
✓ Preparation of action plans by DAEs, financial institutions, and private companies
✓ In accordance with the action plan, DAE will carry out market-oriented agricultural promotion activities (e.g., training on methods for staff, guidance on cultivation techniques for farmers, and acceptance of tours from private companies, etc.)
✓ In accordance with the action plan, financial institutions and private companies will implement market-oriented agricultural promotion activities (e.g., training on methods for staff and employees, support for the dissemination of cultivation techniques, etc.)
✓ Scale up the above activities (organizing the knowledge gained from the above activities, holding a national workshop to share knowledge, creating a draft implementation manual based on the results of the workshop, etc.)

<u>Project Component</u>
✓ Establishment of regulated markets, provision for grading, standardization of produce, standardization of weight and measures, daily broadcasting of market price of agricultural products
✓ Construction of community seed storage, cold storage, and food silo in the different climatic stress zone
✓ Adaptation policy for market price support for producers and consumers
✓ Promoting investment in agriculture with a business model with high potential for return on investment
</td></tr>
<tr><td>Expected Project Results</td><td>✓ Crop production increased
✓ Job opportunity created</td></tr>
<tr><td>Engagement of Key Stakeholders</td><td>BADC, DAM, DAE, RHD, LGED, LGD, BIWTA, ICT, CHTDB, BIDA, PPPA, Private sector and others</td></tr>
<tr><td>Indicative Cost Estimate</td><td>
Total project cost: 2.66 million USD
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Approach Name</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>4th Year</th><th>5th Year</th><th>Total</th></tr>
<tr><td>Smallholder horticultural farmers empowerment & promotion (Bangla-SHEP)</td><td>0.532</td><td>0.532</td><td>0.532</td><td>0.532</td><td>0.532</td><td>2.660</td></tr>
<tr><td>Total Amount</td><td>0.532</td><td>0.532</td><td>0.532</td><td>0.532</td><td>0.532</td><td>2.660</td></tr>
</table>
</td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ In the Bangla-SHEP approach, farmers predict demand based on market research to determine which crops to plant. In the concept idea using this approach, the project's purpose is to improve the livelihoods of farmers. This project will gradually improve the accuracy of the farmer's forecast, and the livelihood of farmers will improve accordingly. After the project is completed, farmers' forecasting accuracy and livelihood improvements will continue. However, as a general rule, project goals should be achieved by the end of the project, so the indicators (degree of achievement) should be set assuming the degree of improvement in livelihood at the end of the project.</td></tr>
</table>

Concept Idea (12)

Item	Contents
Project Title	The project for increasing food stockpiling capacity to strengthen the resilience of food self-sufficiency
Keywords	Food Security, Rice Self-Sufficiency, Food Stockpiling Facilities, Public Food Rationing, Access to Food, Stockpiling Methods, Transportation Methods, Parboiled
NAP Sector/Investment Plan	CSA10: Improvement of storage or post-harvest facilities, transport, communications, and e-commerce-based market facilities for agricultural products
Project Rationale, Objectives, and Approach of the Project	(Background) In recent years, Bangladesh's self-sufficiency rate has improved due to increased production of rice, a staple food. However, there are two concerns: (1) Since the population is still on the rise (population growth rate = 1.1%), it is necessary to increase production in order to bring the self-sufficiency rate closer to 100%. (2) Changes in the frequency, intensity, and timing of droughts and floods due to climate change will reduce rice production and reduce self-sufficiency. In addition to the above two concerns, considering that there are three harvest times in a year, rice production is increasing, and there is a risk of price collapse in good harvest years, there is a need for air conditioning equipment that can maintain the quality of stockpiled food and food storage facilities equipped with machines that can be used to load and unload quickly. Currently, rice is stockpiled in about 600 food storage warehouses scattered all over the country, this stock will be used to maintain rice self-sufficiency in times of disasters and to distribute food to the poor (estimated to be about 40% of the population). However, considering the above-mentioned problems (1) and (2), the amount of stockpile is not sufficient. In addition, many of the existing warehouses are old, there is no ventilation system, and loading and unloading are done manually. In order to solve the above issues, the Ministry of Food has set a target of increasing storage capacity to 3.7 million tons by 2025 (Eighth-five-year Plan). This concept idea is a way to achieve this goal. (Purpose) In consideration of Bangladesh's rice storage method in Bangladesh (parboiled), the new rice stockpile warehouses will be established using flat bagged type. Or updating the old ones by introducing modern warehouses. The warehouse is expected to be equipped with forklifts, pallets, and a good air conditioning system. In addition, technical training in operation management will be conducted.
Expected Project Areas	All over Bangladesh Food production area Food consumption areas (areas with a high concentration of the poor)
Project/Programme Description	<u>Key Approach</u> ✓ Strengthening food storage capacity by constructing air-conditioned warehouses ✓ Reduction of labor by introducing modern storage technology (forklifts, etc.) ✓ Improvement of loading and unloading capacity through the construction of truck yards, etc. <u>Project Component</u> ✓ Daily broadcast of the market prices of agricultural products ✓ Maintaining 100% self-sufficiency by strengthening rice stockpiling

<table>
<tr><td></td><td>capacity
✓ Maintaining the quality of stockpiled rice through air-conditioning management in warehouses</td></tr>
<tr><td>Expected Project Results</td><td>✓ Resilience is enhanced for crop production due to reduced flood vulnerability.</td></tr>
<tr><td>Engagement of Key Stakeholders</td><td>MoDMR, MoF, DCF, RCF, MoA and others</td></tr>
<tr><td>Indicative Cost Estimate</td><td>Total project cost: 20.6 million USD
✓ This project cost was roughly estimated with the men/month multiplied by the labor unit cost.
Unit: Million USD
<table>
<tr><th>Approach Name</th><th>1st Year</th><th>2nd Year</th><th>3rd Year</th><th>Total</th></tr>
<tr><td>Improving the capacity of public food storage to reduce response time, maintain quality, and expand capacity</td><td>7.0</td><td>7.0</td><td>6.6</td><td>20.6</td></tr>
<tr><td>Total Amount</td><td>7.0</td><td>7.0</td><td>6.6</td><td>20.6</td></tr>
</table></td></tr>
<tr><td>Remarks/ Acknowledgment</td><td>✓ It is important to research and determine the location of the food stockpile warehouse. The warehouses in rural areas have the advantage of lower construction land costs and shorter distances to deliver rice than urban areas, but the distance to the distribution destination is longer. On the other hand, if storage warehouses are built near the poor, food can be distributed quickly, but transportation costs become high because the distance between the production area and the warehouse is longer.</td></tr>
</table>

ATTACHMENT 8 Workshop Record

Knowledge Study Workshop Result

Date February 07, 2024

Venue: Pan Pacific Sonargaon, Dhaka, Bangladesh

Sector	Comments
Water	Salinity is increasing and rainwater harvest is a good solution.
	In the presentation, the drought problem was not addressed.
	Rainwater harvest and issues of transboundary rivers also need to be addressed.
	Salinity intrusion must be taken seriously.
	In the future, due to climate change, migration will happen, which will lead shortage of drinking water.
	Action Aid is also working on rainwater harvest. Action Aid has a design and likes to share.
Climate change adaptation	Development partners working in Bangladesh need to address adaptation measures, and JICA is addressing this.
	Cost-effectiveness should be studied.
	Variations of weather in the North and South must be taken into consideration.
	Cooperation and collaboration are needed to address the climate change adverse impact.
	The reduction of emissions was addressed and concern about impact on the society was expressed, especially on women and children. These need to be addressed.
	Online education on disasters should be introduced.
Disaster	For flash floods, we need India's cooperation because watersheds cover India.
	Repeated disasters should be addressed.
	Rainwater harvesting is a good approach, especially during and after a disaster.
	It was seen that after 2015 monsoon rain reduced and salinity increased.
	The cyclone also impacts increasing salinity.
	Thunderstorm adaptation must be considered.
	Infrastructure must include future disasters.
	The impact of repeated disasters on society should be addressed.
Agriculture	The agricultural sector needs protection, coordination, and infrastructure.
	Farmers are using cell phones. We need a smart technological approach.
Environment	Conservation should be given priority.
Fund	Hard loans should be avoided (soft loans are preferable).

Source: JST

Workshop Attendants List

No.	Name	Affiliation	Position
1	Dr. Farhina Ahmed	MoEFCC	Secretary
2	Md. Iqbal Abdullah Harun	MoEFCC	Additional Secretary
3	Dharitri Kumar Sarkar	MoEFCC	Deputy Secretary
4	Roslina Parven	MoEFCC	Senior Assistant Secretary (Climate Change-1)
5	ICHIGUCHI Tomohide	JICA Bangladesh Office	Chief Representative
6	MIURA Mari	JICA Bangladesh Office	Senior Representative
7	ITO Daisuke	JICA Bangladesh Office	Representative (Disaster Risk Reduction and Climate Change)
8	Md. Anisuzzaman Chowdhury	JICA Bangladesh Office	Senior Program Manager
9	Maruf Shehab	Action Aid	Head of Innovation
10	Farah Kabir	Action Aid	Country Director
11	Md. Obaid Hossain	BADC	Deputy Chief Engineer
12	Dr. M. Asaduzzaman	BARI	Senior Scientific Officer
13	Pain Shuov	BGS	ED
14	Dr. Muhdmmad Abul Kalam Mallik	BMD	Meteorologist
15	A.S., Maniuzzaman Khan	BRAC	Program Head, Climate Change Program
16	Tanim	Brighters	Surveyor
17	Prof. Dr. Munsur Rahman	BUET	IWKM. BUET Prof
18	Unme Falima Romana Afri	BWDB	Superintending Engineer Design Circle-1, BWDB
19	Dr. Md. Abul Basher	BWDB	Superintending Engineer
21	B.M. Tamim Al Hossain	CEGIS	Sr. Specialist CCDM
22	Cdr Latiful Hoq Kazmi PGS, BN	Chattogram City Cooperation (CCC)	Chief conservancy officer
20	Mokhlesur Rahman	CNRS	Executive Director
23	Falguni Majumdar	DAE	UAO
24	Dr. Akram Chowdhury	DAE	Project director, Focal Point, BDP2100
25	Mst. Irin Parvin	DAE	Upazila Agriculture Officer
26	Dr. Mariam Akhter Akhter	DCF	DCEF
27	Abul Kashem Faruki Fahim	Department of Disaster Science and Climate Resilience, Dhaka University	Lecturer
28	Dr. Mohammad Shahadd Hossin	Department of Livestock Services (DLS)	ULO
29	Md. Abdul Alim	DG Food	Executive Engineer
30	Abul Kashem FarukiFahim	Dhaka University	Lecturer
31	Mohammad Moullcashem	DNCC	SE
32	Shaheda Begum	DOE	Deputy Director
33	Md. Shahed Ali	DoF	Deputy director (Planning)
34	Md. Nazrul Islam	DSCC	City Planner

No.	Name	Affiliation	Position
35	Ms. Neeltje Kielen	Embassy of the Kingdom of the Netherlands	1st Secretary / Delegated Representative Water
36	AKM Sohel	ERD	Joint Secretary
37	Arfan Uzzaman	FAO	Climate Change Expert
38	Razia Sultana	FPMU	Research officer
39	Reisal	GCA	Senior Specialist
40	Md. Maksudul Islam	General Economics Division	Deputy Chief
41	Kazi Delwar Hossain	General Economics Division, Planning Commission	Additional Secretary
42	Tarique Hassan	GIZ	Senior Advisor
43	Mohammad Ishtiuq Hossain	GIZ	
44	Raisa Imran	IDMVS Dhaka university	Lecturer
45	Md. Amirul Islam	IWM	DED (Opn)
46	Dr. ABM Zahid Hossain	IWM Division	Senior Scientist
47	Manik Kumar Saha	KFW Development Bank	Portfolio Coordinator
48	Zannatul Ferdous	Lecturer Dhaka University	Lecturer
49	Farzana Mannan	LGD	Joint Secretary
50	ASM Shahedur Rahman	LGED	Project Director SSWrDDz
51	Md. Anwar Hossain	LGED	Additional Chief Engineer & Project Director, Climate Resilient Local Infrastructure Centre
52	Taslima Akter	LGRD Minister	Joint Secretary
53	M. Mobassherul Islam	MoWR	Deputy Secretary
54	Md. Sadikur Rahman	Swiss contact	Manager communication
55	Arif M. Fasisal	UNDP	Programme Specialist
56	Ram Sharma	UNDP	CTA
57	Bronwyn Llewellyn	USAID	Environment officer
58	Ms. Swarna Kazi	World Bank	Senior DRM Specialist
59	Fahim Rahim	World Bank	DRM Consultant
60	TAKATA Satoshi	JICA Survey team	Team leader/climate change adaptation policy
61	FUJITA Daisuke	JICA Survey team	Disaster risk reduction sector and climate change adaptation
62	KUNO Toshihiko	JICA Survey team	Agricultural sector and climate change adaptation
63	Mahbub Reza	JICA Survey team	Technical Assistant (Agriculture)
64	Amirul Hossain	JICA Survey team	Technical Assistant (water, disaster)
65	Liton Dewan	JICA Survey team	Assistant (logistics)
66	Golam Kibira	JICA Survey team	Member JICA Survey Team

Source: JST

Photo of the Workshop

Member from MoEFCC, JICA and JST

Speech by Dr. Farhina Ahmed

Speech by Md. Iqbal Abdullah Harun

Speech by Mr. ICHIGUCHI Tomohide


Attendants


Comment by an Attendant